Ps at the Interfaces

On the Syntax, Semantics, and Morphology of Spatial Prepositions in German

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Abstract in English

In this thesis, I spell out the syntax, semantics, and morphology of spatial prepositions in German. I do this by using a parsimonious model of grammar with only one combinatorial engine that generates both phrases and words: syntax (Marantz 1997, Bruening 2016). I follow the tenets of the Minimalist Program (MP) (Chomsky 1995) with Bare Phrase Structure (BPS) as its phrase structural module. I show that combining Distributed Morphology (DM) (Halle and Marantz 1993, Embick 2015) to model Phonological Form (PF) and Discourse Representation Theory (DRT) (Kamp and Reyle 1993, Kamp et al. 2011) to model Logical Form (LF) makes it possible to gain deeper and new insights into the system of German spatial prepositions.

I classify spatial prepositions along a widely accepted typology (Jackendoff 1983, Piñón 1993, Zwarts 2005b, 2008, Gehrke 2008, Svenonius 2010). Place prepositions denote static locations (regions), while path prepositions denote dynamic locations (spatial paths). I model spatial paths denoted by path prepositions as rectilinear line segments; they can be directed, as in the case of goal and source prepositions, or undirected, as in the case of route prepositions – a distinction that can be accounted for in terms of Krifka's (1998) directed and undirected path structures. As for directed goal and source prepositions, which I consider to be derived from place prepositions, I follow Krifka (1998) and Beavers (2012) in assuming that directed spatial paths receive their direction from a mapping between motion events and their spatial projections. I identify two types of goal and source prepositions: (i) (pseudo)-geometric goal and source prepositions and (ii) non-geometric goal and source prepositions. When combined with manner of motion verbs, (pseudo)-geometric goal and source prepositions give rise to achievement predicates, while non-geometric goal and source prepositions give rise to accomplishment predicates. That is, the former denote spatial paths conceptualized as punctual, while the latter denote spatial paths conceptualized as extended. Route prepositions – the morphologically simplex ones in German are *durch* ('through'), *um* ('around'), and *über* ('over, across') – are importantly different from source and goal prepositions. They are not directed and they turn out to be semelfactive-like. I propose that they denote spatial paths with a tripartite structure, consisting of a non-initial, non-final path (the NINF-path) that is flanked by two tail paths, one at each end. It can be shown that route

prepositions do not commit to direction, which is why I advocate that spatial paths denoted by route prepositions should be modeled in terms of Krifka's (1998: 203) plain path structure *H*, which is undirected – an algebraic structure that has not received much attention yet.

In addition, I propose to classify spatial prepositions according to a classification that is orthogonal to the one described in the previous paragraph. This classification involves three classes: (i) geometric prepositions, (ii) pseudo-geometric prepositions, and (iii) non-geometric prepositions. Geometric prepositions refer to geometric relations that can be spelled out in a parsimonious, perception-driven model of space (Kamp and Roßdeutscher 2005). Typical examples of prepositional phrases headed by geometric prepositions are: ***in** der Kiste* ('in the.DAT box'), ***in** die Kiste* ('into the.ACC box'), ***aus** dem Haus* ('out of the house'), ***an** der Wand* ('on the wall'), and ***auf** dem Tisch* ('upon the table'). The geometric prepositions are further subdivided into (i) the topological prepositions *in* ('in'), *aus* ('out of'), *an* ('on'), and *auf* ('upon'); and (ii) the projective prepositions *hinter* ('behind'), *vor* ('in front of'), *über* ('above'), *unter* ('under'), and *neben* ('beside'). While route prepositions are different from both goal and source prepositions, each route preposition shares a geometric concept with a topological goal preposition (derived from a topological place preposition) and, in one case, with a topological source preposition: (i) interiority is shared by *in*, *aus*, and *durch*; (ii) contiguity is shared by *an* and *um*; and (iii) verticality is shared by *auf* and *über*. The projective prepositions are not treated in this thesis, but the topological prepositions and the route prepositions are central targets. Pseudo-geometric prepositions look like geometric prepositions, but do not refer to geometric relations. Instead, they express functional locative relations. Typical examples of prepositional phrases headed by pseudo-geometric prepositions are: ***in** der Schweiz* ('in [the.DAT] Switzerland'), ***in** die Schweiz* ('to [the.ACC] Switzerland'), and ***auf** Sylt* ('on Sylt'). It can be shown that pseudo-geometric prepositions behave differently from geometric prepositions in several ways. For example, they do not license a postpositional recurrence of the preposition; compare, for instance, *auf dem Tisch drauf* with *auf Sylt *drauf*. Moreover, the choice of a pseudo-geometric preposition is heavily influenced by denotational properties of the noun it co-occurs with (e.g. *auf* is used with islands, *in* with countries). The peculiar goal preposition *nach* ('to'), which is obligatorily used with determinerless toponyms, turns out to be a special instance of a pseudo-geometric preposition. The non-geometric prepositions *bei* ('at'), *zu* ('to'), and *von* ('from') form a third class of spatial prepositions. They do not only impose semantic selection restrictions distinct from geometric and pseudo-geometric prepositions, but also behave differently with regard to lexical aspect.

The fine-grained syntacticosemantic analysis I present in this thesis does not only make it possible to spell out PF and LF for spatial prepositions, but it also serves as input to a morphological case approach (Marantz 1991, McFadden 2004) that accounts for the case assignment properties of spatial prepositions in German. I show that German prepositions inherently assign dative case, and that other cases, such as accusative, morphologically derive from dative case in certain syntacticosemantic contexts. The morphological case approach proposed in this thesis straightforwardly accounts for the well-known dative/accusative alternation that manifests itself in (pseudo)-geometric place prepositions co-occurring with dative case, while (pseudo)-geometric goal prepositions co-occur with accusative case. In addition, it accounts for the facts that route prepositions exclusively co-occur with accusative case, and that non-geometric prepositions and all source prepositions exclusively co-occur with dative case.

Zusammenfassung auf Deutsch

In dieser Arbeit buchstabiere ich die Syntax, Semantik und Morphologie von räumlichen Präpositionen des Deutschen aus. Dafür nutze ich ein sparsames Grammatikmodell mit nur einer generativen Komponente, der Syntax. Sie generiert sowohl Phrasen als auch Wörter (Marantz 1997, Bruening 2016). Ich folge den Prinzipien des Minimalistischen Programms (MP) (Chomsky 1995) mit Bare Phrase Structure (BPS) als dessen Phrasenstrukturmodul. Ich zeige, dass eine Kombination aus Distribuierter Morphologie (DM) (Halle und Marantz 1993, Embick 2015) für die Phonetische Form (PF) und Diskursrepräsentationstheorie (DRT) (Kamp und Reyle 1993, Kamp et al. 2011) für die Logische Form (LF) es ermöglicht, tiefere und neue Einsichten in das System deutscher räumlicher Präpositionen zu erlangen.

Ich klassifiziere räumliche Präpositionen gemäß einer weithin akzeptierten Typologie (Jackendoff 1983, Piñón 1993, Zwarts 2005b, 2008, Gehrke 2008, Svenonius 2010). Place-Präpositionen denotieren statische Orte (Regionen), während Path-Präpositionen dynamische Orte (räumliche Pfade) denotieren. Ich modelliere von Path-Präpositionen denotierte räumliche Pfade als geradlinige Liniensegmente. Diese können gerichtet sein, wie im Fall von Goal- und Source-Präpositionen, oder ungerichtet, wie im Fall von Route-Präpositionen – ein Gegensatz, der mit Krifkas (1998) gerichteten und ungerichteten Pfadstrukturen modelliert werden kann. Bezüglich gerichteter Goal- und Source-Präpositionen, welche ich als von Place-Präpositionen abgeleitet betrachte, folge ich Krifka (1998) und Beavers (2012) in der Annahme, dass gerichtete räumliche Pfade ihre Richtung von einer Abbildung zwischen Bewegungsereignissen und deren räumlicher Projektion erhalten. Ich identifiziere zwei Typen von Goal- und Source-Präpositionen: (i) (pseudo)-geometrische Goal- und Source-Präpositionen und (ii) nicht-geometrische Goal- und Source-Präpositionen. Wenn diese beiden Typen mit Verben kombiniert werden, die die Art und Weise einer Bewegung ausdrücken, so führen (pseudo)-geometrische Goal- und Source-Präpositionen zu Achievement-Prädikaten, während nicht-geometrische Goal- und Source-Präpositionen zu Accomplishment-Prädikaten führen. Das heißt, die ersteren denotieren als ausgedehnt konzeptualisierte räumliche Pfade, während die letzteren als punktuell konzeptualisierte räumliche Pfade denotieren. Route-Präpositionen – die morphologisch einfachen im Deutschen sind *durch*, *um* und *über* – sind grundlegend verschieden von Goal- und Source-Präpositionen. Sie sind nicht gerichtet und erweisen sich als semelfaktivartig. Ich schlage vor, dass sie dreigeteilte räumliche Pfade denotieren. Diese bestehen aus einem nicht-initialen, nicht-finalen Pfad (dem NINF-Pfad), welcher von zwei Zipfel-Pfaden (*tail paths*) flankiert wird, einem an jedem Ende. Es kann gezeigt werden, dass Route-Präpositionen nicht richtungsbezogen sind. Aus diesem Grund plädiere ich dafür, dass die von Route-Präpositionen denotierten räumlichen Pfade mit Krifkas (1998: 203) einfacher Pfadstruktur *H*, welche ungerichtet ist, modelliert werden sollten – einer algebraischen Struktur, die bislang wenig Aufmerksamkeit erfuhr.

Ferner schlage ich vor, räumliche Präpositionen gemäß einer Klassifikation quer zu der aus dem vorigen Absatz in drei Klassen einzuteilen: (i) geometrische Präpositionen, (ii) pseudo-geometrische Präpositionen und (iii) nicht-geometrische Präpositionen. Geometrische Präpositionen referieren auf geometrische Relationen, die sich in einem sparsamen, perzeptionsgetriebenen Raummodell ausbuchstabieren lassen (Kamp und Roßdeutscher 2005). Typische Präpositionalphrasen mit geometrischen Präpositionen sind: ***in** der Kiste*, ***in** die Kiste*, ***aus** dem Haus*, ***an** der Wand*, und ***auf** dem Tisch*. Die geometrischen Präpositionen werden ferner unterteilt in (i) die topologischen Präpositionen *in*, *aus*, *an* und *auf*; sowie (ii) die projektiven Präpositionen *hinter*, *vor*, *über*, *unter* und *neben*. Während sich Route-Präpositionen von sowohl Goal- als auch Source-Präpositionen unterscheiden, so hat jede Route-Präposition ein geometrisches Konzept mit einer topologischen Goal-Präposition (abgeleitet von einer topologischen Place-Präposition) gemeinsam und, in einem Fall, mit einer topologischen Source-Präposition: (i) das Konzept eines Inneren wird von *in*, *aus* und *durch* geteilt; (ii) das Konzept der Nähe wird von *an* und *um* geteilt; und (iii) das Konzept der Vertikalität wird von *auf* und *über* geteilt. Die projektiven Präpositionen werden in dieser Arbeit nicht behandelt. Die topologischen Präpositionen und die Route-Präpositionen sind hingegen ein wesentlicher Bestandteil. Pseudo-geometrische Präpositionen sehen wie geometrische Präpositionen aus, dennoch referieren sie nicht auf geometrische Relationen. Stattdessen drücken sie funktionale Orte aus. Typische Beispiele von Präpositionalphrasen mit pseudo-geometrischen Präpositionen sind: ***in** der Schweiz*, ***in** die Schweiz* und ***auf** Sylt*. Es kann gezeigt werden, dass sich pseudo-geometrische Präpositionen in mehrfacher Hinsicht anders verhalten als geometrische Präpositionen. Sie erlauben beispielsweise keine postpositionale Wiederholung der Präposition; vergleiche etwa *auf dem Tisch drauf* mit *auf Sylt *drauf*. Außerdem ist die Wahl einer pseudo-geometrischen Präposition in hohem Maße abhängig von denotationalen Eigenschaften des Nomens, mit welchem die Präposition zusammen auftritt (z.B. *auf* wird mit Inseln verwendet, *in* mit Ländern). Die eigentümliche Goal-Präposition *nach*, welche beispielsweise mit artikellosen Toponymen obligatorisch ist, stellt sich als eine spezielle Instanz der pseudo-geometrischen Präpositionen heraus. Die nicht-geometrischen Präpositionen *bei*, *zu* und *von* bilden eine dritte Klasse räumlicher Präpositionen. Sie erlegen nicht nur semantische Auswahlbeschränkungen auf, die von geometrischen und pseudo-gemoetrischen Präpositionen verschieden sind, sondern sie verhalten sich auch anders im Bezug auf lexialischen Aspekt.

Die feinkörnige syntaktikosemantische Analyse, die ich in dieser Arbeit präsentiere, macht es nicht nur möglich, PF und LF für räumliche Präpositionen auszubuchstabieren, sondern sie dient auch als Eingabe für einen morphologischen Kasusansatz (Marantz 1991, McFadden 2004), der die Kasuszuweisungseigenschaften räumlicher Präpositionen im Deutschen erklärt.

Ich zeige, dass deutsche Präpositionen inhärent Dativ zuweisen und dass andere Kasus, wie zum Beispiel Akkusativ, in bestimmten syntaktikosemantischen Kontexten morphologisch von Dativkasus abgeleitet sind. Der in dieser Arbeit vorgeschlagene morphologische Kasusansatz erklärt die bekannten Dativ/Akkusativ-Alternation; (pseudo)-geometrische Place-Präpositionen treten mit Dativ auf, (pseudo)-geometrische Path-Präpositionen mit Akkusativ. Zusätzlich erklärt der Ansatz warum Route-Präpositionen ausschließlich mit Akkusativ auftreten, und warum nicht-geometrische Präpositionen und alle Source-Präpositionen mit Dativ auftreten.

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List of Abbreviations

A	adjective
A-P	Articulatory-Perceptual
abs	absolutive
acc	accusative
ADJ	Adjacency
AGR	agreement
AP	adjective phrase
Appl	applicative
ApplP	applicative phrase
Asp	aspect
AspP	aspect phrase
BPS	Bare Phrase Structure
C	complementizer
c-command	constituent-command
c-select	constituent-select
C-I	Conceptual-Intentional
CP	complementizer phrase
D	determiner
dat	dative
def	definite
Deg	degree
dir	directional
DM	Distributed Morphology
DP	determiner phrase
DRS	Discourse Representation Structure
DRT	Discourse Representation Theory
Dx	deixis

DxP	deixis phrase
EI	Encyclopedia Item
EPP	Extended Projection Principle
erg	ergative
expl	expletive
F	functional
fem	feminine
FP	functional phrase
FPR	Figure/Path Relation
GB	Government and Binding
gen	genitive
gov	governed
HM	Head Movement
iff	if and only if
imp	imparfait (French)
indef	indefinite
inf	inferior
IPA	International Phonetic Alphabet
IPCA	Idiosyncratic Prepositional Case Assignment
K	case
KP	case phrase
LF	Logical Form
Lin	linearization
loc	locative
M	morpheme
masc	masculine
MCP	Movement along Connected Paths
MO	Mapping-to-Objects
MSE	Mapping-to-Subevents
MSO	Mapping-to-Subobjects
MP	Minimalist Program
MR	Movement Relation
MUSE	Mapping-to-Unique-Subevents

MUSO	Mapping-to-Unique-Subobjects
N	noun
neut	neuter
ninf	non-initial, non-final
nom	nominative
NP	noun phrase
Num	number
obj	object
occ	occupy
obl	oblique
P	preposition
pass	passive
PCA	Prepositional Case Assignment
PCI	Prepositional Case Impoverishment
PF	Phonological Form
pl	plural
POSC	Primacy of Orthogonality in Spatial Conceptualization
PP	preposition phrase (or prepositional phrase)
PPS	Primary Perceptual Space
PRO	big PRO (silent pronoun)
prog	progressive
prox	proximity
ps	passé simple (French)
Q	light preposition Q
QP	Q-Phrase (cf. light preposition Q)
refl	reflexive
SDeWaC	Stuttgart `.de`-domain Web-as-Corpus
sg	singular
SINC	Strictly Incremental Relation
SMR	Strict Movement Relation
SP	spatial path
subj	subject
synsem	syntacticosemantic

T	tense
TH	theme vowel
TP	tense phrase
UE	Uniqueness-of-Events
UG	Universal Grammar
UO	Uniqueness-of-Objects
unbd	unbounded
UT	utterance time
V	verb
VI	Vocabulary Item
VoiceP	Voice phrase
VP	verb phrase
XbT	X-bar Theory (or $\bar{X}$ Theory)

The following special characters are used:

א **Aleph** (first letter of the Semitic abjads)
...

ב **Beth** (second letter of the Semitic abjads)
...

ג **Gimel** (third letter of the Semitic abjads)
...

© **Copyright symbol**
Indicator for Content features

ℓ **Script small L**
Metasymbol for Encyclopedia Items

$\wp$ **Weierstraß p**
Metasymbol for Vocabulary Items

$\surd$ **Radical sign**
Root

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Chapter 1

Introduction

Prepositions present plenty of puzzling phenomena.[1] Focusing on the domain of morphologically simplex, spatial prepositions in German, this thesis identifies the following five puzzling phenomena:

(I) **Semantic interplay of preposition and complement noun:**
On the one hand, the choice of a preposition can influence the interpretation of its complement noun. On the other hand, the interpretation of a complement noun can also influence the interpretation of the respective preposition.

(II) **Morphological interplay of preposition and complement noun:**
Morphosyntactic properties of a complement noun can influence the choice of the respective preposition.

(III) **Morphosyntactic properties:**
A preposition can have distinct morphosyntactic properties depending on its interpretation.

(IV) **Prepositional aspect (Zwarts 2005b):**
Some prepositions describing paths in space are unambiguous with regard to prepositional aspect to the effect that they have either a bounded or an unbounded interpretation, while other prepositions describing paths in space are ambiguous between a bounded and an unbounded interpretation.

(V) **Prepositional case assignment:**
Prepositions determine the case of their complement nouns in a way that appears to be arbitrary in some respects, yet systematic in others.

In the following, I will illustrate these puzzling phenomena with respective examples.

[1] One of these puzzling phenomena concerns the rather marginal question of why the preposition of all words in the first sentence of this thesis is the only word that does not begin with P.

As for the first part of the puzzling phenomenon (I), namely that the choice of a preposition can influence the interpretation of its complement noun, consider the Twitter tweet in (1) by the German satire show *extra-3* on the occasion of Obama's Cuba visit in March 2016.[2]

(1) Wichtiges Detail: Obama kritisiert Menschenrechtsverletzungen IN Kuba [...],
important detail: Obama criticizes human rights violations in Cuba
nicht AUF Kuba [...].
not upon Cuba

When used with the preposition *in* ('in'), the toponym *Kuba* ('Cuba') is interpreted as denoting the state of Cuba, i.e. the Republic of Cuba, but when it is used with the preposition *auf* ('upon'), the toponym is interpreted as denoting the island of Cuba. As a matter of fact, the state of Cuba and the island of Cuba are not completely coextensive with one another, which is clarified in Figure 1. So, *auf Kuba* includes the Guantanamo Bay Naval Base, a place Obama would like to be silent about.

Figure 1: Map of Cuba

As for the second part of the puzzling phenomenon (I), namely that the interpretation of a complement noun can also influence the interpretation of the respective preposition, consider the clause in (2).

(2) Lenny und Carl waren **auf** dem Standesamt.
Lenny and Carl were upon the civil registry office
'Lenny and Carl were on top of/at the civil registry office.'

The noun *Standesamt* ('civil registry office') is ambiguous to the effect that it can be interpreted as a building or as an institution. Depending on the interpretation of the noun *Standesamt*, the interpretation of the preposition *auf* varies. When the noun is interpreted as a building, the preposition literally means *on top of*. In this case, Lenny and Carl were on top of the building of the civil registry office, for instance, because they are roofers. In contrast, when the noun is interpreted as an institution, the preposition means *at*. In this case, Lenny and Carl were at the institution of the civil registry office, for instance, because they were grooms who got married. Thus, I will refer to this ambiguity as the 'roofer/groom ambiguity.'

[2] URL: `https://twitter.com/extra3/status/711992190847717376` (30.06.2017)

As for the puzzling phenomenon (II), namely that morphosyntactic properties of the complement noun can influence the choice of a preposition, consider the island/state of Cuba again. In order to express that Cuba – both the island or the state – is the goal of a motion event, the preposition *nach* ('to') is typically used. This is, in particular, the case when the noun *Kuba* occurs without a determiner, as in (3a). If, however, the noun has the morphosyntactic property of occurring with a determiner, as is the case in (3b), where *Kuba* is modified by the adjective *schön* ('beautiful'), then the preposition *nach* is ungrammatical. In this case, either *in* ('in') for the state reading or *auf* ('upon') for the island reading must be used; see the first part of the puzzling phenomenon (I).

(3) a. Obama reiste **nach** Kuba.
Obama traveled to Cuba

b. Obama reiste **in/auf/*nach** das schöne Kuba.
Obama traveled in/upon/to the beautiful Cuba

As for the puzzling phenomenon (III), namely that a preposition can have distinct morphosyntactic properties depending on its interpretation, consider the contrast in (4). For instance, if a preposition such as *an* ('on, at') in (4a) has a geometrically well-defined interpretation (here: spatial contact), then it has the morphosyntactic property of optionally licensing a postpositional recurrence including a deictic element (here: *dr-* 'there'). However, if the same preposition has a functional interpretation that is not geometrically definable as in (4b), then the preposition cannot co-occur with a postpositional recurrence.

(4) a. Hans war **an** der Felswand (**dran**)
Hans was on the rock face there.on
'Hans was at the rock face.'

b. Hans war **an** der Nordsee (*dran)
Hans was on the North Sea there.on
'Hans was at the North Sea.'

As for the puzzling phenomenon (IV), namely that some prepositions describing paths in space are unambiguous with regard to prepositional aspect (Zwarts 2005b), while others are ambiguous, consider the contrast between (5) and (6). Both the preposition *zu* ('to') in (5a) and the circumposition *auf ... zu* ('towards') in (5b) describe directed paths in space to the effect that they have the park as a goal. In contrast, the preposition *durch* ('through') in (6) describes paths in space for which the notion 'goal' is not applicable. It describes paths in space that are undirected routes with regard to the park. Applying frame adverbials as a standard test for telicity, we can see that the 'goal prepositions' *zu* in (5a) and *auf ... zu* in (5b) give rise to either a telic (bounded) interpretation or an atelic (unbounded) interpretation. In contrast, the 'route preposition' *durch* in (6) is ambiguous; it gives rise to a telic (bounded) and an atelic (unbounded) interpretation (Piñón 1993, Zwarts 2005b).

(5) a. Hans rannte in/*für 5 Minuten **zu** einem Park.
Hans ran in/*for 5 minutes to a park
'Hans ran to the park in/*for 5 minutes.'

b. Hans rannte für/*in 5 Minuten **auf** einen Park **zu**.
Hans ran for/*in 5 minutes upon a park to
'Hans ran towards a park for/*in 5 minutes.'

(6) Hans rannte in/für 5 Minuten **durch** einen Park.
Hans ran in/for 5 minutes through a park
'Hans ran through the park in/for 5 minutes.'

As for the puzzling phenomenon (V), namely that prepositions determine the case of their complement nouns in a way that appears to be arbitrary in some respects, yet systematic in others, we should first look at the systematic aspects. Consider the well-known dative/accusative alternation of German prepositions (Bierwisch 1988, Zwarts 2005a, Van Riemsdijk 2007, Arsenijević and Gehrke 2009, Caha 2010, Den Dikken 2010). Some prepositions like *in* ('in') refer to static locations (regions) when co-occurring with a dative complement, as in (7a), while they refer to dynamic locations (paths in space) when co-occurring with an accusative complement, as in (7b).

(7) a. Hans stand **in** einem Wald.
Hans stood in a.DAT forest
'Hans stood in a forest.'

b. Hans rannte **in** einen Wald.
Hans ran in a.ACC forest
'Hans ran into a forest.'

In addition to the prepositions that alternate like *in* in (7), there are also prepositions that do not alternate. Strangely enough, non-alternating prepositions do not uniformly co-occur with one particular case. For instance, *bei* ('at') in (8), which refers to static locations, does not alternate and co-occurs with a dative complement. And so do *aus* ('out of') and *zu* ('to') in (9), which both refer to dynamic locations. However, there are still other prepositions like *durch* ('through') in (10) that also refer to dynamic locations, but that co-occur with an accusative complement.

(8) Hans stand **bei** einem Wald.
Hans stood at a.DAT forest
'Hans stood at a forest.'

(9) Hans rannte **aus**/**zu** einem Wald.
Hans ran out of/to a.DAT forest
'Hans ran out of/to a forest.'

(10) Hans rannte **durch** einen Wald.
Hans ran through a.ACC forest
'Hans ran through a forest.'

This thesis will show that these puzzling phenomena can be straightforwardly accounted for by spelling out the syntax, semantics, and morphology of German spatial prepositions in a parsimonious model of grammar, where only one combinatorial engine generating both phrases and words is assumed (Marantz 1997, Bruening 2016). In particular, I will show that combining Minimalist Syntax (Chomsky 1995), Discourse Representation Theory (Kamp and Reyle 1993, 2011, Kamp et al. 2011), and Distributed Morphology (Halle and Marantz 1993, Embick 2015), in order to spell out syntax, semantics, and morphology, respectively, enables us to systematically analyze spatial prepositions, which leads to deeper and new insights into the system of spatial prepositions in German.

One of these new insights is, for instance, a classification of spatial prepositions along a geometric dimension. In particular, I will argue that spatial prepositions can be (i) geometric prepositions, which refer to geometric relations that can be spelled out in a parsimonious, perception-driven model of space (Kamp and Roßdeutscher 2005); (ii) pseudo-geometric prepositions, which look like geometric prepositions, but do not refer to geometric relations, but to functional locative relations; and (iii) non-geometric prepositions, which do not refer to any locative relations whatsoever. This new classification is orthogonal to a widely accepted typology, in which spatial prepositions are classified as place and path prepositions, and in which the latter being further sub-classified into directed path prepositions (goal and source prepositions) and undirected path prepositions (route prepositions) (Jackendoff 1983, Piñón 1993, Zwarts 2005b, 2008, Gehrke 2008, Svenonius 2010). This new classification will contribute to a better understanding and explanation of the puzzling phenomena (I) to (III).

Further, I will exploit Krifka's (1998: 203, 205) distinction between an undirected path structure H and a directed path structure D to model route prepositions and goal (and source) prepositions, respectively. This will contribute to a straightforward explanation of the puzzling phenomenon (IV); cf. prepositional aspect (Zwarts 2005b).

Spelling out spatial prepositions in the grammatical model described above, makes it also possible to formulate a morphological case approach (Marantz 1991, McFadden 2004) that accounts for the case assignment properties of spatial prepositions in German, that is, for the puzzling phenomenon (V).

As mentioned above, I will spell out the syntax, semantics, and morphology of German spatial prepositions in this thesis. I will do this by assuming the Y-model of grammar (Chomsky 1995, Marantz 1997, Bobaljik 2002, 2008, Embick and Noyer 2007, Embick and Marantz 2008, Harley 2012, 2014, a.o.), where Syntax is considered to be the only combinatorial engine (Marantz 1997, Bruening 2016). Syntactic structures on which no further syntactic operations are executed constitute Spell-Out. Syntactic structures at Spell-Out interface with the Articulatory-Perceptual (A-P) systems, on the one hand, and with the Conceptual-Intentional (C-I) systems, on the other. The interface representation of the A-P systems is Phonological Form (PF). The operations executed at PF constitute the Morphology. The interface representation of the C-I systems is Logical Form (LF). The operations executed at LF constitute the Semantics. The Y-model of grammar is depicted in Figure 2.

The structure of this thesis reflects the Y-model of grammar. Chapter 2 will address the syntax, Chapter 3 the morphology, and Chapter 4 the semantics. Then, Chapter 5 will spell out German spatial prepositions with regard to syntax, semantics and morphology. Then, Chapter 6 will lay out a morphological case approach to spatial prepositions in German that is based on the syntacticosemantic analyses proposed in Chapter 5. Let us briefly look at these chapters individually.

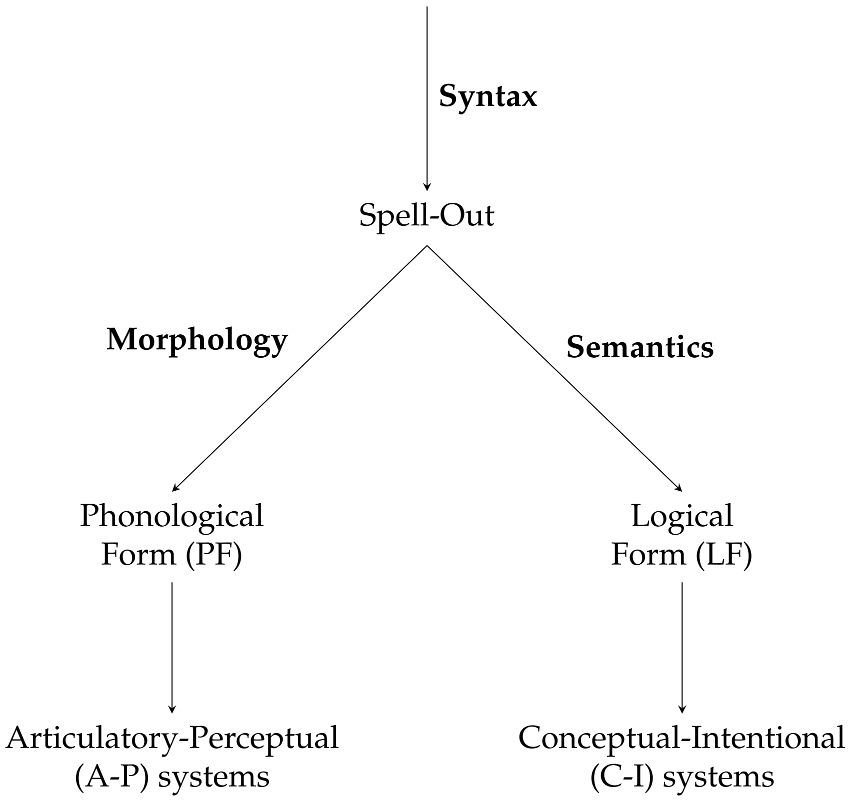


Figure 2: The Y-model of grammar

Chapter 2 will present the syntactic module within the Y-model of grammar. In this thesis, I will adopt the tenets of the Minimalist Program (MP) (Chomsky 1995, Adger 2003). Section 2.1 will focus on various types of features; features are considered to be the core building blocks of the grammatical theory adopted here. Section 2.2 will present the principles and operations according to which structure is generated in the Minimalist Program (MP) (Chomsky 1995). MP applies Bare Phrase Structure (BPS) as its phrase structure module. Section 2.3 will clarify the status of Roots in the approach proposed here. I will advocate an approach that is, in certain respects, comparable to the one proposed by De Belder and Van Craenenbroeck (2015). Section 2.4 will summarize Chapter 2.

Chapter 3 will explore the morphological branch of the Y-model of grammar, that is Phonological Form (PF). In this thesis, I will adopt the tenets of Distributed Morphology (DM) (Halle and Marantz 1994, Embick 2015). Section 3.1 will present the operation of Vocabulary Insertion. In DM, morphophonological exponents are inserted late, i.e. after the syntactic derivation, into the terminal nodes of syntax. Vocabulary Insertion is controlled by the

Subset Principle (Halle 1997). Section 3.2 will present the Late Linearization Hypothesis according to which the elements of a phrase marker are linearized at Vocabulary Insertion (Embick and Noyer 2001). Section 3.3 will address the notion of ‘ornamental morphology’ (Embick and Noyer 2007: 305), i.e. morphology that is syntacticosemantically unmotivated and “ornaments” the syntactic representation. Section 3.4 will present morphological operations on nodes, e.g. Impoverishment, where certain features are deleted from a node under specified conditions (Bonet 1991, Embick 2015). Section 3.5 will present the morphological displacement operations Lowering and Local Dislocation (Marantz 1988, Embick and Noyer 2001, 2007). Section 3.6 will present morphophonological Readjustment Rules (Embick 2015). Section 3.7 will summarize Chapter 3.

Chapter 4 will explore the semantic branch of the Y-model of grammar, that is Logical Form (LF). In this thesis, I will adopt the tenets of Discourse Representation Theory (DRT) (Kamp and Reyle 1993, 2011, Kamp et al. 2011) to model LF. As for the model of space, I will follow Kamp and Roßdeutscher (2005). As for algebraic structures, I will follow Krifka (1998), Beavers (2012). Section 4.1 will present the semantic construction algorithm at LF, where each terminal node of a syntactic structure receives a context-dependent interpretation. Compositionally, the interpretations of the terminal nodes are combined bottom-up along the syntactic structure by means of unification-based composition rules. As for the representation of LF, Discourse Representation Theory (DRT) (Kamp and Reyle 1993, 2011, Kamp et al. 2011) is chosen. One of the features of DRT is that interpretation involves a two-stage process: (i) the construction of semantic representations referred to as Discourse Representation Structures (DRSs), i.e. the LF-representation proper; and (ii) a model-theoretic interpretation of those DRSs. Section 4.2 will briefly address the general conceptualization of ‘Figure’ and ‘Ground’ in language, as introduced by Talmy (1975, 2000). Section 4.3 will focus on the model-theoretic aspects relevant for the semantic modeling of spatial prepositions. I will present two models of three-dimensional space: (i) the vector space model of space, as advocated by Zwarts (1997, 2003b, 2005b), Zwarts and Winter (2000); and (ii) the perception-driven model of space, as advocated by Kamp and Roßdeutscher (2005), who base their approach on principles formulated by Lang (1990). In this thesis, I will adopt Kamp and Roßdeutscher’s (2005) parsimonious, perception-driven model of space, which will be presented in the Sections 4.3.1 to 4.3.6. Section 4.4 will present the algebraic foundations. Section 4.4.1 will present the mereological structures that will be used in the modeling of spatial paths. In particular, plain/undirected path structures H (Krifka 1998: 203) and directed path structures D (Krifka 1998: 203) will be presented. Spatial paths can serve as incremental themes measuring out events (Dowty 1979, 1991, Tenny 1992, Jackendoff 1996, Krifka 1998, Beavers 2012); thus, Section 4.4.2 will present incremental relations between spatial paths and motion events. I will briefly present Beavers’ (2012) Figure/Path Relations (FPRs) that account for double incremental themes. Section 4.5 will focus on spatial paths. I briefly presented two approaches to spatial paths: (i) an axiomatic approach, where spatial paths are taken as primitives in the universe of discourse (Piñón 1993, Krifka 1998, Beavers 2012); and (ii) a constructive approach, where spatial paths are defined as continuous functions from the real unit interval $[0,1]$ to positions in some model of space (Zwarts 2005b: 748). In this thesis, I will opt for an axiomatic approach to spatial paths. Section 4.6 will address prepositional aspect, which is argued to relate to the distinction between bounded and unbounded reference Jackendoff (1991), Verkuyl and Zwarts (1992), Piñón (1993), Zwarts (2005b). Following Zwarts (2005b), I will assume that cumulativity is the algebraic property characterizing prepositional aspect. Section 4.7 will discuss the force-dynamic effect of the German topological preposition *auf* ('upon'), which can be characterized as 'support form below'. Using Talmy's (2000: 413, 415) terms 'Agonist' and 'Antagonist' for the force entities at issue, I will characterize this force-dynamic effect such that the complement of the preposition serves as an Antagonist that prevents the Agonist from falling down. Section 4.8 will summarize Chapter 4.

Chapter 5 will spell out the syntax, semantic, morphology of spatial prepositions in German. This chapter is the core of this thesis because it illustrates how spatial prepositions could be implemented in the Y-model of grammar. First, Section 5.1 will classify spatial prepositions according to several criteria. Section 5.1.1 will introduce the distinction between place prepositions, on the one hand, and path prepositions, on the other. Path prepositions are further subdivided into directed path prepositions (goal and source prepositions) and undirected path prepositions (route prepositions) (Jackendoff 1983, Piñón 1993, Zwarts 2006, a.o.). Section 5.1.2 will propose a geometry-based classification of spatial prepositions that is orthogonal to the place/path typology. I propose that spatial prepositions can be (i) geometric prepositions, (ii) pseudo-geometric prepositions, or (iii) non-geometric prepositions. Section 5.1.3 will classify path prepositions into bounded and unbounded path prepositions. Section 5.1.4 will map these classifications to syntactic structure. Then, Section 5.2 will briefly touch upon the cartographic decomposition of spatial prepositions (Svenonius 2006, 2010, Pantcheva 2011). Then, Section 5.3 will introduce three abstract Content features that relate to geometric concepts and that figure in the derivation of the geometric prepositions: [א] relating to interiority in Section 5.3.1; [ב] relating to contiguity in Section 5.3.2; and [נ] relating to verticality in Section 5.3.3. Then, Section 5.4 will derive the lexical structure of spatial prepositions and spell out PF-instructions for their morphophonological realization and LF-instructions for their semantic interpretation. Then, Section 5.5 will derive the functional structure of spatial prepositions and spell out PF-instructions for their morphophonological realization and LF-instructions for their semantic interpretation. Then, Section 5.6 will illustrate how a fully-fledged PP, i.e. a prepositional CP, headed by a spatial preposition can be integrated in various verbal contexts. Finally, Section 5.7 will summarize Chapter 5.

Chapter 6 will discuss prepositional case in German. I will present (i) the case assignment properties of (spatial) prepositions in German (Zwarts 2006); (ii) several previous approaches to prepositional case (Bierwisch 1988, Arsenijević and Gehrke 2009, Caha 2010, Den Dikken 2010); and (iii) a morphological case theory proposed for the verbal domain Marantz (1991), McFadden (2004). This will pave the way for a proposal of a morphological case approach to spatial prepositions in German that is based on the syntacticosemantic analyses of spatial prepositions presented in Chapter 5.[3] First, Section 6.1 will present the case assignment properties of spatial prepositions in German. Then, Section 6.2 will present four previous approaches to prepositional case: Den Dikken (2010) in Section 6.2.1; Caha (2010) in Section 6.2.2; Arsenijević and Gehrke (2009) in Section 6.2.3; and Bierwisch (1988) in Section 6.2.4. Then, Section 6.3 will motivate and outline the hypothesis that case is not a phenomenon of the syntax proper, but of the morphological component of the grammar. This section will present a morphological case approach spelled out for the verbal domain (Marantz 1997, McFadden 2007). Then, Section 6.4 will lay out a morphological case theory for simplex spatial prepositions in German that is based on the syntacticosemantic analysis of spatial prepositions presented in Chapter 5. Finally, Section 6.5 will summarize Chapter 6.

Chapter 7 will conclude and provide some prospects for future work.

This thesis has the following appendixes. Appendix A will provide synopses of Chapter 5 and Chapter 6. Appendix B will provide proofs that negative non-initial, non-final paths give rise to bounded route PPs, while positive non-initial, non-final paths give rise to unbounded PPs. Appendix C will provide a mapping between orthographic (graphemic) representations and phonemic IPA-representations used in this thesis. Appendix D will list the picture credits for the images used in this thesis.

[3]The morphological case approach to prepositions proposed by Haselbach and Pitteroff (2015) presents an early stage of the morphological case theory developed in Section 6.4. The morphological case approach presented in Haselbach and Pitteroff (2015) was jointly developed by Boris Haselbach and Marcel Pitteroff. At that stage, however, the approach was syntacticosemantically not as elaborated as it is here. Moreover, Sections 6.2 and 6.3 overlap with Haselbach and Pitteroff (2015), to some extent. For the most part, this work was carried out by me.

Chapter 2

Syntax

In this thesis, I advocate a parsimonious model of grammar (Marantz 1997, Bruening 2016, a.o.) with only one combinatorial component – **syntax** – that is capable of generating both phrases and words. Adopting the theoretical tenets of the **Minimalist Program (MP)** (Chomsky 1995, Adger 2003, Hornstein et al. 2005, Boeckx 2006, a.o.), I assume the common **Y-model of grammar** (Chomsky 1995, Marantz 1997, Bobaljik 2002, 2008, Embick and Noyer 2007, Embick and Marantz 2008, Pfau 2009, Harley 2012, 2014, a.o).[4] The basic Y-model is sketched in Figure 3 below. Each derivation of a linguistic unit starts out with the Numeration, a set of intentionally-selected items capable of generating structure. Numeration feeds the derivational workspace where syntactic operations (Merge, Adjoin, Agree, and Move) are carried out, in order to build structure in the module termed **Syntax**. Syntactic structures on which no further syntactic operations are executed constitute Spell-Out. Syntactic structures at Spell-Out interface with the **Articulatory-Perceptual (A-P) systems** on the one hand, and with the **Conceptual-Intentional (C-I) systems** on the other. The representational interface level between Spell-Out and the A-P systems is termed **Phonological Form (PF)**. The set of operations that are executed in order to arrive at PF are morphological operations. This set of morphological operations constitutes the module Morphology. The representational interface level between Spell-Out and the C-I systems is termed **Logical Form (LF)**. The set of operations that are executed in order to arrive at LF are semantic operations. The set of semantic operations constitutes the module Semantics.

By assumption, several lists feed the Y-model of grammar. Building on Halle and Marantz (1993), Marantz (1997), Harley (2012), a.o., I assume **List 1**, **List 2**, and **List 3**. List 1 is assumed to comprise the "syntactic primitives, both interpretable and uninterpretable, functional and contentful" (Harley 2014: 228). In this thesis, I suggest to split List 1 into (i) the **Lexicon** and (ii) the **Content**. The Lexicon contains (bundles of) functional primitives, viz. category and syntacticosemantic/morphosyntactic features, taken from the initial state of grammar termed Universal Grammar (UG) (Chomsky 1995: 14), while the Content contains (bundles of) contentful primitives that are not relevant to Syntax but potentially relevant to Morphology

[4] A model akin to the Y-model is the T-model; see Bobaljik (2002) for a discussion.

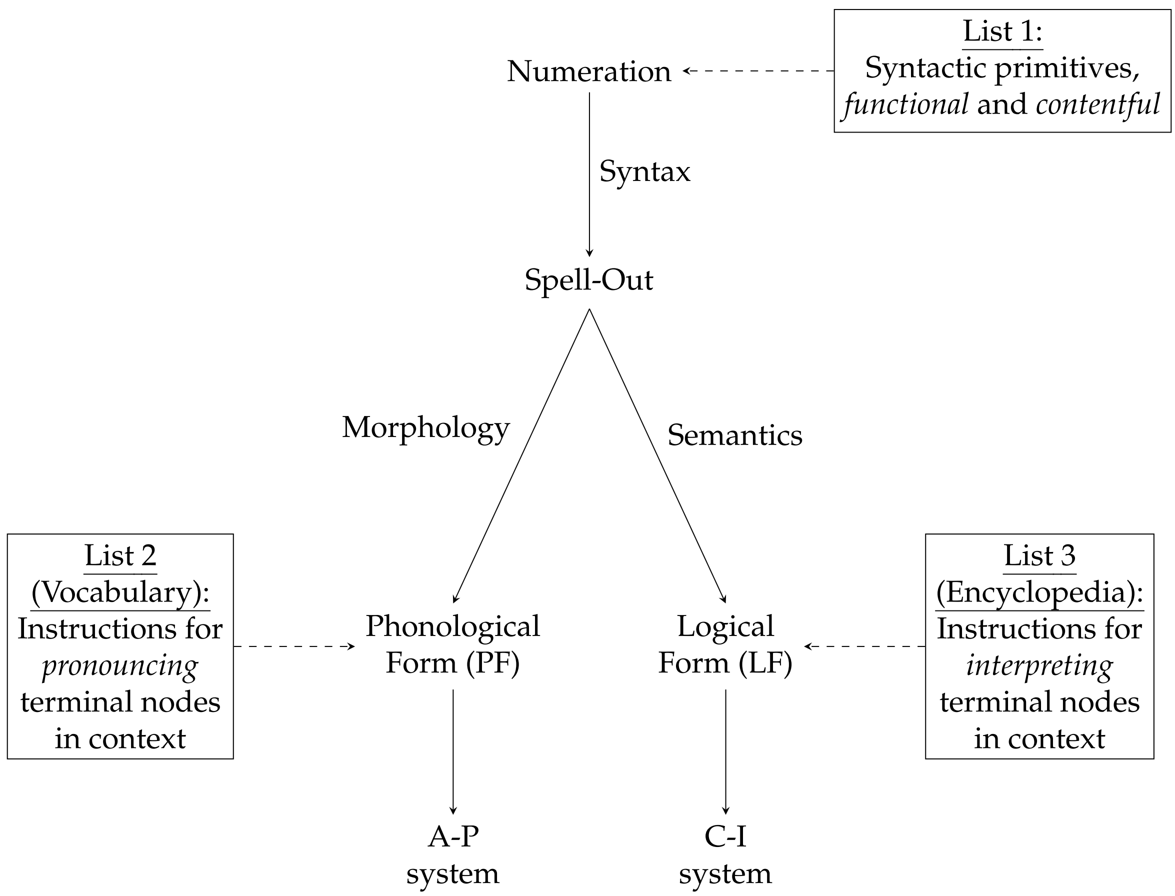


Figure 3: The basic Y-model of grammar

and Semantics. The fundamental distinction between Lexicon and Content is that the former is generative (i.e. capable of generating structure), while the latter is not generative. Being the only generative module, the Lexicon corresponds to what Marantz (1997: 201) terms the "pure lexicon." Notwithstanding cross-linguistic patterns, the substance and the feature bundling in the Lexicon and the Content are assumed to be language-specific. Following Harley (2014: 228), I assume that List 2, termed **Vocabulary**, contains "instructions for pronouncing terminal nodes in context", and that List 3, termed **Encyclopedia**, contains "instructions for interpreting terminal nodes in context."

(11) a. **Lexicon** (subset of List 1):
The generative (syntactic) items of a language.
b. **Content** (subset of List 1):
The non-generative, contentful items of a language.
c. **Vocabulary** (List 2):
Instructions for pronouncing terminal nodes in context.
d. **Encyclopedia** (List 3):
Instructions for interpreting terminal nodes in context.

In this chapter, I lay out the syntactic module within the Y-model of grammar, as sketched in Figure 4. The syntactic building blocks are features, which are the subject of Section 2.1. Then, Section 2.2 discusses the principles according to which syntactic structure is built. Then, Section 2.3 clarifies the status of Roots in the approach that is proposed here.

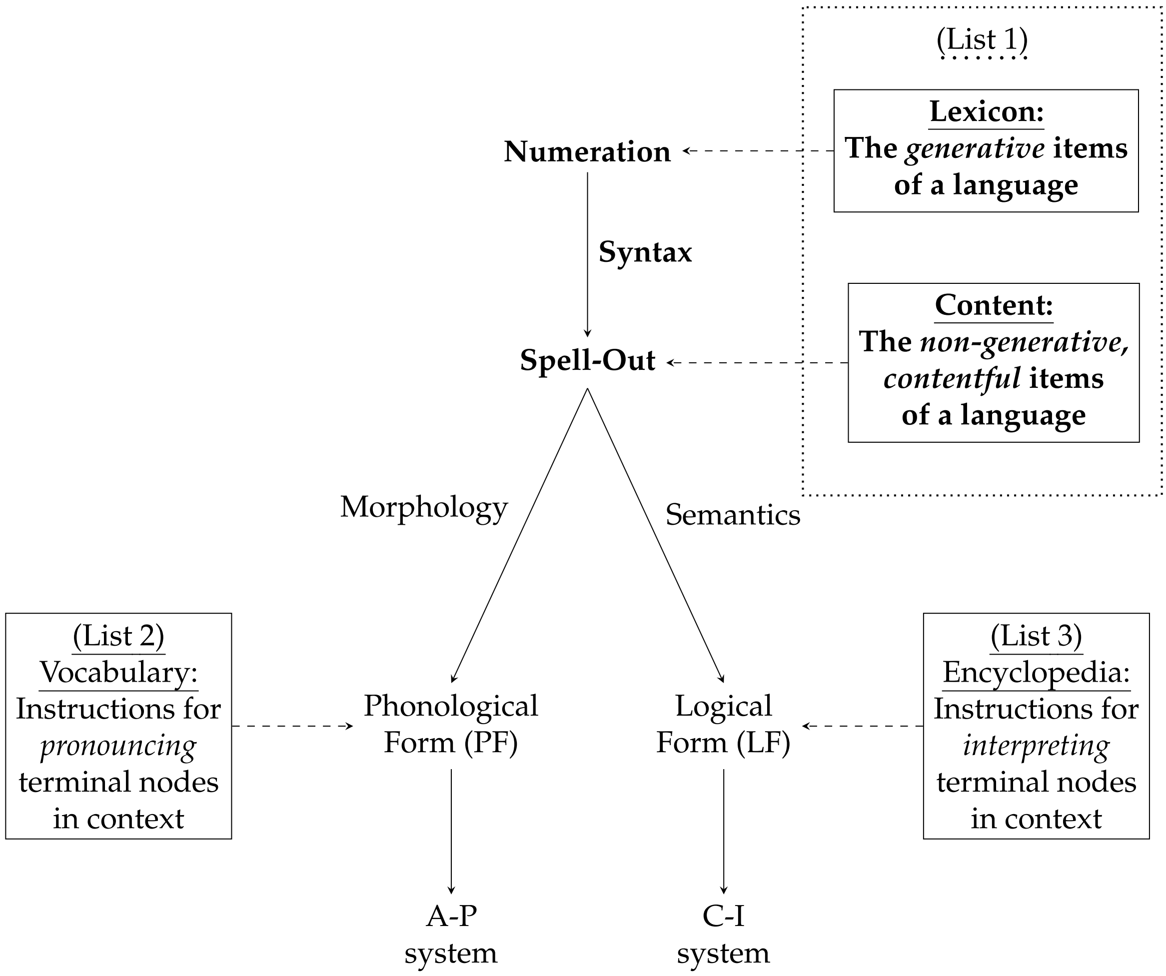


Figure 4: Syntax in the Y-model of grammar

2.1 Features

Features are the core building blocks of the grammatical model assumed in this thesis. We can think of features as abstract properties of linguistic units. For instance, if we consider a word as a morphosyntactic unit, then "a morphosyntactic feature [...] is a property of a word" (Adger 2003: 26). Features are essential in linguistic theory because they help to determine the linguistic behavior of the respective carrier. For instance, features may determine the syntactic operations that the carrier may undergo or how the carrier is phonologically realized and semantically interpreted.

Let me first clarify the theoretical status of features. There are two opposing views on features. On the one hand, features can be seen as part of a description language for grammatical theory. On this view, "feature theory does not constrain the objects of linguistic theory but merely describes them" (Adger and Svenonius 2011: 28). For example, Head-driven Phrase Structure Grammar (Pollard and Sag 1987, 1994) takes this view. On the other hand, features can be seen as "properties of syntactic atoms and hence [they] are directly objects of the theory" (Adger and Svenonius 2011: 28). In this sense, features can enter into relationships with each other to form structure. This view means that the feature theory and the theory of grammar correlate such that constraining the former implies constraining the latter. This makes the feature theory central in the overall theory of grammar and thus characteristic for a given syntactic theory. This thesis takes the latter view on features, namely that they are primitives of the grammar. Adger and Svenonius (2011: 28) further point out that the Minimalist framework (Chomsky 1995) is "a set of guidelines which constrain the general hypothesis space within which these various theories can be entertained." Anticipating the syntactic operation Merge, which is the core operation for structure building (cf. Section 2.2), Adger and Svenonius (2011: 31) give an informal definition of feature.

(12) **Features**:

a. Syntax builds structure through recursive application of Merge.
b. The smallest element on which Merge operates is a syntactic atom.
c. A syntactically relevant property of a syntactic atom which is not shared by all syntactic atoms and which is not derivable from some other property is a feature.

(Adger and Svenonius 2011: 31)

Note that I typically indicate (bundles of) features by means of square brackets; that is, I indicate that X is a feature by writing [X].

2.1.1 Types of features

This section addresses feature systems and where to allocate features in the Y-model of grammar advocated in this thesis. Three types of feature systems figure in linguistic theory: (i) privative features, (ii) binary features, and (iii) multi-valent features. This section discusses each of these systems in turn. **Privative features** consist of attributes only. Attributes are atomic symbols. Adger (2010: 187) defines privative features as given in (13).

(13) **Privative feature** (preliminary version):
An atomic symbol drawn from the set $F = \{A, B, C, D, E, ...\}$ is a feature.

(Adger 2010: 187)

One useful extension of (privative) features is to assume uninterpretability as a formal property capturing structural dependencies. One disadvantage of simple privative features, as defined in (13), is that they are not powerful enough to state structural dependencies. For this, we would need a separate system including rules that state which features may or may not combine to form complex syntactic objects. Entertaining two such systems is undesirable. Avoiding this situation motivates the notion of **uninterpretability** as a formal property of features that captures syntactic dependencies (Chomsky 1995). In particular, the feature prefix *u*, which indicates uninterpretability, sets up structural dependencies in the syntactic derivation. This is achieved by making the "syntactic structure building rules sensitive to the presence of the *u*-prefix, ensuring that when a feature bears such a prefix, there must be another feature in the structure which is exactly the same, but lacks the prefix. This implements Chomsky's notion of checking" (Adger 2010: 189). In this sense, the *u*-prefix does a purely formal job ensuring syntactic dependencies. At this point, I refer to Section 2.2, which addresses the uninterpretability of features in the context of the syntactic operation Merge. Adger extends the definition of privative features by uninterpretability as given in (14).

(14) **Privative feature** (final version):

a. An atomic symbol drawn from the set F = $\{A, B, C, D, E, ...\}$ is a feature.
b. An atomic symbol drawn from the set F = $\{A, B, C, D, E, ...\}$ and prefixed by *u* is a feature.

(Adger 2010: 188)

A more complex feature system involves **binary features**. A disadvantage of privative features is that it soon becomes clumsy, though not impossible, to cope with agreement phenomena ubiquitous in natural language. One way to enrich a feature system such that it can account for these phenomena is to equip features with a value. That is, each feature attribute is assigned a certain feature value. A basic step is to allow values drawn from a binary set. Typically, the binary values are positive (plus, +) and negative (minus, −) (Jakobson 1932, Bierwisch 1967, Adger 2003, 2010). Adger defines a binary feature as a combination of an attribute and a value, as given in (15). Note that I represent binary features with the value prefixed to the attribute, e.g. [+X], instead of the pair notation $\langle X, + \rangle$.

(15) **Binary feature:**
A feature is an ordered pair $\langle \text{Att}, \text{Val} \rangle$ where

a. Att is drawn from the set of attributes $\{A, B, C, D, E, ...\}$, and
b. Val is drawn from the set of values $\{+, -\}$.

(Adger 2010: 191)

A further enrichment of the feature system is to allow a larger set of possible feature values, i.e. not only binary values. Adger refers to such systems as multi-valent feature systems. In this thesis, I refrain from using multi-valent features. An even more complex feature system allows the recursive embedding of features as values. I also refrain from this kind of feature system. Note, however, that Functional Unification Grammars commonly implement recursive features. For example, Lexical Functional Grammar (Bresnan 2001) exploits a recursive feature system for its so-called F-structure (i.e. functional structure).

The choice of the adequate feature system is, of course, an empirical question. However, on a theoretical level, we can say that one should prefer, according to the law of parsimony (Occam's razor), the simplest system or the most economic feature system. As mentioned above, a privative feature system using only atomic features hardly copes with the agreement phenomena in natural language. Thus, I also use binary feature systems in this thesis. However, I eschew more complex systems. As a consequence, the grammar implemented here comprises a mixture of a privative and binary features.

Here, I make use of Svenonius' (2007b) distinction between interface features and module-internal features: Interface features are those features that figure across grammatical modules, while module-internal features figure only in one grammatical module. In the Y-model of grammar advocated in this thesis, there are three modules, (i) syntax, i.e. the branch from Numeration to Spell-Out, (ii) morphology, i.e. the PF-branch from Spell-Out to the A-P interface, and (iii) semantics, i.e. the LF-branch from Spell-Out to the C-I interface. On this view, interface features that figure across modules can only be those that have repercussions in syntax. I assume that two lists feed the syntax. The Lexicon list feeds the Numeration, while the Content list feeds Spell-Out. On the one hand, the features in the Lexicon are universal and generative. In line with Chomsky (1995), Alexiadou (2001, 2004), a.o., I take the view that UG provides a universal set of features. A given language picks out a subset of these features and stores (bundles of) them in its Lexicon. These features can generate syntactic structure. Generally, I assume two types of features in the Lexicon, (i) category (or categorial) features, which are addressed in Section 2.1.2, and (ii) syntacticosemantic (synsem) features, which are addressed in Section 2.1.3. On the other hand, the features in the Content are language-specific and non-generative. Content features are addressed in Section 2.1.4.

Note at this point that features referring to the grammatical notion of case are often also subsumed under the syntactically-relevant features. That is, they are considered to be interface features. In this thesis, I do not take this perspective. Adopting a morphological case approach (Zaenen et al. 1985, Yip et al. 1987, Marantz 1991, McFadden 2004, Bobaljik 2008, Schäfer 2012, a.o.), I propose in Section 6.4 that – from a prepositional perspective – case features do not need to be assumed in the syntax proper. Thus, I consider case features to be PF-internal features. This contrasts with Adger (2003), for instance, who conceives case as a syntactic category. Putting case into the syntax proper, Adger assumes that functional heads may bear uninterpretable case features that must be checked by nominal elements. In particular, Adger models case by means of a multi-valent feature system comprising an attribute 'CASE' and possible values such as 'NOM' (for nominative), 'ACC' (for accusative), etc. For example, in order to assign nominative to subjects, Adger (2003: 211) assumes that a finite tense head bears an uninterpretable case feature [*u*CASE : NOM]. Furthermore, he assumes that a finite tense head values nominative on a DP in its specifier under Agree. As already mentioned, I part company with Adger (2003) with respect to case features. First, I do not assume that case features figure in syntax proper. Instead, I assume that case feature are PF-internal features, the value of which is determined post-syntactically at the morphology interface, on the basis of the output from syntax. Second, in line with Bierwisch (1967), Halle and Vaux (1997), McFadden (2004), a.o., I assume that the morphological realizations of case, i.e. *nominative*, *accusative*, etc., do not correspond to primitive features or feature values in the system, but that they are the realizations of more abstract case features; cf. Section 6.3.2.

2.1.2 Category features

Category features are syntactically-relevant interface features. Generally, we can identify (i) features for lexical categories, (ii) features for functional categories, and (iii) features for light categories. They are discussed in the following paragraphs.

Lexical categories

The major category features are those relating to the traditional word classes **verb (V)**, **noun (N)**, **adjective (A)**, and **preposition (P)** (e.g. Adger 2003: 36).[5] These four categories are often referred to as lexical categories. The lexical categories figure in structure building. The syntactic operation Merge is sensitive to categories by exploiting the formal feature property of uninterpretability. Uninterpretable category features can also be referred to as c-selectional (categorial selectional) features or as subcategorization features (Adger 2003: 84). I assume, as commonly accepted, that these four lexical categories form four syntactic domains.

In principle, the four lexical categories can be decomposed into more abstract features. Several scholars assume a decomposition of the lexical categories into abstract binary features (e.g. Chomsky 1970, Jackendoff 1977, Bresnan 1982, Hengeveld 1992, Déchaine 1993, Wunderlich 1996, Hale and Keyser 1997, Baker 2003). While all approaches differ fundamentally with respect to the kind and motivation of these abstract features – as well as the distribution of the feature values – all approaches share the idea that the four lexical categories can be decomposed by means of two binary features. For example, Hale and Keyser (1997: 207) propose that the four major categories can be defined in structural and predicational terms. Hale and Keyser assume the feature [±COMPLEMENT], which states whether a category "necessarily combines with another category which stands in the structural relation 'immediate sister' to it". Additionally, they assume the feature [±SUBJECT], which states whether or not a category "projects a predicate and must, therefore, have a subject". Equipped with these two binary features, Hale and Keyser decompose the lexical categories N, V, A, and P as follows. The feature [+COMPLEMENT] groups the categories verb and preposition together, because these categories normally take a structural complement; the feature [−COMPLEMENT] groups the categories noun and adjective together, because these categories normally do not take a structural complement. The feature [−SUBJECT] groups the categories noun and verb together because these categories normally do not project a predicate requiring a (semantic)

[5]Note that some scholars (e.g. Grimshaw 2000, Baker 2003) do not consider P to be a lexical category on par with V or N. Grimshaw (2000), for example, treats prepositions as a functional part of the extended projection of N. This thesis, however, treats P as a lexical category on par with V, N, and A.

subject; and the feature [+SUBJECT] groups the categories adjective and preposition together because these categories normally project a predicate requiring a (semantic) subject. That is, nouns are specified as [−COMPLEMENT, −SUBJECT], verbs as [+COMPLEMENT, −SUBJECT], adjectives as [−COMPLEMENT, +SUBJECT], and prepositions as [+COMPLEMENT, +SUBJECT]. Note, however, that I do not implement such a decomposition of the lexical category features in this thesis, even though it is, in principle, feasible. Instead, I use the privative features N, V, A, and P for the four lexical categories.

Functional categories

In addition to lexical categories, functional categories are identified for each of the four categorial domains (e.g. Fukui 1986, Speas 1986, Abney 1987, Van Riemsdijk 1990, Ritter 1993, a.o.). The traditional distinction between lexical and functional categories concerns the assumption that lexical categories may assign thematic roles (Higginbotham 1985), while functional categories may not do so (Fukui 1986, Speas 1986). Note that this does not mean that functional categories may not have semantic content. In fact, the semantic content of functional categories is said to be functional in nature, rather than conceptually involving thematic relations. Structurally, functional categories are generally assumed to project syntactic structure and to surmount the lexical categories.

Let us now very briefly look at the functional categories commonly assumed in the verbal, nominal, and adjectival domain; then we will look at the functional categories in the prepositional domain in more detail. For the verbal domain, the following functional categories are typically assumed: **C** (for **complementizer**) for words like *that* or *for* (Rosenbaum 1965), **T** (for **tense**) hosting tense information (Pollock 1989), and **Asp** (for **aspect**) hosting aspectual information (Borer 1994). Their typical hierarchical order above the lexical category V is given in (16).

(16) **Functional categories in the verbal domain:**
C > T > Asp > V

For the nominal domain, the following functional categories are typically assumed: D (determiner) for determiners like *the* or *a* (Abney 1987), and Num (number) hosting number information (Ritter 1991, 1993) are commonly assumed. For the functional structure of noun phrases, see also Valois (1991), Longobardi (1994), Szabolcsi (1994), Alexiadou (2001), to mention a few. The typical hierarchical ordering of the functional categories above the lexical category N is given in (17).

(17) **Functional categories in the nominal domain:**
D > Num > N

For the adjectival domain, Abney (1987) proposes the functional category Deg (degree) for elements like *so* or *too*, as in *so/too big* (Abney 1987: 189); see also Adger (2003: 347), Radford

(2004: 79), a.o. As in the verbal and the nominal domain, the functional category in the adjectival domain is assumed to be hierarchically above the lexical category A, as given in (18).

(18) **Functional categories in the adjectival domain:**
Deg > A

One of the first proposals for an additional functional category in the prepositional domain comes from Van Riemsdijk (1990). He proposes the functional category 'little p', hierarchically above the lexical category P. With the functional category little p, Van Riemsdijk (1990) accounts for German postpostional and circumpositional phrases as in (19). In particular, he proposes that elements like *nach* ('according to') in (19a) or *unten* ('down') in (19b) occupy the functional category little p, while an element like *in* of the fused form *im* (*in* plus *dem*, 'in the.DAT') in (19b) occupies the lexical category P.

(19) a. meiner Meinung **nach**
my.DAT opinion according-to
'in my opinion'

b. im Tal **unten**
in.the.DAT valley down
'down in the valley'

(Van Riemsdijk 1990: 233)

For German, Van Riemsdijk (1990: 239) assumes the surface realization as given in (20); that is, the lexical category P precedes the nominal phrase while the functional category little p follows it.[6]

(20) $[_{pP}\ [_{PP}\ P^{\circ}\ NP\ ]\ p^{\circ}\ ]$

(Van Riemsdijk 1990: 239)

Building on Koopman (2000, 2010), Den Dikken (2003, 2006, 2010) proposes a more articulated functional structure dominating the lexical category P. Establishing a range of functional categories, both Koopman and Den Dikken decompose Van Riemsdijk's (1990) functional category little p. Distinguishing between a locative lexical category P_{loc} and a directional lexical category P_{dir}, Den Dikken (2010) assumes the functional categories and their respective hierarchical ordering in (21a) and (21b).[7] Generalizing over locative [PLACE]

[6] Interestingly, Van Riemsdijk (1990: 240–241) observes that the surface realization of the functional category little p and lexical category P in Hungarian seems to be the mirror image of that in German, namely that the functional category little p precedes the nominal phrase, while the lexical category P follows it. For Hungarian, he (1990: 240–241) thus proposes the structure $[_{pP}\ p^{\circ}\ [_{PP}\ NP\ P^{\circ}\ ]\ ]$.

[7] Note that Koopman and Den Dikken sometimes use different labels for the functional categories of the prepositional domain. In particular, $C^{[PLACE]}$ equals C(Place), $Dx^{[PLACE]}$ equals Deg(Place), $Asp^{[PLACE]}$ equals Place, $C^{[PATH]}$ equals C(Path), $Dx^{[PATH]}$ equals Deg(Path), and $Asp^{[PATH]}$ equals Path. Note also that Noonan (2010) and other scholars who propose comparable functional categories for the prepositional domain use again other labels.

and directional [PATH], the functional categories for spatial prepositions in (21c) can be assumed.

(21) **Functional categories in the prepositional domain:**

a. Locative prepositions
$C^{[PLACE]} > Dx^{[PLACE]} > Asp^{[PLACE]} > P_{loc}$

b. Directional prepositions
$C^{[PATH]} > Dx^{[PATH]} > Asp^{[PATH]} > P_{dir}$

c. Spatial prepositions (generalized)
$C^{[SPACE]} > Dx^{[SPACE]} > Asp^{[SPACE]} > P$

(Den Dikken 2010: 100, 104)

At this point, we should look at a detail that remains implicit in Den Dikken's approach, but that will become important in this thesis. In order to distinguish between the lexical categories P_{loc} and P_{dir}, we can (or maybe have to) assume additional features that may combine with the lexical category feature P constituting prepositional heads. Let me be more precise: In Chapter 5, I argue that several syntacticosemantic features are characteristic for spatial prepositions: the features [LOC] and [AT], which can co-occur with the directional feature [±TO], and the feature [±NINF], which is characteristic of route prepositions. Prepositions that contain only the feature [LOC] or the feature [AT] correspond to Den Dikken's P_{loc}. Prepositions that contain the feature [±TO] or the feature [±NINF] correspond to Den Dikken's P_{dir}. Note that I assume that both these features are not categorial in nature, but syntacticosemantic; see Section 2.1.3.

Let us come back to Den Dikken's approach and look first at the functional category $Dx^{[SPACE]}$. The basic motivation for assuming $Dx^{[SPACE]}$ is the proper treatment of measure phrases. Focusing on Dutch, both Koopman and Den Dikken assume that spatial measure phrases are hosted in the specifier of $Dx^{[SPACE]}$. Consider the locative PP in (22); where the measure phrase *tien meter* ('ten meter') modifies the preposition *naast* ('next to').

(22) [$_{PP}$ tien meter naast de deur] heeft Jan gezeten
ten meter next to the door has Jan sat
'Jan sat ten meters away from the door'

Den Dikken analyzes this as in (23). The locative functional category $Dx^{[PLACE]}$ hosts the measure phrase in its specifier, while P_{loc} realizes the preposition *naast*. The complement of the preposition follows the lexical category.

(23) [... [*tien meter* $Dx^{[PLACE]}$ [... [P_{loc}=*naast* DP=*de deur*]]]]
ten meter next.to the door

(Den Dikken 2010: 79)

Let us now look at C$^{[\text{SPACE}]}$ and Asp$^{[\text{SPACE}]}$. One of the main arguments for both concerns the possible placement of so-called "r-pronouns" in Dutch. In Dutch, r-pronouns such as *er* ('there') occur in the prepositional domain when the complement of the preposition is pronominal. Crucially, r-pronouns do not appear in the canonical complement position to the right of the lexical category P, but somewhere left to it. Consider the locative PPs in (24), showing that an r-pronoun may appear both in front of and after a potential measure phrase. This is presumably hosted by the functional category Dx$^{[\text{SPACE}]}$, and it occurs, in any case, in front of the lexical preposition *naast*.

(24) a. [$_{\text{PP}}$ **er** tien meter naast] heeft Jan gezeten
there ten meter next to has Jan sat

b. [$_{\text{PP}}$ tien meter **er** naast] heeft Jan gezeten
ten meter there next to has Jan sat

both: 'Jan sat ten meters away from it.'

(Den Dikken 2010: 79)

Den Dikken analyzes this as in (25). He claims that r-pronouns originate, as expected, in the complement position of the lexical category P$_{\text{loc}}$ and obligatorily move to either the specifier of Asp$^{[\text{PLACE}]}$ or further up to the specifier of C$^{[\text{PLACE}]}$. In (25), the symbol t_i (for trace) indicates the base position of the r-pronoun *er*. Furthermore, the trace and the r-pronoun are co-indexed, as indicated by the subscript $_i$. For details on the movement operation, I refer the reader to Section 2.2.2.

(25) [$\langle er_i \rangle$ C$^{[\text{PLACE}]}$ [*tien meter* Dx [$\langle er_i \rangle$ Asp$^{[\text{PLACE}]}$ [P$_{\text{loc}}$=*naast* t_i]]]]

(Den Dikken 2010: 79)

Further motivation for the functional category Asp$^{[\text{SPACE}]}$ comes from deictic particles in German. In German, unlike in English or Dutch, postpositional elements may involve a deictic particle like *hin* ('thither') or *her* ('hither') in the case of directional prepositions (see Van Riemsdijk and Huijbregts 2007, Noonan 2010, for instance; see also Roßdeutscher 2009 for a semantic analysis of German *hin* and *her*). Consider the data in (26).

(26) a. auf das Dach **hin**-auf/-über/-unter
on the.ACC roof thither-on/-over/-under
'up/over/down/ onto the roof'

b. aus dem Haus **her**-aus
out.of the.DAT house hither-out.of
'out of the house'

(Den Dikken 2010: 101)

Den Dikken argues that the functional category Asp$^{[\text{SPACE}]}$ may host deictic particles such as *hin* and *her*. In particular, he (2010: 101) presents the potential morphological realizations of Asp$^{[\text{SPACE}]}$ in German, given in Table 1. The two versions of Asp, i.e. the locative Asp$^{[\text{PLACE}]}$

and the directional Asp$^{[\text{PATH}]}$, pair with two orientational features: [PROXIMAL] meaning 'toward the speaker' and [DISTAL] meaning 'away from the speaker'.

	[PROXIMAL]	[DISTAL]
Asp$^{[\text{PLACE}]}$	*hier*	*da/dort*
Asp$^{[\text{PATH}]}$	*her*	*hin*

Table 1: Realizations of German Asp$^{[\text{SPACE}]}$ (Den Dikken 2010: 101)

In order to derive a directional PP such as *auf das Dach hinüber* ('over onto the roof'), we can further assume that C$^{[\text{PATH}]}$ may host a prepositional element like *über* ('over'), while the lexical category P_{dir} hosts the prepositional element *auf* ('upon'). Assuming that Asp$^{[\text{PATH}]}$ head-moves to C$^{[\text{PATH}]}$, we arrive at the ultimate surface form in (26a). Section 5.5 discusses the functional structure of spatial PPs in more detail.[8]

(27) [C$^{[\text{PATH}]}$=*über* [... [Asp$^{[\text{PATH}]}$=*hin* [P_{dir}=*auf* DP=*das Dach*]]]]
over thither on the roof

A further assumption in Den Dikken's approach is that the directional lexical category P_{dir} may embed the locative lexical category P_{loc}, with potential locative functional categories intervening. The full-fledged hierarchy of functional and lexical categories of the domain of spatial prepositions according to Den Dikken is given in (28). While I principally assume a functional prepositional structure as presented above, I do not assume that a lexical P_{dir} embeds functional prepositional structure.

(28) C$^{[\text{PATH}]}$ > Dx$^{[\text{PATH}]}$ > Asp$^{[\text{PATH}]}$ > P_{dir} > C$^{[\text{PLACE}]}$ > Dx$^{[\text{PLACE}]}$ > Asp$^{[\text{PLACE}]}$ > P_{loc}
(adapted from Den Dikken 2010: 99)

Some scholars (e.g. Alexiadou 2010a,b, Alexiadou et al. 2010) hypothesize a parallelism of functional categories across the lexical domains V, N, A, and P. That is, the hierarchy of functional categories is supposed to be structured parallel to one another. With regard to the verbal, nominal, and prepositional domains, Den Dikken (2010) is explicit about this assumption by claiming the parallelism in (29).

(29) **Parallelism of functional categories:**

a.	C$^{[\text{FORCE}]}$	>	Dx$^{[\text{TENSE}]}$	>	Asp$^{[\text{EVENT}]}$	>	V
	(= C)		(= T)		(= Asp)		
b.	C$^{[\text{DEF}]}$	>	Dx$^{[\text{PERSON}]}$	>	Asp$^{[\text{NUM}]}$	>	N
	(= D)				(= Num)		
c.	C$^{[\text{SPACE}]}$	>	Dx$^{[\text{SPACE}]}$	>	Asp$^{[\text{SPACE}]}$	>	P

(adapted from Den Dikken 2010: 100)

[8] For Head Movement, I refer the reader to Matushansky (2006)

The description of the categories in (29) also serves as a recapitulation of the functional categories for the domains presented above. The functional category C$^{[\text{FORCE}]}$, known simply as C in the verbal domain, finds its matching pieces in C$^{[\text{DEF}]}$, known as D in the nominal domain, and in C$^{[\text{SPACE}]}$ in the spatial prepositional domain. The functional category Dx$^{[\text{TENSE}]}$, known as T in the verbal domain, finds its matching piece in Dx$^{[\text{SPACE}]}$ in the spatial prepositional domain. For the nominal domain, Den Dikken assumes that Dx$^{[\text{PERSON}]}$ hosts information on person. The functional category Asp$^{[\text{EVENT}]}$, known simply as Asp in the verbal domain, finds its matching pieces in Asp$^{[\text{NUM}]}$, known as Num in the nominal domain, and in Asp$^{[\text{SPACE}]}$ in the spatial prepositional domain.

Light categories

In addition to the lexical and functional categories discussed above, we can identify a third type of category features that is neither clearly lexical nor clearly functional. Items of the lexical categories normally contribute conceptually-grounded lexical-semantic information, and they may establish thematic relations. Items of the functional categories, on the other hand, contribute functional semantic information, for example tense in the verbal domain. Crucially, functional categories are characterized by the fact that they do not establish thematic relations. However, the categories that are subject of this section typically do establish thematic relations, i.e. they behave more like lexical categories; but, unlike genuine lexical categories, they do not contribute conceptually-grounded lexical-semantic information. Such categories are typically referred to as **light categories** (e.g. Folli and Harley 2007) or semi-lexical categories (e.g. Alexiadou 2005: 20, Meinunger 2006: 90, Harley 2013a: 34).[9] I refer to categories of this type as light categories.

First, let us look at light categories commonly assumed in the verbal domain. Recall from the discussion on lexical categories that the lexical category V can take a complement. The complement is often referred to as the internal argument. However, unlike the internal argument, it is often assumed that external arguments of verbs are not introduced by the verb itself, i.e. the lexical category V, but by an additional light category (Chomsky 1995, Kratzer 1996, Harley 1995, 2013a, Marantz 1997, a.o.). This light category is often referred to as little *v* (Chomsky 1995) or Voice (Kratzer 1996). Marantz (1984: 25) observes that the choice of the external argument normally does not influence the interpretation of a verb, unlike the choice of the internal argument. Consider the examples of the verb *kill* in (30), where the interpretation of the verb depends on the choice of the internal argument.

(30) a. kill a cockroach = cause the bug to croak
b. kill a conversation = cause the conversation to end
c. kill an evening watching TV
= while away the time span of the evening

[9] I have nothing to say about the discussion concerning semi-lexicality in the sense of Van Riemsdijk (1998). For this, see the contributions in Corver and Van Riemsdijk (2001).

d. kill a bottle = empty the bottle

e. kill an audience = entertain the audience to an extreme degree

(Kratzer 1996: 114, glosses by Harley 2011)

Based on this observation, Chomsky (1995) proposes that a separate light verb dubbed little v, rather than the lexical category V introduces the external argument. Kratzer (1996) relates this light category to the voice of the verb, which is why she labels it Voice. I adopt the term Voice for this light category.

Structurally, Voice, if present, is assumed to be hierarchically above the lexical category V, but below the functional categories of the verbal domain. Normally, active Voice licenses an external argument in its specifier position, whereas passive voice does not. See also Bruening (2013) for a recent account on passive voice. External arguments are often interpreted as agents or causers. See, e.g., Harley (2013a) for a recent discussion on the role of Voice and its distinctness from other (semi)-lexical categories in the verbal domain.

In addition to Voice, many scholars (Marantz 1993, Collins 1997, McGinnis 1998, Pylkkänen 2000, 2002, Anagnostopoulou 2001, Cuervo 2003, McFadden 2004, McIntyre 2006, 2009, Miyagawa and Tsujioka 2004, Lee-Schoenfeld 2006, a.o.) assume a light category for verbal applicatives, i.e. Appl (or with various other labels, such as v_{appl}). Pylkkänen (2002: 17) adduces the data from the Bantu language Chaga in (31), originally discussed by Bresnan and Moshi (1990: 148–149), to motivate the category Appl. Unlike, for example, English or German, where applicatives are normally not morphologically marked on verbs, Chaga shows morphological marking on a verb when a benefactive argument is licensed in an applicative structure. Consider the examples in (31), where the morpheme *-í-* on the verb indicates an applicative construction with an additional argument (in boldface).

(31) a. N-ᾶ-ί̃-lyì-**í**-à **m-kà** k-élyá
FOC-1S-PR-eat-APPL-FV 1-wife 7-food
'He is eating food for his wife.'

b. N-ᾶ-ί̃-zrìc-**í**-à **mbùyà**
FOC-1S-PR-run-APPL-FV 9 friend
'He is running for a friend.'

(Bresnan and Moshi 1990: 148–149)

One crucial applicative property, with respect to argument structure, is that applicatives introduce a further argument – the applied argument – in their specifier position. Semantically, applied arguments can serve, a.o., as benefactives or malefactives of the respective verb (Pylkkänen 2002, Lee-Schoenfeld 2006, McIntyre 2006, 2009).[10] An example of an applicative construction in English is given in (32).

(32) I baked **him** a cake.

(Pylkkänen 2002: 17)

[10]Note that McIntyre uses the term "ficiaries" to cover both beneficiaries and maleficiaries.

Examples from German, where applied arguments are usually marked with dative case, are given in (33) and (34).[11] Sometimes, an (additional) possessive interpretation between the applied argument and the direct object is possible, as in (34).

(33) a. Ihm ist ein Hund gestorben.
him.DAT is a.NOM dog died
'He had a dog die.'

b. Jemand hat mir das Auto geklaut.
someone has me.DAT the car stolen
'I had someone steal my car.'

(McIntyre 2006: 186)

(34) Mein Bruder hat der Mami das Auto zu Schrott gefahren.
my brother has the.DAT mom the car to scrap driven
'My brother totaled mom's car (totaled the car on mom).'

(Lee-Schoenfeld 2006: 104)

Basically two distinct positions for applicatives are identified: one hierarchically above and one hierarchically below the lexical category V.[12] This gives rise to the terms high applicative and low applicative, respectively. High applicatives are located between Voice and V, while low applicatives are located below V. These distinct positions are justified semantically. High applicatives relate an applied argument to the event denoted by the verb (event-related applicative). Low applicatives relate an applied argument to the internal argument of the verb (entity-related applicative). McIntyre (2006, 2009) assumes that German shows both high and low applicatives, although some authors reject this view. Pylkkänen (2002), for example, treats all German applicatives as low ones. I follow McIntyre in assuming that German shows indeed both high and low applicatives. (35a) is an instance of a high applicative, as the individual denoted by the applied argument (i.e. him) is affected by the event denoted by the verb (i.e. the breaking of the plate), not only by the entity denoted by the internal argument of the verb (i.e. the plate). (35b) is an instance of a low applicative as the individual denoted by the applied argument (i.e. him) receives the entity denoted by the internal argument (i.e. a book), establishing a possession relation between the two.

(35) a. (weil) Anne ihm den Teller zerbrach
since Anne him.DAT the.ACC plate broke
'since Anne broke his plate'

b. (weil) ich ihm ein Buch gab
since I him.DAT a.ACC book gave

[11] McIntyre (2006, 2009) labels the applicative category V^{dat} because he predominantly discusses German data where this category is assumed to introduce an applied argument with dative morphology.

[12] Note that some scholars assume more (or less) structural types of applicatives. Cuervo (2003), for instance, argues for three main types of applicatives. Next to the commonly assumed high and low applicatives, she assumes a so-called "affected applicative," which embeds under a dynamic verb and requires a stative predicate in its complement.

'since I gave him a book'

(McIntyre 2006: 186–187)

Let us summarize the light categories for the verbal domain presented above. In addition to the lexical category V, we can assume the light category Voice introducing external arguments and the category Appl introducing applied arguments. While Voice is hierarchically above all other (semi)-lexical categories in the verbal domain, Appl may be above ($\text{Appl}_{\text{high}}$) or below ($\text{Appl}_{\text{low}}$) the lexical category V. (36) summarizes this picture.

(36) **Light categories in the verbal domain:**
Voice > $\text{Appl}_{\text{high}}$ > V > Appl_{low}

Let us now look at a light category proposed for the prepositional domain by Svenonius (2003). Svenonius hypothesizes an external-argument-introducing light category hierarchically above the lexical category P. Adopting the term from Van Riemsdijk (1990), Svenonius labels this light category little *p*. However, in terms of the classification of categories applied in this thesis, Van Riemsdijk's (1990) little p and Svenonius' (2003) little *p* do not have the same status. In particular, Van Riemsdijk's little p is a functional category, because it is not assumed to establish any thematic relation; while Svenonius' little *p* is a light category, because it is in fact assumed to establish a thematic relation.[13]

Prepositions often serve to express spatial relations between entities. A cognitive notion that is relevant in the context of spatial relations is the relation between Figure and Ground as defined by Talmy (1975, 2000) (cf. Section 4.2). With respect to prepositions, Svenonius (1994, 2003) observes an uneven behavior of the argument denoting the Ground, on the one hand, and the argument denoting the Figure, on the other. First, a preposition may select the Ground, but not the Figure. In particular, he (2003: 435) posits the generalizations in (37).

(37) a. P c-selects the Ground
b. P does not c-select the Figure

(Svenonius 2003: 435)

Second, a preposition may place selection restrictions on the Ground, but not on the Figure. Third, in languages with morphological case, a preposition may case-mark the Ground argument but not the Figure argument; see Haselbach and Pitteroff (2015) and Section 6.4 of this thesis for a morphological case approach to prepositions. Svenonius (2003) proposes that the Figure argument is introduced in the specifier of a light category called little *p*, while the Ground argument is introduced in the complement position of the lexical category P. Assuming that the cognitive relation between Figure and Ground is reflected in prepositional syntax, Svenonius (2003: 435) draws a parallelism between the prepositional and verbal domain by stating that "the close relationship between P and the Ground on the one hand,

[13] This thesis distinguishes the two categories under discussion by representing Van Riemsdijk's (1990) little p with an upright character and Svenonius' (2003) little *p* with an italic character.

and the more distant relationship between P and the Figure on the other, is reminiscent of the asymmetric relationship a verb has with its two canonical arguments, the Agent and Patient [...].” Furthermore, he (2003: 436) concludes that “the Figure is the ‘external’ argument of the preposition.” Building on these considerations, Svenonius (2003) formulates the so-called **Split P Hypothesis**, stating that a separate prepositional light category, little *p*, introduces an external argument in its specifier position, in parallel to Voice in the verbal domain (Kratzer 1996). In (38a), for example, *hay* is the Figure and *the wagon* is the Ground. Svenonius analyzes the prepositional structure as in (38b), where the Ground appears as the complement of the lexical category P, while the Figure appears in the specifier of little *p*.

(38) a. We loaded hay on the wagon.
b. [DP=*hay* little *p* [P=*on* DP=*the wagon*]]
(adapted from Svenonius 2003: 436)

Note that this thesis does not dwell on the Split P Hypothesis any further, even though it could be incorporated here in principle. In Chapter 5, I propose a prepositional light category in order to account for goal and source prepositions derived from locative prepositions. I label this light preposition as Q. Hierarchically, Q is between little *p* and P. (39) shows the light category little *p* hierarchically above the lexical category P.

(39) **Light categories in the prepositional domain:**
little *p* > Q > P

Let us summarize the discussion on light categories. Next to the fundamental split of categories into lexical categories (V, N, A, and P), on the one hand, and functional categories (e.g. C, T, or D), on the other hand, we identified so-called light categories, which are structurally in the middle. Like lexical categories, light categories may introduce arguments and establish thematic relations. Unlike lexical categories, however, light categories normally do not contribute conceptually-grounded lexical-semantic information. For the verbal domain, we can identify two light categories. First, the light category Voice (Kratzer 1996) is assumed to introduce external arguments interpreted as agents or causers. Second, the light category Appl for applicatives (cf. Pylkkänen 2000, a.o.) is assumed to introduce applied arguments interpreted as benefactor or malefactors. Appl comes in two versions: one above ($\text{Appl}_{\text{high}}$) and one below ($\text{Appl}_{\text{low}}$) lexical category V. For the prepositional domain, Svenonius (2003) proposes the light category little *p*, in analogy to Voice, that is supposed to introduce an external argument, which may be interpreted as a Figure with respect to a Ground (Talmy 1975, 2000).

2.1.3 Syntacticosemantic features

This section briefly addresses the class of **syntacticosemantic (synsem) features** (40); that is, those features from the universal inventory of features that have both a syntactic and a semantic impact.

(40) **Syntacticosemantic (synsem) features:**
Features from the universal inventory of syntacticosemantic features [...].
(Embick 2015: 6)

One group of synsem features are the so-called "ϕ-features" (phi-features) which normally comprise features for person, number, and gender (e.g. Adger and Harbour 2008: 2, Bobaljik 2008: 295). One characteristic of ϕ-features is that they are motivated by semantic and morphological facts (Adger 2003: 45).[14] Furthermore, ϕ-features are typically subject to predicate-argument agreement, such as subject-verb agreement. For example, the Russian verbs in (41a) agree with the singular subjects in gender (feminine), while the verbs in (41b) agree with the plural subjects in number (plural).

(41) a. Devočk-a poigral-a v komnate. Potom on-a pospal-a.
girl-FEM played-FEM in room then PRON-FEM slept-FEM.
'The girl played in the room. Then she slept.'
b. Devočk-i poigral-i v komnate. Potom on-i pospal-i.
girl-PL played-PL in room then PRON-PL slept-PL
'The girls played in the room. Then they slept.'
(Bobaljik 2008: 295)

Focusing on German, I will briefly present in the following the commonly assumed ϕ-features for number, gender, and person. German shows singular and plural number. That is, regarding the category number, we can assume the binary features [±SG] for singular and [±PL] for plural. Even though, at first glance, they seem to be complementary, that is, [+SG] seems to equal [−PL] and vice versa, we should assume both of them. Consider a language that has dual next to singular and plural number, such as the Uto-Aztecan language Hopi. With a binary feature system involving a singular and a plural feature, we can account for dual number by stating that dual number is specified as [+SG, +PL]. In fact, dual number in Hopi seems to be constructed by means of singular and plural morphology in combination, as illustrated in (42c).

(42) a. Pam taaqa wari
that man.SG ran.SG
'That man ran.'

[14] Note that ϕ-features and other synsem features often relate to a language's inflectional morphology, which is why they are alsp referred to as **morphosyntactic features** (Stump 2005: 50). In this thesis, I occasionally use the term 'morphosyntactic' in order to refer to both morphology and syntax at the same time.

b. Puma taʔtaq-t yuʔti
those man.PL ran.PL
'Those men ran.'

c. Puma taʔtaq-t wari
those men.PL ran.SG
'Those two men ran.'

(Adger 2003: 28)

We can conclude from the Hopi data in (42) that [±SG] and [±PL] are in fact not in complementary distribution. See also a similar discussion on this topic in Adger (2010: 192–193). For the sake of consistency, I assume – also for German, which does not have dual, but obviously singular and plural – both number features [±SG] and [±PL]. Considering the category of grammatical gender, German has feminine, masculine, and neuter. Using a binary feature system, we have, in principle, several options to express this. A natural way to account for this three-way gender distinction is to assume a binary feature [±FEM] for feminine and a binary feature [±MASC] for masculine. In this way, we can define feminine gender as [+FEM, −MASC], masculine gender as [−FEM, +MASC], and neuter gender as [−FEM, −MASC]. Considering the category of grammatical person, German has first person, second person, and third person. In order to account for this, we can assume the binary features [±1] and [±2]. From a semantic point of view, it makes sense to assume that these features correlate with the two interlocutors 'speaker' and 'hearer'. With the two person-features, we can represent the tripartite of person in German as follows. For first person, the speaker, we can assume the feature bundle [+1, −2], for second person, the hearer, the feature bundle [−1, +2], and for the third person, neither speaker nor hearer, the feature bundle [−1, −2].

Let's turn away from the discussion on ϕ-features and, instead, take a brief look at the synsem features proposed in Chapter 5, for the domain of spatial prepositions. I will argue that, considering German, we have evidence for at least two locative synsem features. I label them [LOC] and [AT]. Anticipating a classification of spatial prepositions along a geometric dimension (cf. Section 5.1.2), I argue that the feature [LOC] underlies locative pseudo-geometric and locative geometric prepositions. Both geometric and pseudo-geometric prepositions can derive goal and source prepositions. Therefore, I will argue that the synsem feature [LOC] can be dominated by the directional synsem feature [±TO]: [+TO] derives goal prepositions, while [−TO] derives source prepositions. Furthermore, the locative synsem feature [AT] is characteristic for non-geometric prepositions, which can also derive goal and source prepositions. Thus, I assume the directional synsem feature [±TO] that can also dominate [AT]. I will argue additionally that the feature [±NINF] (for **n**on-**i**nitial, **n**on-**f**inal paths) is characteristic for route prepositions.

2.1.4 Content features

Let us now look at **Content features**, that is, at the features that make up the Content list. By assumption, Content features are inserted into derivations after the syntactic computation is accomplished, but before structures are sent off to the interfaces. In particular, I assume that Content features are inserted into Root positions (cf. Section 2.3) at Spell-Out. By insertion into Root positions, Content features become Roots. On these assumptions, much of the discussion in the literature on roots is also relevant for Content features (e.g. Marantz 1997, Embick 2000, Harley and Noyer 2000, Pfau 2000, 2009, Arad 2003, 2005, Borer 2005a,b, 2013, Acquaviva 2009a,b, Siddiqi 2009, Acquaviva and Panagiotidis 2012, Haugen and Siddiqi 2013, the contributions in Alexiadou et al. 2014, as well as Harley 2014 and the commentaries thereon).

It is sometimes argued that prepositions are functional (e.g. Grimshaw 1991, 2000, 2005, Baker 2003, Botwinik-Rotem 2004), which would ultimately mean that prepositions do not involve Roots. However, Svenonius (2014: 442) states "that at least some functional items must have conceptual content [...]". In particular, he (2014: 442) argues that the English prepositions

> [...] *in* and *on* [...] behave identically, just like *cat* and *mouse* do. But unlike [PLURAL] or [DEFINITE], the distinction between *in* and *on* is not an independently motivated syntactically relevant feature. For some pairs, such as *over* and *under*, there is enough crosslinguistic data to suggest that the distinguishing feature is never syntactically relevant (that is, no language has a grammatically significant distinction between [UP] and [DOWN] like the one observed for [±DEFINITE]).

The distinguishing feature Svenonius alludes to in his statement can be attributed to Content features (Roots) inasmuch as they are supposed to represent idiosyncratic differences that are irrelevant to the computational system of grammar (Marantz 1995, 1996). Hence, I take Svenonius' statement as an invitation to assume that – at least some – prepositions can involve Content features.

Generally, Content features are (i) language-specific, (ii) conceptually grounded, and (iii) non-generative features that (iv) receive a semantic interpretation at LF and a morphological realization at PF. I briefly discuss these four claims in the following.

Regarding the claims that **Content features are language-specific** and conceptually grounded, let me point to Adger's (2003: 37–38) statement concerning semantic features, the conception of which comes close to my own conception of Content features.

> It seems likely that semantic features are universal, common to us all, but that different languages group semantic features in different ways so as to reflect the artefacts and concepts that are important to the culture in which the language is spoken. Of course, this cultural variation should not be over-emphasized: an

> enormous amount of what we think, perceive, taste, hear, etc. is common to all human beings as a result of our shared cognitive and physical limitations, and similar or identical collocations of semantic features will be involved in all languages for the lexical items that correspond to these concepts. It may even be the case that it is the universal aspect of our mental capacities that give rise to basic semantic features.

Regarding the claim that **Content features are conceptually grounded**, I take the view that Content features are like indexes (Pfau 2000, 2009, Acquaviva 2009a, Harley 2014). In particular, I assume that Content features serve as abstract differential indexes to the effect that they differentiate various concepts, which are not grammatical in nature. That is, Content features encode that piece of information that differentiates two distinct grammatical entities (e.g. phrases or clauses), with all else being equal, i.e. when all bits of grammatically-relevant information have been abstracted away. In this sense, my conception of Content features comes close to Acquaviva's (2009a) conception of Roots as differential indexes. He (2009a: 16) states that "the root DOG acts as an index that makes the noun *dog* different from nouns based on other roots [e.g. from the noun *cat*]. In the abstract syntactic representation before Vocabulary insertion, roots do not mean anything by themselves, but act as name-tags which define identity and difference. Their function is differential, not substantive." That is, Acquaviva's roots are like the indices $_1$ and $_2$ in (43).

(43) He$_1$ likes broccoli, but he$_2$ doesn't.

(Acquaviva 2009a: 16)

Consider the two clauses in (44). Arguably, the two clauses are syntactically, semantically, and morphologically parallel except for the choice of head noun of the direct object. It is *cat* in (44a), while it is *dog* in (44b); the difference between which is – I think – not a grammatical one. I assume that this kind of this difference is expressed by Content features. That is, the direct object DP in (44a) contains the Content feature [©CAT], while the direct object DP in (44b) contains the Content feature [©DOG] instead.[15] Apart from that, everything else in the two clauses is arguably the same.

(44) a. John petted a fluffy *cat*.
b. John petted a fluffy *dog*.

In my approach, Content features are conceptually grounded not to the effect that they have substantive semantic meaning – in fact, I assume that a Content feature is meaningless in and of itself – but to the effect that they differentiate concepts. The question whether Roots – which in a way correspond to my Content features – are contentful is by no means uncontroversial. Some scholars hypothesize that Roots inherently relate in some (under-specified) way or another to conceptual (or semantic) features, while other scholars reject

[15] In general, I indicate Content features with the prefix ©.

this hypothesis. For instance, Siddiqi (2009: 18) states that "roots are abstract morphemes linked to a basic concept (the root for *cat* is √CAT)", while Borer (2014: 356) states that Roots "never have Content it goes without saying that they have no formal semantic properties of any kind." I think that this opposition reveals two fundamentally different conceptions of Roots. In principle, scholars advocating contentful Roots take a semantics-based conception of Roots, while scholars rejecting contentful Roots take a morphology-based conception of Roots. By advocating the conception of Content features, I follow those scholars who take a semantics-based view of Roots.

Consider Rappaport Hovav's (2014) argument in favor of contentful Roots based on homonymy. In particular, she discusses a textbook example of homonymy, viz. the two English words *bank* ('riverside') and *bank* ('financial institution'). Even though the two nouns might be etymologically related, they synchronically do not share a single index-identified Root. Rather, they only share a single morphophonological exponent, namely /bæŋk/. This is because the morphosyntactic contexts, in which the two words/Roots appear, do not disambiguate the respective meanings. All else being equal, the sentence (45) is ambiguous only with respect to the lexical ambiguity of *bank*.

(45) He went to the bank.

(Rappaport Hovav 2014: 433)

The fact that the sentence (45) preserves exactly the lexical ambiguity under discussion shows that the two instances of *bank* are in contrastive distribution. This leads Rappaport Hovav (2014: 434)

> [...] to the conclusion that there is a single string of phonemes – a single VI – which represents two distinct roots. But this is really just another way of saying that these two roots are individuated semantically. Thus [...] the criterion for individuation in this case is purely semantic.

The semantic individuation criterion that Rappaport Hovav alludes to in her statement is best captured in terms of differential indexes on conceptual structure, i.e. Content features.

Regarding the claim that **Content features are non-generative**, I take the view that they have no bearing on syntactic computation. In particular, I assume that Content features do not project syntactic structure and, thus, they do not take arguments (Alexiadou and Lohndal 2013, 2014, Alexiadou 2014, Borer 2014, De Belder and Van Craenenbroeck 2015). Content features do not affect the syntactic derivation in any way. Assuming that Roots are defined derivationally (cf. Section 2.3), I take the view that De Belder and Van Craenenbroeck's (2015) operation Primary Merge generates an insertion site for Content features. The structural position generated by Primary Merge is the Root position, which has the property that whatever is in it cannot project.

Regarding the claim that **Content features can affect the semantic interpretation at LF and the morphological realization at PF**, I follow Rappaport Hovav (2014: 432) in assuming that roots, i.e. Content features, qua abstract morphemes are "identified by their bipartite nature" and that they are "individuated by a link between sound (a VI) and meaning (an instruction for interpretation)." That is, Content features are associated with Encyclopedia Items at LF and with Vocabulary Items at PF.[16] In that sense, Content features are not different from universal Lexicon features.

In this thesis, I assume two kinds of Content features. For one, I assume that **idiosyncratic Content features** express the arbitrary (morphological and semantic) differences between two grammatical entities, with all else being equal. For instance, the Content features [©CAT] and [©DOG] discussed above are instances of idiosyncratic Content features.[17] In a nominal context, they give rise to the nouns *cat* and *dog*. Idiosyncratic Content features are what Arad (2005: 99) alludes to by stating that "each root [i.e. Content feature] specifies some idiosyncratic core that differs from other cores, or roots." In addition to idiosyncratic Content features, I assume highly **abstract Content features**.[18] I assume that the function of abstract Content features is (at least) twofold. On the one hand, they can relate to general perceptually-grounded concepts like 'verticality' or 'interiority', while, on the other hand, they can bundle with idiosyncratic Content features and thereby give rise to particular aspects of meaning of the idiosyncratic Content features. Even though this bundling seems to be systematic to some extent, it can be – from a grammatical point of view – arbitrary. Before I illustrate this kind of bundling, let us first look at a case where abstract Content features relate to perceptually-grounded concepts.

Content features can become Roots (cf. Section 2.3), and so can abstract Content features. Abstract Content features can become Roots as singletons; or they can become Roots as feature bundles together with idiosyncratic Content features. Let me flesh out these two possibilities with an example. Let us first look at the case where abstract Content features become Roots as singletons. I claim that the abstract Content feature [א] as a singleton relates to the concept of interiority when being inserted into a Root position of a spatial preposition. However, it can give rise to different LF-interpretations in different structural environments. In particular, the abstract Content feature [א] gives rise to the LF-predicate 'in' in the Root position of a locative preposition, while it gives rise to the LF-predicate 'durch-bar' in the Root position of a route preposition. Anticipating the precise interpretation algorithm at LF, I claim that German has an Encyclopedia Item that provides the LF-instructions for P in (46); cf. Section 5.4.

[16]Exceptions of the general rule that Content features have both a semantic interpretation at LF and a morphological realization at PF are, e.g., Harley's (2014) *caboolde* items (aka *cran*-morphemes). I do not discuss such mismatches here, but refer to the respective literature, especially the comments on Harley (2014).

[17]Note that I indicate idiosyncratic Content features with the prefixed symbol ©. Note also that the labeling of Content features is arbitrary – as it is, in principle, the case for all features. Instead of labeling a Content feature [©DOG], one could have labeled it [©5S43FY] without any difference. Nevertheless, for the sake of comprehensibility, I generally choose transparent feature labels.

[18]I represent abstract Content features by means of Hebrew characters, e.g. א (aleph), ב (beth), ג (gimel), etc.

(46) **LF-instructions for P** (sketch):

a.	P	$\leftrightarrow$	[durch-bar(v, x) $\wedge$ ...]	/ "[א] in Root position of route P"
b.		$\leftrightarrow$	[in(r, x)]	/ "[א] in Root position of locative P"

Both the predicate in, which denotes a relation between a region r and a material object x, to the effect that r is the interior of x; and the predicate durch-bar, which denotes a relation between a spatial path v and a material object x, to the effect that v is a path through x, relate to the concept of interiority. I refer the reader to Section 5.3.1 for a model-theoretic definition of the LF-predicates in and durch-bar.

Let us now look at a case where abstract Content features become Roots as feature bundles, together with idiosyncratic Content features. I claim that, in such cases, an abstract Content feature can give rise to a certain aspect of meaning of the concept that is differentiated by the respective idiosyncratic Content feature it bundles with. That is, various abstract Content features can bring out various aspects of meaning of idiosyncratic Content features in the very same structural context. Across idiosyncratic Content features, this can be systematic to some extent, but, in general, the bundling of abstract and idiosyncratic Content features is more or less arbitrary, from a grammatical point of view. For instance, the idiosyncratic Content feature [©CUBA] relates to the geographic entity Cuba. The German noun *Kuba* ('Cuba'), however, can be interpreted as a state, i.e. the state of Cuba; or as an island, i.e. the island of Cuba. This difference is clearly not a grammatical difference. Thus, I do not attribute this difference to a (synsem or category) feature from the Lexicon. Instead, I claim that the idiosyncratic Content feature [©CUBA] can bundle with abstract Content features, e.g. [א] and [נ], and thereby the various interpretations of *Kuba* can arise. Both the Content feature bundle [©CUBA, א] and the Content feature bundle [©CUBA, נ] can be interpreted in the very same nominal Root position as the noun *Kuba*. But while the feature bundle [©CUBA, א] is interpreted as the Cuban state (47a), the feature bundle [©CUBA, נ] is interpreted as the Cuban island (47b). That is, German has the Encyclopedia Items that provide the respective LF-predicates in (47); cf. Section 5.4 and, in particular, (362) on page 220.

(47) **LF-instructions for the noun *Kuba*** (sketch):

a.	N	$\leftrightarrow$	[State-of-Cuba(x)]	/ "[©CUBA, א] in Root position of N"
b.		$\leftrightarrow$	[Island-of-Cuba(x)]	/ "[©CUBA, נ] in Root position of N"

This kind of Content-feature bundling is arguably systematic across comparable idiosyncratic Content features. Consider the German noun *Malta*, which behaves identical to *Kuba*. That is, the Content feature bundles [©MALTA, א] and [©MALTA, נ] are LF-interpreted as the Maltese state and the Maltese island, respectively. This is simply due to the fact that Malta can be (conceptionalized as) both a state and an island. However, this kind of systematicity finds its limitations in the state of affairs of the world. In the first place, there is no grammatical reason why Content feature bundles such as [©HAITI, נ] or [©HISPANIOLA, א], for instance, should not exist. I claim that the respective interpretations are simply not available (indicated with #), because a state of Hispaniola (48c) and an island of Haiti (48d) do not exist in the (actual) world.[19] Hispaniola is an island (48a) and Haiti is a state (48b). See also Section 5.4 and, in particular, (359) on page 218.

(48) **LF-instructions for the nouns *Hispaniola* and *Haiti*** (sketch):

a.	N	$\leftrightarrow$ [Island-of-Hispaniola(x)]	/	"[©HISPANIOLA, $\gimel$] in N's Root pos."
b.		$\leftrightarrow$ [State-of-Haiti(x)]	/	"[©HAITI, $\aleph$] in N's Root position"
c.		$\leftrightarrow$ #[State-of-Hispaniola(x)]	/	"[©HISPANIOLA, $\aleph$] in N's Root pos."
d.		$\leftrightarrow$ #[Island-of-Haiti(x)]	/	"[©HAITI, $\gimel$] in N's Root position"

The interpretation of abstract Content features depends on the idiosyncratic Content feature it bundles with. In particular, I do not claim that bundling with the abstract Content feature [$\aleph$] always yields a state reading and that bundling with [$\gimel$] always yields an island-reading. This is a peculiarity in the domain of idiosyncratic Content features relating to geographic entities. In other conceptual domains, the abstract Content features [$\aleph$] and [$\gimel$] can give rise to other aspects of meaning. In fact, I claim that abstract Content features form classes in particular conceptual domains (more or less) systematically. Staying within the domain of geographic entities, I assume that the abstract Content feature [$\aleph$] is not exclusively characteristic of state readings. Combined with the other idiosyncratic Content features it can also be characteristic of city readings, territory readings, region readings, etc. Likewise, the abstract Content feature [$\gimel$] is not exclusively characteristic of island readings. It can also be characteristic of mountain readings, square readings, etc. Furthermore, even though the bundling of abstract and idiosyncratic Content features is systematic to some extent, it is arbitrary from a grammatical point of view. There is no grammatical reason for why bundling with [$\aleph$] can yield state readings, for instance, but not island readings; nor for why, the other way round, [$\gimel$] can yield island readings, but not state readings. Such generalizations are language-specific and not universal.

2.2 Building structure

This thesis builds on principles of the Minimalist Program (MP) proposed by Chomsky (1995). MP applies **Bare Phrase Structure (BPS)** as its phrase structure module. Section 2.2.1 lays out the tree-structural relations and projection principles of BPS; Section 2.2.2, the major operations of BPS. Based on insights from that, Section 2.2.3 derives the notions complement, specifier, and adjunct. Then, that section also discusses briefly the differences between

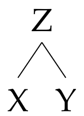
[19] Note that this might, of course, change. For instance, between 1804 and 1844, the island of Hispaniola had the name Haiti. (Thanks to Kerstin Eckart (pc) for pointing that out to me.) In fact, at that time, the name *Haiti* denoted both an island and a state, like *Kuba* and *Malta* today.

BPS and X-bar Theory (XbT), which is the phrase structure module of Government and Binding (GB) (Chomsky 1981, Haegeman 1994, a.o.), MP's predecessor.

2.2.1 Tree-structural relations and projection

Let us begin with two basic tree-structural relations, namely **motherhood** and **sisterhood**. In (49), Z is the 'mother' or 'mother node' of X and Y. Conversely, X and Y are 'daughters' or 'daughter nodes' of Z. X is the 'sister' or 'sister node' of Y and vice versa.

(49)



Another important tree-structural relation is **constituent-command (c-command)**. In general parlance, c-command gives one for every node its sisters and the descendants of the sisters. I adopt the definition of c-command put forth by Adger (2003: 117) in (50).

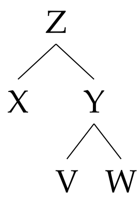
(50) **C-command:**
A node α c-commands a node β if and only if α's sister either

a. is β, or
b. contains β.

(Adger 2003: 117)

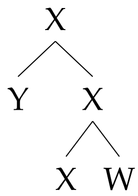
With this straightforward definition of the structural relation of c-command, we can identify the following c-command relations in the exemplary tree in (51). The node X c-commands the nodes Y, V, and W. The node Y c-commands the node X and the node V c-commands the node W which itself c-commands the node V. The node Z does not c-command any other node.

(51)



It is generally assumed in MP that syntactic nodes consist of features. This thesis straightforwardly adopts the notion of projection "where features from a daughter node project on to the mother node in a syntactic object" (Adger 2003: 76). In this context, it is worth noting that I consider a syntactic object to be either an element taken from the Numeration (normally a head) or a complex element that is the output of a syntactic operation. Assume the category X merges with the category W. One of the categories projects. Let us assume here, that X projects. The new complex syntactic object is therefore also of category X. We will further assume that this complex syntactic object merges with the category Y. Assume again that X projects. Assume also that now no further merge takes place where X projects. The respective structure is represented by the tree diagram in (52).

(52)



A crucial property of BPS is that the phrasal status of distinct levels of projection is derived when the structure has been built; unlike in X-bar Theory (cf. Section 2.2.3), where the phrasal status is representationally given in a template predetermining the respective levels of projection. In the tree in (52), we find distinct levels of projection of X. Chomsky (1995) defines them as in (53).

(53) **Levels of Projections:**

a. A **minimal projection** X° (or X) is a functional head selected from the numeration.

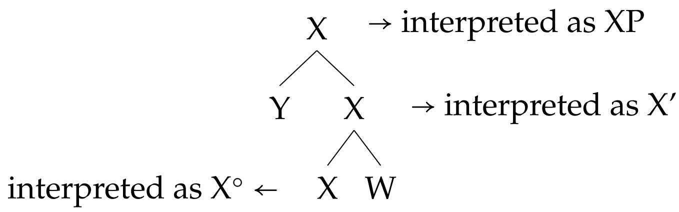
b. A **maximal projection** XP (or X″) is a syntactic object that does not project.

c. An **intermediate projection** X′ is a syntactic object that is neither an X° nor an XP.

(Chomsky 1995: 242–243)

Let us now apply the definitions of the levels of projection to our exemplary tree in (52), which yields the tree in (54).

(54)

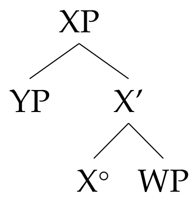


(Boeckx 2006: 176)

According to (53b), the syntactic objects Y and W are interpreted as phrases, i.e. YP and WP, respectively, because they do not project here.[20] In our example, the lowest X node is interpreted as a minimal projection X°, the highest X node is interpreted as a maximal projection, and the middle X node is interpreted as an intermediate projection X′. We obtain the customary tree structure diagram in (55).

[20]Note that, in this exemplary tree, Y and W can also be interpreted as minimal because they are items selected from the numeration. Later, I will use the notation Y°/YP for this configuration.

(55)



Under this perspective, the terms ‘maximal projection’ and ‘minimal projection’ are derived properties in BPS. A minimal projection is simply any node which does not dominate a copy of itself, and a maximal projection is any node which is not dominated by a copy of itself (Harley 2013b: 66).

2.2.2 Syntactic operations

Let us now look at the syntactic operations for structure building in Bare Phrase Structure (BPS). We can identify the syntactic operations Merge, Adjoin, Agree, and Move. This section presents them in turn.

Recall from Section 2.1.1 that we identified uninterpretability as a property of features. In particular, uninterpretable features, which are prefixed with *u*, figure in syntactic structure building. Adger (2003) assumes that uninterpretable features may not be present in the structure when the structure is sent off to the interfaces, i.e. at Spell-Out. In particular, he formulates the general constraint of Full Interpretation as given in (56).

(56) **Full Interpretation:**
The structure to which the semantic interface rules apply contains no uninterpretable features.

(Adger 2003: 85)

Hence, all uninterpretable features must be deleted in the course of the syntactic derivation before the structure is sent off to the interfaces at PF. An uninterpretable feature $[u\mathrm{F}]$ is deleted by **checking** it with a matching interpretable feature F.[21] Therefore, Adger formulates the checking requirement in (57).

(57) **Checking Requirement:**
Uninterpretable features must be checked, and once checked, they delete.

(Adger 2003: 91)

One tree-structural relation under which checking can take place is sisterhood, as formulated in (58).

(58) **Checking under Sisterhood:**
An uninterpretable c-selectional feature $[u\mathrm{F}]$ on a syntactic object Y is checked when

[21] Note that the function of the *u*-prefix is similar to the function of Sternefeld’s (2007: 35) star features: *Ein Baum ist wohlgeformt, wenn jedes Merkmal* $[*\alpha*]$ *des Baumes (genau) ein lokales Gegenstück der Form* $[\alpha]$ *hat* (A tree is well-formed, if each feature $[*\alpha*]$ of the tree has (exactly) one local counterpart of the form $[\alpha]$).

Y is sister to another syntactic object Z which bears a matching feature F.

(Adger 2003: 85)

Merge

For building a binary tree structures, Chomsky (1995) formulates the core recursive syntactic operation **Merge**, which inputs two syntactic objects and outputs one syntactic object containing the two. In (59), I adopt Adger's (2010) definition of Merge, which follows the one by Chomsky (1995: 243–244).

(59) **Merge**:

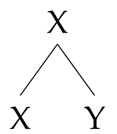
a. Lexical items are syntactic objects.

b. If A is a syntactic object and B is a syntactic object, then Merge of A and B, $K = \{A, \{A, B\}\}$, is a syntactic object.

(Adger 2010: 186)

The reason why I adopt Adger's definition instead of Chomsky's original definition is that it already includes the notion of projection. Chomsky (1995: 243) defines $K = \{\gamma, \{\alpha, \beta\}\}$, with γ being the outputted label of K. Chomsky (1995: 244) then argues that one of the two constituents α or β necessarily "*projects* and is the *head* of K". **Projection** means 'percolation' or 'handing over' of features to the label. Consider Chomsky's original definition of Merge and suppose that α projects. In this case, we can substitute γ with α, arriving at Adger's definition. K, as defined above, is usually represented in bracket notation (60a) or as a tree-diagram (60b).

(60) a. $[_X$ X Y $]$

b. 

With the checking requirement formulated in (57) and with the idea that checking can take place under sisterhood (dubbed as 'pure checking' by Adger 2003: 168), as formulated in (58), we can motivate the syntactic operation Merge. Adger describes the syntactic operation Merge, as in (61).

(61) a. Merge applies to two syntactic objects to form a new syntactic object.

b. The new syntactic object is said to contain the original syntactic objects, which are sisters, but which are not linearized.

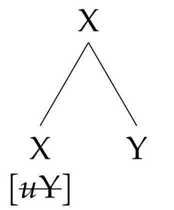
c. Merge only applies to the root [i.e. topmost] nodes of syntactic objects.

d. Merge allows the checking of an uninterpretable [...] feature on a head, since it creates a sisterhood syntactic relation.

(Adger 2003: 90–91)

Feature checking under Merge can be represented as in (62).

(62)



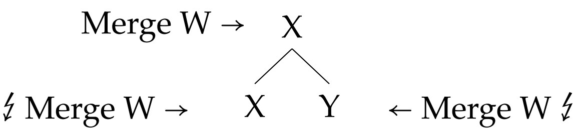
The operation Merge is restricted such that it can only target the topmost node of a syntactic tree.[22] Adger formulates this condition as the **Extension Condition** given in (63). Chomsky (1995: 190) refers to this condition as ‘Extend Target’.

(63) **Extension Condition:**
A syntactic derivation can only be continued by applying operations to the root [i.e. topmost] projection of the tree.

(Adger 2003: 95)

Suppose a configuration as in (64), where the node X merges with the node Y, and X projects. The Extension Condition restricts the derivation such that any other node W can only Merge with the structurally higher node X, but not with the lower instance of X or with Y.

(64)

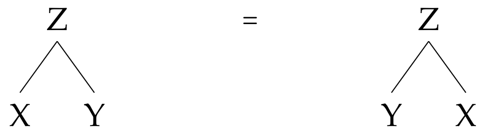


If at least one syntactic object that is input to Merge is taken from the Numeration, we speak of **external Merge**. The reason for referring to this as external Merge is the following. If the two syntactic objects α and β merge and one (suppose β) is taken from the Numeration, it is essentially *external*, i.e. not contained in one of the two. External Merge contrasts with **internal Merge**, which amounts to the syntactic operation Move which we will discuss below. I usually refer to external Merge simply as Merge.

Unlike Adger, who defines an argument “as a constituent in a sentence which is assigned a θ-role by a predicate” (Adger 2003: 81), I consider an **argument** to be the syntactic object selected under the operation Merge. In turn, the syntactic object that selects in any Merge operation is referred to as the **head** (Adger 2003: 91). This definition of a head leads to a mismatch of the term head in BPS, as compared to X-bar Theory. In X-bar Theory, minimal projections are defined as heads, while in BPS intermediate and maximal projections can also serve as heads.

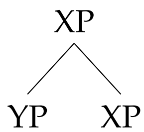
[22] Adger (2003) and others use the term ‘root’ to refer to the topmost node in a syntactic tree. In this thesis, however, I will use the term root/Root to refer to a different grammatical concept (cf. Section 2.3). In order to avoid confusion, I will use the term ‘topmost’, rather than ‘root’, when referring to the highest node in a tree.

Note that I assume that syntactic structures are abstract representations *without* a commitment to their surface linearization. That is, the two structures in (65) are syntactically identical. Following Embick and Noyer (2007), I assume that structures are linearized by a morphological operation after the syntactic derivation. I refer the reader to Section 3.2 for a more detailed discussion.

(65)


Adjoin

We can identify another syntactic operation with which it is possible to generate structure, namely **Adjoin**. In contrast to Merge, which is triggered by the checking requirement of uninterpretable features, "Adjoin [...] does not need to be triggered. [...]. Adjoin inserts a phrasal object into another phrasal object at its outermost level. It does not create a new object, it expands one of the old ones by stretching its outermost layer into two parts and inserting the adjoined object between them" (Adger 2003: 112). Adjoin, like Merge, follows the Extension Condition given in (63). The syntactic operation Adjoin can be schematized as in (66), where the constituent YP (the **adjunct**) adjoins to the constituent XP (the **adjunction site**).

(66)


One property of the operation Adjoin that follows from its non-triggered nature is that the distributional behavior of adjunction sites is the same whether or not they have and adjunct (Adger 2003: 112).

Agree

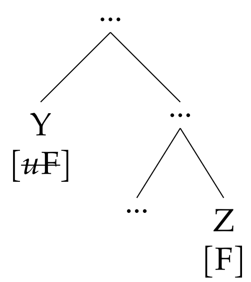
At the beginning of this section, the syntactic operation Merge has been defined as checking under sisterhood. As the relation of sisterhood can be considered to be a local instance of the c-command relation (Adger 2003: 169), we can additionally assume a more general (i.e. not sisterhood-based, but c-command-based) relation of feature checking. This relation is referred to as **Agree**. Adger (2003) provides the definition of Agree in (67).

(67) **Agree**:
An uninterpretable feature $[u\text{F}]$ on a syntactic object Y is checked when Y is in a c-command relation with another syntactic object Z which bears a matching feature F.

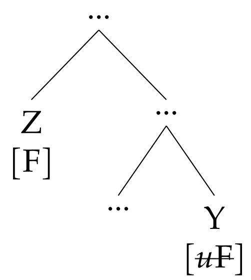
(Adger 2003: 168)

Agree as checking under c-command gives rise to a more general (and thus possibly more distant) checking of uninterpretable features in configurations such as those sketched in (68). The interpretable feature F on Z checks the uninterpretable feature [uF] on Y. The structural condition that holds between Y and Z is c-command, no matter which of the two nodes dominates the other.

(68) a.



b.



Checking under sisterhood, as defined in (58), is a subtype of Agree (i.e. checking under c-command), because sisterhood can be reduced to a more local version of c-command, i.e. sisterhood is contained in c-command (Adger 2003: 169). In fact, Sigurðsson (2004, 2006) considers Agree to be a precondition on the syntactic operation Merge, which builds on checking under sisterhood ("Agree Condition on Merge").

At this point of the discussion, it is crucial to distinguish the syntactic operation Agree from **morphological agreement**, which I assume to take place in morphology (Bobaljik 2008). Sigurðsson (2004) claims that whenever Merge applies, the possibility of morphological agreement arises. The actual morphological realization of syntactic Agree is then considered to be a parameter of a given language. Sigurðsson substantiates this claim by presenting data from various Germanic languages, showing that morphological agreement is subject to immense variation, and that it seems to be impossible to generalize over all instances (Sigurðsson 2004). Consider the patterns of predicate argument agreement sketched in (69), i.e. finite verb agreement and predicate agreement. While English is poor in agreement morphology, as having almost none (except for third person singular -s), Icelandic is rich in agreement morphology. German and Swedish are in the middle, as they have more agreement morphology than English, but less than Icelandic. In German, the finite verb agrees with the subject (which is also known as subject-verb agreement), whereas in Swedish, an adjectival predicate agrees with the subject.

(69) a. They would-∅ be rich-∅. (English)

b. They would-AGR be rich-∅. (German)
c. They would-∅ be rich-AGR. (Swedish)
d. They would-AGR be rich-AGR. (Icelandic)

(Sigurðsson 2004)

Move

Besides the syntactic operations Merge, Adjoin, and Agree, I assume a fourth syntactic operation, called **Move**. Informally, we can say that Move is an operation that changes the position of syntactic objects. However, Move is not a primitive operation, but the result of the interaction between two operations, one of which is Merge. The general idea is that, under Move, (a copy of) some syntactic object Y that is contained in another syntactic object X (re)-merges with X.[23] With respect to the other operation involved in Move, we basically find two approaches: (i) the Trace Theory of movement (Chomsky 1973, Haegeman 1994: 309–313) and (ii) the Copy Theory of movement (Chomsky 1993: 34–35, Nunes 1995, 2011).[24] These two approaches differ fundamentally with respect to the second operation constituting Move – next to Merge – and ultimately with respect to the theoretical status of the moved element and its in-situ position. Within a Trace Theory, the syntactic object targeted by Move is physically displaced, leaving behind an empty category, or trace *t*, before is it re-merged. That is, the second operation constituting Move is a displacement operation. The Copy Theory stands in contrast to that. Here, the syntactic object targeted by Move is copied to the effect that the master copy remains in situ (and becomes phonologically silent), while the copy merges. That is, the second operation constituting Move is a copy operation.[25]

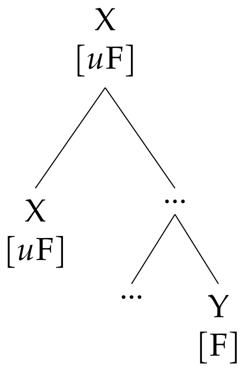
In the following, I briefly sketch both approaches to the operation Move. Like the operation Merge, the operation Move is triggered by some uninterpretable feature that must be checked locally. Assume a projecting syntactic object X bearing an uninterpretable feature $[u\text{F}]$ that has to be checked locally. Instead of selecting an external constituent with a matching feature, X (the probe) scans its c-command domain for an internal syntactic object with a matching feature F. Let's further assume that X finds a matching feature on the downstairs-embedded, non-projecting syntactic object Y (the goal), as in (70).

[23] The fact that a syntactic object is (initially) contained in another syntactic object gives rise to the term *internal* Merge.

[24] See also Boeckx (2006: 105–106).

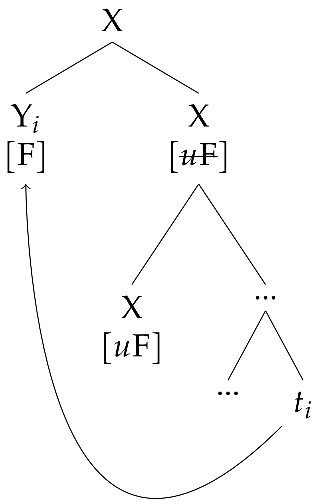
[25] Hornstein (2001), Hornstein et al. (2005) argue that a copy operation seems to be independently needed to build up a Numeration from List 1. In particular, they (2005: 215) argue that List 1 does not shrink like a bag of marbles when an item of it is taken to build up a Numeration, but that items of List 1 are *copied* into a Numeration.

(70)



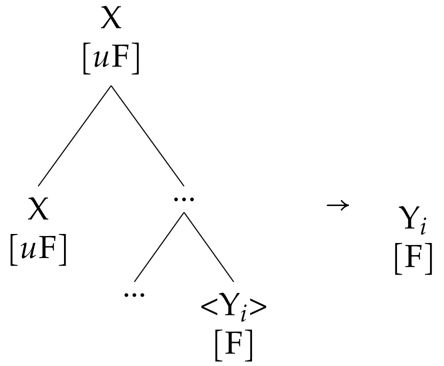
Within a Trace Theory approach, the probe X attracts the goal Y into its local domain, thereby checking the uninterpretable feature [*u*F] locally. The displaced syntactic object Y_i leaves behind a trace t_i. The displaced constituent and the trace are co-indexed. (71) illustrates Move within a Trace Theory approach.

(71)

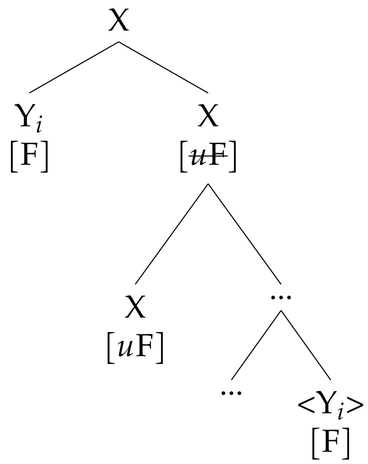


Within a Copy Theory approach, the goal Y is copied under co-indexation (72a) and then merged with the probe X – obeying the Extension Condition in (63) – and thereby checking the uninterpretable feature [*u*F] locally (72b).

(72) a. Copy goal:



b. Merge goal with probe:



The master copy of Y_i, i.e. its lower instance, ultimately undergoes phonological deletion, which means that it is not pronounced (Nunes 1999, 2004, Boeckx 2006: 165–167). Phonological deletion is indicated by angle brackets. Note that it is argued, in favor of the Copy Theory, that there are instances where the master copy in fact receives a phonological realization. Consider, for example, the Afrikaans data in (73), where the intermediate instances of *met wie* ('with who') are in fact overtly realized (Hornstein et al. 2005: 215).

(73) **Met wie** het jy nou weer gesê **met wie** het Sarie gedog **met wie** gaan
with who have you now again said with who did Sarie thought with who go
Jan trou?
Jan marry
'Who(m) did you say again that Sarie thought Jan is going to marry?'
(Du Plessis 1977: 725)

Note that the so-called Copy Construction in German (Höhle 1996, Fanselow and Mahajan 2000, Fanselow and Ćavar 2001), exemplified in (74), can be analyzed along the same lines as in the Afrikaans example.

(74) a. **wer** denken Sie **wer** sie sind
who think you who you are
'who do you think you are'

b. **wen** denkst Du **wen** sie meint **wen** Harald liebt
who think you who she believes who Harald loves

'who do you think that she believes that Harald loves'

(Fanselow and Mahajan 2000: 219)

With regard to the question Trace Theory vs. Copy Theory, I have nothing more to say than the following. The Copy Theory has the theoretical advantage that we do not have to stipulate a new theoretical primitive, i.e. an empty category or trace. Hornstein et al. (2005: 213) note that "a copy [...] is not a new theoretical primitive; rather, it is whatever the moved element is, namely, a syntactic object built based on features of the numeration".

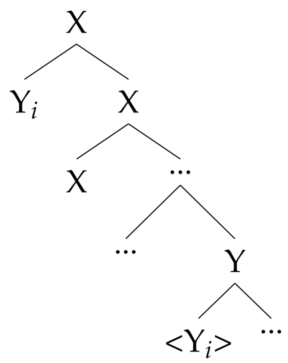
The sequence of the positions occupied by a constituent undergoing the operation Move is referred to as the **(movement) chain**. For example, (72b) constitutes the movement chain [Y_i,<Y_i>]. Chomsky (1995: 253) argues that a movement chain is subject to the condition that all members of a movement chain have the same phrase structure status. He formulates the Chain Uniformity condition in (75).

(75) **Chain Uniformity:**
A chain is uniform with regard to phrase structure status.

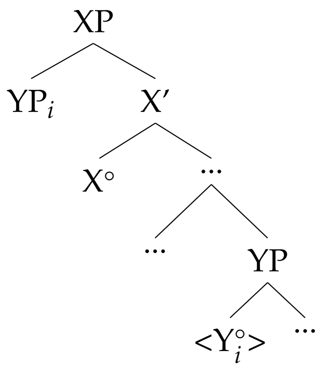
(Chomsky 1995: 253)

Chain Uniformity rules out configurations where a projecting syntactic object moves into a position where it cannot project. Assume a derivation as in (76a), where the projecting terminal node Y moves into the local domain of X, i.e X projects. Let us determine the phrasal structure status of the nodes in (76b). According to the principles formulated in (53), the lower copy of Y is interpreted as a minimal projection (Y_i°) because it projects in this position, while the higher copy of Y is interpreted as a maximal projection (YP_i) because it does not project in this position.

(76) a.



b.



The configuration in (76b) gives rise to the movement chain [YP,<Y°>]. Its elements have different phrasal statuses ([maximal projection,<minimal projection>]), which violates Chain Uniformity.

2.2.3 Complements, specifiers, and adjuncts

This section elaborates on the notions **complement**, **specifier**, and **adjunct** as structural notions. Strictly speaking, we can identify two instances of Merge (59) that are technically the same, but that generate different levels of projection. On the one hand, there is the Merge operation that Adger (2003: 105–108) dubs **First Merge**. The characterization of First Merge is that the projecting syntactic object inputted to the Merge operation is interpreted as a minimal projection. The non-projecting syntactic object that undergoes First Merge next to the projecting one is called **complement**. On the other hand, there is **Second Merge** (Adger 2003: 109–110) that is characterized such that the projecting syntactic object is not interpreted as a minimal projection. The non-projecting syntactic object undergoing Second Merge next to the projecting one is called **specifier**.[26] The syntactic object undergoing Adjoin that is not expanded is called the **adjunct**. The operation Adjoin is also sometimes referred to as adjunction (Adger 2003: 110–114). These considerations give rise to the relational definition of complement, specifier, and adjunct in (77). Hence, these notions refer to structural positions.

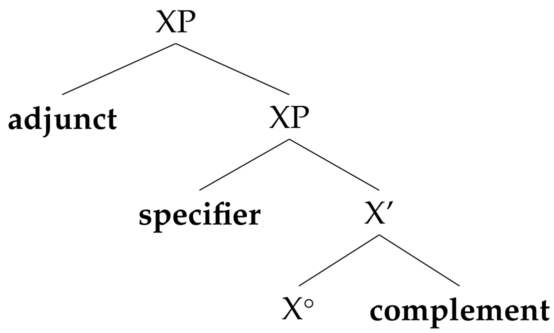
(77) a. **Complement:** Sister of minimal projection
b. **Specifier:** Sister of intermediate projection
c. **Adjunct:** Sister of maximal projection

(Adger 2003: 110–111)

In a tree diagram, this looks as depicted in (78).

[26]The terms Spec-X, Spec,X or SpecX refers to a specifier position of X.

(78)

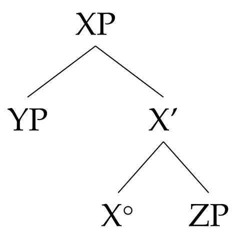


The specifier position and the complement position are argument positions because they are generated by the operation Merge. They contrast with adjuncts, which are not selected by Merge, but undergo the operation Adjoin. The relation between X° and its complement, as well as the relation between X° and its specifier are considered to be local. This follows from the definition of Merge, which involves checking under sisterhood – arguably a local tree-structural relation (Adger 2003: 169).

Bare Phrase Structure vs. X-bar Theory

At this point, it is helpful to say something about the differences between Bare Phrase Structure (BPS) and **X-bar Theory (XbT)**. Note that this comparison is only a brief overview of the differences between XbT and BPS; for a more detailed discussion on this topic, I refer the reader to Adger (2003), Hornstein et al. (2005), Boeckx (2006), Lohndal (2012). XbT, first proposed by Chomsky (1970) and further developed by Jackendoff (1977), states a hierarchical segmentation of phrases. Each phrase is segmented into a maximal projection, at least one intermediate projection, and a minimal projection. Recall the tree in (55) illustrating the levels of projection, which I repeat here in (79). As this exemplary phrase comprises two arguments, namely YP in a specifier position and ZP in the complement position, the XbT tree and the BPS tree of this phrase basically look alike.

(79)



However, there is a crucial difference between XbT and BPS concerning the theoretical status of the levels of projection. XbT is representational, that is, structure is built in one fell swoop. The items and arguments are then inserted into the structure. BPS, on the other hand, is derivational; that is, structure is built bottom up bit by bit. This difference in the conceptualization of phrase structure gives rise to the hypothesis that in XbT each and all phrases comprise all levels of projection regardless of the amount of arguments. In BPS, on the contrary, no such preconceived phrase structure is assumed, but the respective levels of projection are set up as required.

Another difference between XbT and BPS is that the former permits binary and unary branching, while the latter only permits binary branching. Consider now the different argument-structural configurations in Table 2 below.

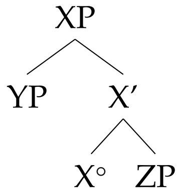
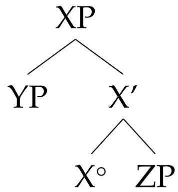
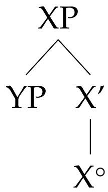
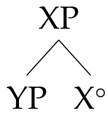
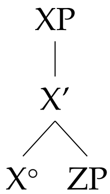
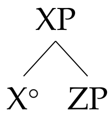
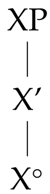
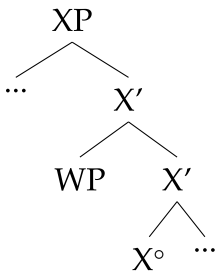
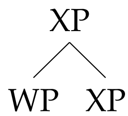
	XbT	**BPS**
(i)		
(ii)		
(iii)		
(iv)		X°/XP
(v)		

Table 2: Structures in XbT vs. BPS

Apart from the theoretical status of the projections (representational in XbT vs. derivational in BPS), a transitive structure such as in row (i) looks identical in both XbT and BPS. With ZP in complement position and YP in specifier position, X projects a minimal projection X°, an intermediate projection X′, and a maximal projection XP. However, the differences become visible when a phrase contains fewer than two arguments. If a phrase contains only one argument, as in the rows (ii) and (iii) in Table 2, XbT structurally distinguishes between the argument in the specifier position and the argument in complement position. Under the assumption of linearization outlined above, i.e. that the order of items in the structure is irrelevant, no such distinction between a specifier and a complement can be made in BPS. This is because the structures in row (ii) and (iii) in Table 2 are identical, i.e. YP and ZP are both in complement position of X°. Chomsky (1995: 247–248) points to a potential problem if the distinction between specifier and complement cannot be made; see also Boeckx 2006: 175–176 and Harley 2011: 17–19. The X-bar-theoretical distinction between the specifier and complement in the rows (ii) and (iii) is often exploited in order to capture an empirically well-motivated distinction of two classes of intransitive verbs, dubbed 'unergative' and 'unaccusative' verbs.[27] While unergative verbs like in *John dances* are assumed to project only a specifier, unaccusative verbs like in *John arrives* are assumed to project only a complement. Both positions then are assumed to surface as the subject. In BPS, both structures collapse in one and we lose this theoretical generalization about argument structure.

However, we can solve this problem by assuming light categories, for instance. Unaccusative verbs are assumed to project only a complement of V, while the single argument of unergative verbs is assumed to be projected by a light category such as Voice. Now consider the case that a phrase contains no argument at all, like in row (iv). Here, XbT assumes the full range of projections from minimal projection X° over intermediate projection X' to maximal projection XP. In contrast, BPS assumes only one node in this case. According to BPS's principles of projection, such mono-node structures are interpreted as minimal and maximal projections at the same time. Thus, a phrase without any argument is represented by X°/XP (or XP/X°) in BPS.

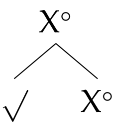
Another difference between XbT and BPS concerns the status of adjuncts, such as WP in row (v). Both XbT and BPS consider adjuncts as optional, but while adjuncts are considered to be endocentric in XbT – adjuncts occur within maximal projections as sisters and daughters of intermediate projections –, adjuncts are considered to be exocentric in BPS – adjuncts occur as sisters of maximal projections.

2.3 Roots

In this section, I propose that **Root** is a derivational notion, just like the notions 'complement', 'specifier', and 'adjunct', which are discussed in Section 2.2.3. That is, Roots are identified derivationally. In particular, I propose that a Root position is a sister and, at the same time, a daughter of a minimal projection – a structural configuration that can be achieved by means of De Belder and Van Craenenbroeck's (2015) operation Primary Merge.[28] A Root is what is inserted in a Root position. The structural position that is indicated with the Root symbol "$\surd$" in (80) qualifies as a Root position.

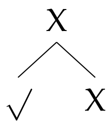
[27] For instance, German unergative verbs normally co-occur with the auxiliary *haben* ('have'), while unaccusatives co-occur with *sein* ('be').

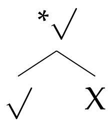
[28] Note that this proposal ultimately requires a redefinition of complements as sisters, *not daughters*, of minimal projections.

(80) 

When generated by Primary Merge, Root positions are empty ∅. That is, Root positions are like place holders in their initial state. I suggest that Root positions can be filled at Spell-Out. Typically Content items (cf. Section 2.1.4) are inserted into Root positions and thereby become Roots. However, De Belder and Van Craenenbroeck (2015) argue that feature bundles from the Lexicon, e.g. bundles of synsem features, can also occur in Root positions. In Chapter 5, I argue that the Root position of certain prepositions (pseudo-geometric prepositions and non-geometric prepositions) can also remain empty.

Alexiadou and Lohndal (2013, 2014), Alexiadou (2014) argue that, when a Root combines with a categorizer, it is always the categorizer that projects, never the Root. In particular, they argue that Roots are always modifiers of functional categorizing heads, i.e. they are supposed to be like adjuncts to functional material (81a). Configurations where roots project are excluded (81b).

(81) a. 

b. 

In order to account for this structural restriction, I adopt De Belder and Van Craenenbroeck's (2015) operation **Primary Merge** to generate insertion sites for Roots. Their (2015: 629) leading thought is that

> there are specific positions in the syntactic structure that will serve as the insertion site for roots [...]. These positions are characterized by the absence of grammatical features and therefore do not play any active role in the syntactic derivation.

One of De Belder and Van Craenenbroeck's empirical arguments for a structural account to Roots is based on the observation that functional Vocabulary Items can occupy positions that are normally occupied by non-functional Vocabulary Items. Consider the Dutch data in (82), where functional Vocabulary Items behave like nouns or like verbs.

(82) a. Ik heb het **waarom** van de zaak nooit begrepen.
I have the why of the case never understood
'I have never understood the motivation behind the case.'

b. In een krantenartikel komt het **wat/hoe/wie/war** altijd voor het **waarom**.
in a newspaper.article comes the what/how/who/where always before the why

'In a newspaper the what/how/who/where always precedes the why.'

c. De studenten **jij**-en onderling.
the students you-INFINITIVE amongst.one.another
'The students are on a first-name basis with each other.'

d. Martha is mijn tweede **ik**.
Martha is my second I
'Martha is my best friend.'

e. Niets te **maar**-en!
nothing to but-INFINITIVE
'Don't object!'

f. Paard is een **het**-word.
horse is a the.NEUTER.DEFINITE-word
'*Paard* takes a neuter article.'

(De Belder and Van Craenenbroeck 2015: 630)

In particular, De Belder and Van Craenenbroeck observe that functional Vocabulary Items do not project their functional features if they surface in the position of a lexical Vocabulary Item. Consider the Dutch example in (83), where the functional Vocabulary Item *ik* ('I') in subject position behaves like a common noun and not like a functional Vocabulary Item. In particular, we would expect that the functional Vocabulary Item *ik* with the ϕ-features specification for first person singular enters into an agreement relation with the verb, that is, that the copula verb *wezen* ('be') should surface as *ben* ('be.1.SG'). However, *ben* in (83) is ungrammatical and the copula verbs shows third person singular agreement morphology, that is, it surfaces as *is* ('be.3.SG').

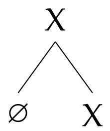
(83) Mijn tweede ik {*ben/is} ongelukkig.
my second I am/is unhappy
'My best friend is unhappy.'

(De Belder and Van Craenenbroeck 2015: 632)

De Belder and Van Craenenbroeck conclude that the functional Vocabulary Item *ik* in (83) occupies a structural position where it cannot project its functional features and thereby trigger morphological agreement.

With regard to the syntactic operation Merge, De Belder and Van Craenenbroeck observe that there is a technical imbalance when Merge is applied for the first time in a derivation; that is, when the **derivational workspace** is empty. In this case, an item is selected from the Numeration, but – unlike in successive selection operations – it is not fed to the operation Merge. Instead, the item is simply put into the derivational workspace. Any other item that is selected afterwards, but before the structure is finalized and sent off to the interfaces, undergoes Merge with an existing syntactic object in the derivational workspace. De Belder and Van Craenenbroeck eliminate this imbalance by proposing that the first item selected from the Numeration is indeed fed to the operation Merge (e.g. as defined in (59) in Section 2.2.2). However, as the very first item selected from Numeration cannot merge with an existing syntactic object, it simply merges with the empty set. The empty set is arguably present if nothing else is present in the derivational workspace. Assume that we have an empty derivational workspace and select the item X from the Numeration. It merges with the empty set into the derivational workspace. As the empty set innately does not contain any features, it naturally follows that only X projects its features. The resulting structure in (84) depicts Primary Merge as outlined above.

(84) **Primary Merge:**



(adapted from De Belder and Van Craenenbroeck 2015: 637)

This structure straightforwardly explains why functional Vocabulary Items do not affect the derivation when they behave like roots. De Belder and Van Craenenbroeck propose that the functional Vocabulary Item *ik* in (83) is inserted in an empty set position generated by Primary Merge. Material in this position cannot project. It follows that morphological agreement does not take place. Anything in this position is 'encapsulated'.

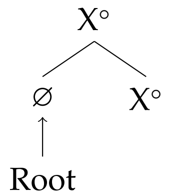
It is crucial to point to a fundamental difference between Primary Merge and other Merge operations, such as First Merge or Second Merge, cf. Section 2.2.3. While First Merge and Second Merge have a clear trigger, namely an uninterpretable (category) feature, Primary Merge does not have such a trigger. For example, take a verb with an internal argument. Initially, such a verb comprises the feature bundle V[*u*D]. The category V determines the category verb and the *u*-prefixed feature [*u*D] triggers First Merge with a DP. What is the corresponding counterpart that triggers Primary Merge? One could think of an uninterpretable empty set feature [*u*∅] or a bare uninterpretable feature [*u*]. However, this does not conform with the definition of uninterpretable features as given in (14b), because the empty set is not a feature.[29] Uninterpretability is typically conceived of as a property of features. Thus, Primary Merge has to be triggered differently. In this thesis, I assume that Primary Merge is triggered by selection from the Numeration.

I assume that Root Insertion happens at Spell-Out. I follow De Belder and Van Craenenbroeck, who suggest that the empty set position generated by Primary Merge constitutes an insertion site for Roots. At Spell-Out, the syntactic derivation is accomplished, and the phrase structure status can be determined. The lower X-node in (84) is clearly a minimal projection because it is an item taken from the Numeration. Thus, it is labeled as X°. What about the higher X-node? As it is completely identical to the lower X-node – it does not contain any further features whatsoever – it is reasonable to also label the higher X-node as a minimal projection. Note that we additionally have to consider the question of whether X

[29]Even if we would assume an uninterpretable empty set feature or a bare uninterpretable feature, this is still fundamentally different from an uninterpretable category feature.

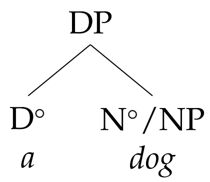
further projects. If X projects further structure, then the higher X-node is merely a minimal projection (X°); this case is illustrated in (85). If X does not project further structure, then the higher X-node is both a minimal and a maximal projection (X°/XP); this case is ignored in (85). What is crucial here is that both the higher and the lower X-node have the status of a minimal projection. The empty set position ∅, which is the sister and the daughter of a minimal projection, serves as the insertion site for Roots. I assume that this happens at Spell-Out.

(85) **Root Insertion at Spell-Out:**



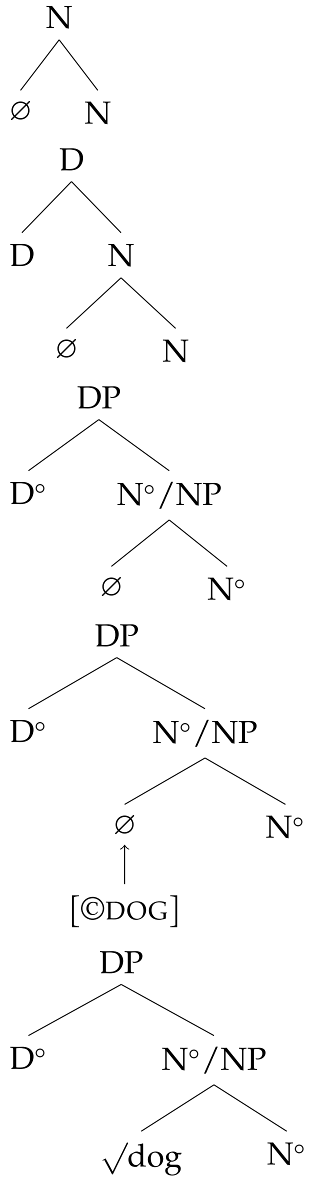
Let me illustrate these considerations with a simplified derivation. Take the DP *a dog*. Abstracting away from the functional structure (e.g. NumP), we can assume the simplified structure in (86) to begin with.

(86)



We can assume that the Root $\sqrt{}$dog – or, to be precise, the Content feature [©DOG] (cf. Section 2.1.4) in a Root position – underlies this derivation. First, N is taken from the Numeration and fed to the operation Primary Merge. It merges with the empty set (87a). Subsequently, D[*u*N] merges with the 'complex' N (87b). At Spell-Out, the phrasal status of the nodes can be determined along the definitions in (53). The lower N-node is a minimal projection (N°) because it is an item selected from the Numeration. As the higher N-node is equivalent to the lower node – it is equivalent to an item selected from the Numeration – is can also be considered to be a minimal projection. In addition, it is also a maximal projection (N°/NP), because it is a syntactic object that does not project. Similarly, the lower D-node is a minimal projection (D°), as it is an item selected from the Numeration, while the higher D-node is a maximal projection (DP), because it does not project (87c). When the phrasal status is determined at Spell-Out, we can insert material into the Root position ∅. In this example, we insert the Content feature [©DOG] (87d). In this position, the Content feature [©DOG] is interpreted as the Root √dog (87e).[30]

(87) a. b. c. d. e.



Root positions are determined derivationally. In BPS, the notions of complement, specifier, and adjunct are derivational. Recall (77) from Section 2.2.3, where we defined complements as sisters of minimal projections, specifiers as sisters of intermediate projections, and adjuncts as sisters of maximal projections. I suggest that we can define Root positions along the same lines. Like complements, Root positions are sisters of minimal projections, but unlike complements, Root positions are additionally also dominated by minimal projections; recall (85). In particular, I propose (88), which is basically an extension of (77).

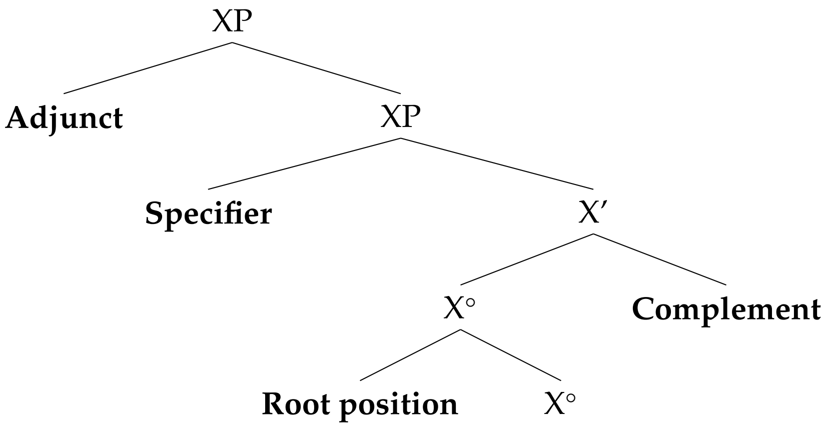
[30] From a phrase-structural point of view, items in Root positions have, by definition, the status of a maximal projection because they do not project, cf. (53b). However, I refrain from labeling Root material as phrasal (e.g. dogP). Instead, I use the common notation with the Root symbol (e.g. √dog).

(88) a. **Root position:** Sister and daughter of minimal projection
b. **Complement:** Sister but not daughter of minimal projection
c. **Specifier:** Sister of intermediate projection
d. **Adjunct:** Sister of maximal projection

extension of (77); (Adger 2003: 110–111)

This can be displayed as in the tree-diagram in (89).

(89)



I propose that Root positions are characteristic for Roots. Put differently, we can identify Roots as the (Content) material inserted into Root positions (90).

(90) **Root:**
A Root is what is inserted into a Root position.

Typically, (bundles of) Content features (cf. Section 2.1.4) are inserted into Root positions and thus become Roots. In (87), this is presented for the Content feature [©DOG] that becomes the Root √dog. However, we can also find other types of features in Root positions. Reconsider the examples in (82) where arguably functional features occur in Root positions (De Belder and Van Craenenbroeck 2015). In (82d), for instance, *ik* ('I') serves as a common noun. That is, we can assume that the synsem feature bundle [+1, +SG] from the Lexicon is inserted into a nominal Root position and thus becomes the Root √ik. However, I do not discuss such cases any further, because they fall outside the scope of this thesis. Instead, I will propose in Section 5.4 that, in the domain of spatial prepositions, Root positions can either be filled with Content features (geometric prepositions) or remain empty (pseudo-geometric prepositions and non-geometric prepositions).

Let me close this section with a brief note on the question of how to account for more than one Root in a given derivation. Primary Merge basically allows one root per derivation, because a Root position is generated only when the workspace is empty and the first item from the Numeration is merged into the empty derivational workspace. De Belder and Van Craenenbroeck (2015: 642) refer to this as **One Derivational Workspace, One Root** ("In every derivational workspace, there is exactly one root, and for every root there is exactly one derivational workspace"). However, a derivation typically involves more than one Root. One possibility to account for this is to assume a layered derivation to the effect that derivations are, in principle, readmitted to the Numeration. Following Zwart (2009: 161), De Belder and Van Craenenbroeck propose that "the output of a previous derivation [can appear] as an atom in the numeration for the next derivation". This means that a derivation is cleared from the workspace and inserted back into the Numeration. With a cleared derivational workspace, Primary Merge can generate a further Root positions.

2.4 Summary

This chapter laid out the syntactic module within the Y-model of grammar. In this thesis, I adopt the tenets of the Minimalist Program (MP) (Chomsky 1995, Adger 2003).

Section 2.1 addressed the notion of 'feature'; features are considered to be the core building blocks of the grammatical theory adopted here. Section 2.1.1 presented the two types of feature systems that are relevant in this thesis: (i) privative features, where features are considered to be attributes; and (ii) binary features – features, that are considered to be pairs consisting of an attribute and a value drawn form a binary domain. Focusing on prepositions, Section 2.1.2 discussed category features. A general division into three types of category features was made: (i) the lexical categories V (verb), N (noun), A (adjective), and P (preposition); (ii) the functional categories C (complementizer) > Dx (deixis) > Asp (aspect); and (iii) light categories such as verbal Voice (Kratzer 1996) or Appl (applicative) (Pylkkänen 2002, McIntyre 2006) and prepositional 'little *p*' (Split P Hypothesis) (Svenonius 2003). The functional categories dominate the lexical categories. Light categories are considered to be in between functional and lexical categories. The Parallelism Hypothesis states that the functional categories, which dominate the lexical categories, are structured in parallel across the lexical domains; cf. Den Dikken (2010: 100 104). Section 2.1.3 briefly addressed syntacticosemantic (synsem) features, i.e. those feature that are drawn from the universal inventory of syntacticosemantic features (Embick 2015: 6). In Section 2.1.4, I introduced Content features, which I consider to be language-specific, conceptually grounded, and non-generative. They can affect the semantic interpretation at LF and the morphological realization at PF. I identified two types of Content features: (i) idiosyncratic Content features, which relate to the arbitrary differences between two grammatical entities, with all else being equal (e.g. the difference between *cat* and *dog*); and (ii) abstract Content features, the function of which is at least two-fold. On the one hand, they can relate to general perceptually-grounded concepts like 'interiority' or 'verticality', while, on the other hand, they can bundle with idiosyncratic Content features and thereby give rise to particular aspects of meaning of the idiosyncratic Content features. This was illustrated with the toponym *Kuba* ('Cuba'), which can denote the island of Cuba or the state of Cuba. Depending on the abstract Content feature the idiosyncratic Content feature bundles with, either of these interpretations is promoted at LF.

Section 2.2 presented the principles according to which structure can be generated in the Minimalist Program (MP) (Chomsky 1995). MP applies Bare Phrase Structure (BPS) as its phrase structure module. Section 2.2.1 laid out the tree-structural relations and projection principles of BPS; Section 2.2.2, the major operations of BPS. Section 2.2.3 derived the notions complement, specifier, and adjunct. Then, that section also discussed the differences between BPS and X-bar Theory (XbT), which is the phrase structure module of Government and Binding (GB) (Chomsky 1981, Haegeman 1994, a.o.), MP's predecessor.

Section 2.3 clarified the status of Roots in the approach proposed here. Adopting the operation Primary Merge (De Belder and Van Craenenbroeck 2015), I defined a Root position as the position that is a sister and a daughter of a minimal projection; cf. (88) on page 56. Consequently, I defined a Root as what is inserted into a Root position; cf. (90) on page 56.

Chapter 3

Morphology

This chapter explores the branch from Spell-Out to the Articulatory-Perceptual (A-P) system in the Y-model of grammar (**Morphology**), as depicted in Figure 5 below.

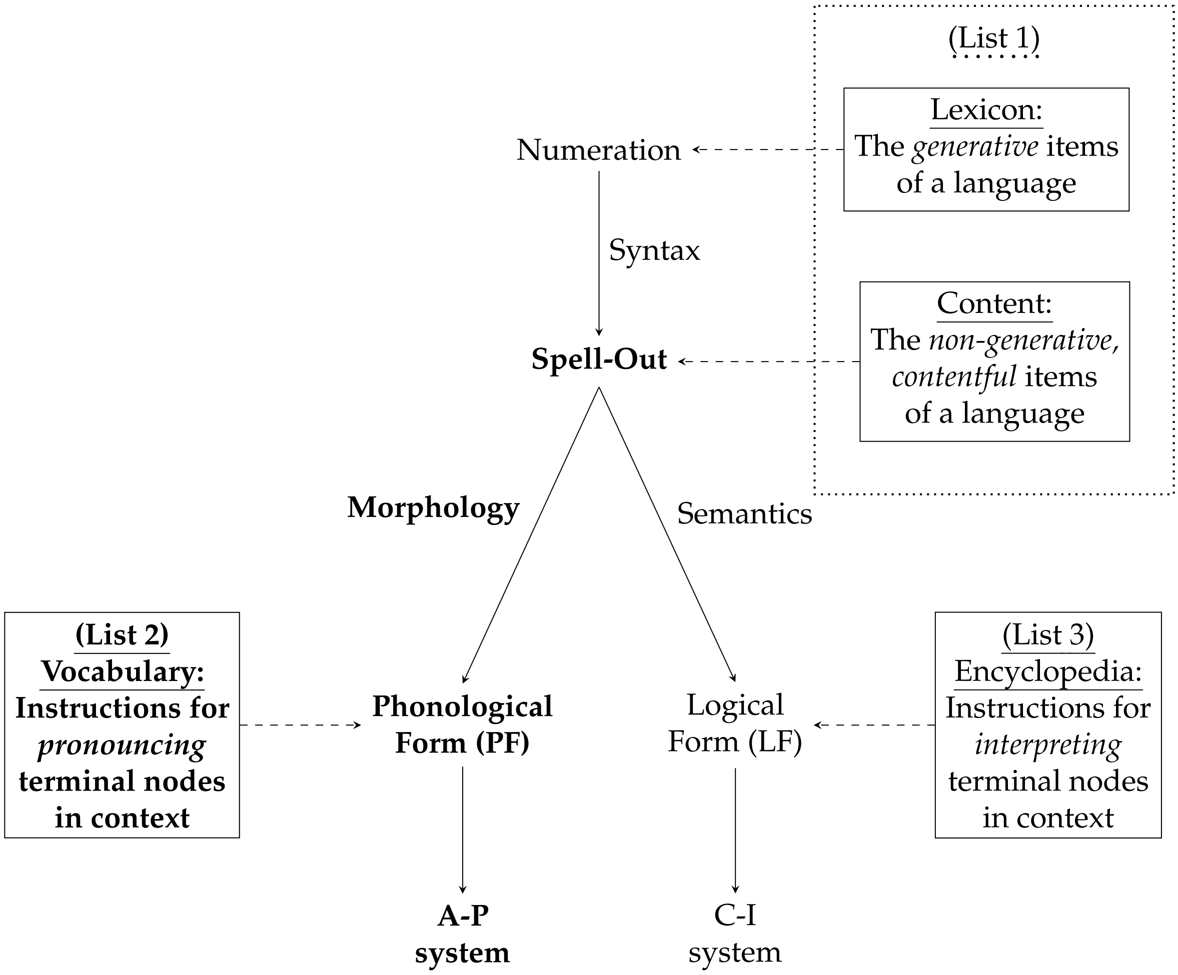


Figure 5: Morphology in the Y-model of grammar

This thesis adopts the tenets of **Distributed Morphology (DM)** (Halle and Marantz 1993, 1994, Halle 1997, Harley and Noyer 2000, Embick and Noyer 2001, 2007, Embick and Marantz

2008, Siddiqi 2009, Harley 2012, Matushansky and Marantz 2013, Embick 2015, a.o.). [31] DM endorses the **Separation Hypothesis** (Beard 1987, 1995), stating that derivations, including their syntacticosemantic formatives, are distinct from their morphological realizations. That is, form and function are separate in DM. The concrete morphophonological realizations are dissociated from the abstract syntactic representations until a later stage of the derivation. Only at PF, the abstract structures are provided with concrete realizations. Bobaljik (2015: 7) gets to the heart of it by stating that "morphology interprets, rather than projecting, syntactic structure." In fact, both the PF-branch and the LF-branch are considered to be interpretative components of the grammar that receive syntactic input from Spell-Out and tailor it to interfaces (Chomsky 1970, Adger 2003: 60).

Let us look at the key features of DM. First, DM assumes **late insertion** of morphophonological exponents. That is, morphophonological features are not assumed to be present in derivations before the PF-branch. In particular, the syntactic module does not operate on morphophonological features. Second, DM assumes **syntactic structures all the way down**. That is, words – take it as a pretheoretical term here – can be structurally decomposed, according to the same structural principles as phrases and clauses. In particular, DM explicitly rejects the Lexicalist Hypothesis (e.g. Di Sciullo and Williams 1987), according to which "words are created in the Lexicon, by processes distinct from the syntactic processes of putting morphemes/words together. Some phonology and some structure/meaning connections are derived in the lexicon, while other aspects of phonology and other aspects of structure/meaning relations are derived in (and after) the syntax" (Marantz 1997: 201).[32] In DM, there is no separate lexicon that builds words out of morphemes and gives them to the syntax that then builds phrases out of these words.[33] Syntax is the only generative engine in the grammar. It forms words, as well as phrases and clauses. Furthermore, Bobaljik (2015: 2) notes that "the functions of morphology in other approaches, and of the Lexicon in particular, are in DM distributed (hence the name) over multiple points in the architecture." Third, DM assumes that the morphophonological exponents, which are inserted late into the structure, are typically underspecified, as compared to the matching features of the insertion site. This kind of **underspecification** is based on three other principles, (i) feature decomposition, (ii) the Subset Principle (Halle 1997), and (iii) specificity. As for **feature decomposition**, it is typically assumed that (complex) features are decomposed into the smallest plausible feature bundles serving as atoms. As for the **Subset Principle**, it is assumed that the feature specification of a morphophonological exponent must meet only a subset of the feature specification of the terminal node where the exponent is to be inserted. Or, put the other way around, the features specified on a terminal node can be a superset of the features specified on the morphophonological exponent that is to be inserted. A major advantage of

[31] In addition, I refer the reader to the DM-website; cf. URL: `http://www.ling.upenn.edu/~rnoyer/dm/` (27.06.2017)

[32] See also Bruening (2016) for a recent discussion against the Lexicalist Hypothesis.

[33] This sentence was written during the partial solar eclipse (≈ 71 % coverage) on March 20, 2015; 10:37 UTC+1; 48°44′47.4″N, 9°06′29.4″E (Pfaffenwaldring 5b, Stuttgart, Germany).

the Subset Principle is that many syncretisms can straightforwardly be derived from it.[34] As for **specificity**, it is assumed that, if several morphophonological exponents meet a subset of the feature specification of a terminal node, then the most specific exponent is inserted into that terminal node. In the context of Vocabulary Insertion (cf. Section 3.1), the principles related to underspecification are discussed in more detail.

At PF, several processes are typically assumed in DM. The core operation at PF is Vocabulary Insertion, i.e. the insertion of morphophonological exponents into syntactic terminals, and thereby realizing them. These exponents are assumed to be stored in a list often referred to as the Vocabulary (or List 2). Section 3.1 addresses Vocabulary Insertion. Concomitant to Vocabulary Insertion, syntactic structures are assumed to be linearized (Embick and Noyer 2001). Section 3.2 addresses Linearization. There are also morphological processes assumed before Vocabulary Insertion and Linearization. For instance, ornamental morphology, i.e. morphological material that is syntactico-semantically unmotivated and only ornaments a syntactic representation, is assumed to be processed early in the PF-branch. Ornamental morphology typically involves the insertion of purely morphological nodes and features into the derivation (e.g. case and agreement). Section 3.3 addresses ornamental morphology. In DM, several operations on nodes are assumed. They are addressed in Section 3.4. In line with Embick and Noyer (2001) and others, I assume morphological movement operations (Morphological Merger), one taking place before and one taking place after Vocabulary Insertion and Linearization. The morphological movement operation prior to Vocabulary Insertion and Linearization is referred to as Lowering, the one after Vocabulary Insertion and Linearization as Local Dislocation. Section 3.5 addresses Lowering and Local Dislocation, i.e. the two instances of Morphological Merger. The morphophonological exponents can be subject to contextually-triggered Readjustment. Morphophonological Readjustment rules are typically assumed to apply late in the PF-branch. Section 3.6 addresses Readjustment rules.

3.1 Vocabulary Insertion

By assumption, the features handed over from Spell-Out to Phonological Form (PF) do not underlyingly have phonological features. Instead, they receive their phonological form at PF, via the operation **Vocabulary Insertion** (Halle and Marantz 1993, 1994, Marantz 1995, Harley and Noyer 1999, Embick and Noyer 2007, Embick 2015, a.o.).[35] Consider the **Late Insertion Hypothesis** in (91), as formulated by Halle and Marantz (1994).

[34] Note that Nanosyntax (cf. Starke 2009) is in this respect the direct opposite of DM, as it assumes the Superset Principle, instead of the Subset Principle. See also Lohndal (2010) for a brief comparison of DM and Nanosyntax.

[35] Note that I assume, unlike Embick (2015) for instance, that this holds for the generative features from the Lexicon and for non-generative, but contentful features from the Content. In fact, Embick (2015: 7) assumes that functional morphemes that are composed of syntacticosemantic (synsem) features do not have a phonological representation, while Roots do have a phonological representation. Embick's synsem features correspond to my Lexicon features and his Roots correspond to my Content features.

(91) **Late Insertion:**
The terminal nodes that are organized into the familiar hierarchical structures by the principles and operations of the syntax proper are complexes of semantic and syntactic features but systematically lack all phonological features. The phonological features are supplied – after the syntax – by the insertion of Vocabulary Items into the terminal nodes. Vocabulary Insertion [...] adds phonological features to the terminal nodes, but it does not add to the semantic/syntactic features making up the terminal node.

(Halle and Marantz 1994: 275–276)

In DM, syntactic terminals are typically referred to as **(abstract) morphemes**. Vocabulary Insertion is the process of phonologically (or morphologically) realizing such abstract morphemes. In DM, it is generally assumed that Vocabulary Insertion applies only to abstract morphemes that are syntactic terminals. This is different from Nanosyntax, for instance, where also phrasal spell-out is assumed. Note also at this point that Halle and Marantz (1993: 118) assume that Vocabulary Insertion takes place only after the application of all morphological operations that modify the trees generated in the syntax.

Each language has a particular set of phonological exponents stored in the **Vocabulary** of that language.[36] Technically, it is assumed that a phonological exponent is inserted into an abstract morpheme, i.e. into a feature bundle serving as a syntactic terminal. In particular, I assume that a phonological exponent $\wp$ can be added to an abstract morpheme M. That is, I operationalize Vocabulary Insertion as an additive process as sketched in (92).[37]

(92) **Vocabulary Insertion:**
$\text{M}[\,] \rightarrow \text{M}[\wp]$

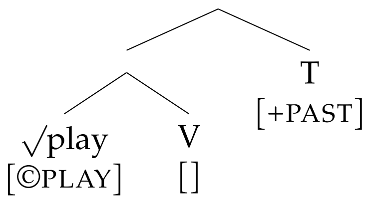
For the sake of illustration, consider the examples in (93). Note that these examples are adapted from Embick (2015: 88). The structure in (93a) shows the morphologically-relevant structure of the past tense of the English verb *play*. The structure consists of the Root $\sqrt{}$play, the abstract verb morpheme V, and the abstract tense morpheme T that is specified as past [+PAST]. None of the abstract morphemes in (93a) contain phonological information. Ignoring the contextual conditions of Vocabulary Insertion for the moment, we can assume that Vocabulary Insertion adds the respective phonological exponents to the effect that they are integrated into the respective feature bundles (93b). The Root receives the exponent

[36] Note that the instructions for pronouncing features stored in VIs are considered language-specific. In fact, the VIs of a language are (or: must be) acquired and memorized by the speakers of that language.

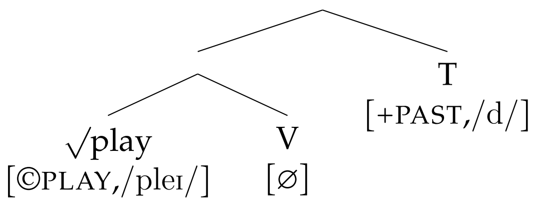
[37] Alternatively, Vocabulary Insertion can be operationalized as a replacive process (Halle 1990, Embick 2015). Here, each feature bundle comes inherently with a place-holder that is replaced by a phonological exponent.

/pleɪ/, the abstract verb morpheme receives the null exponent ∅, and the abstract past tense morpheme receives the exponent /d/. This ultimately yields the verb *played*, viz. /pleɪd/.[38]

(93) a. feature structure of past tense of *play* prior to insertion:



b. feature structure of past tense of *play* after insertion:



Let us now look at the contextual conditions for inserting phonological exponents into an abstract morpheme. By assumption, the Vocabulary is a list of instructions for pronouncing abstract morphemes, and thus the contextual conditions for inserting phonological exponents into abstract morphemes are stored in the **Vocabulary Items (VIs)** of a language. In line with Embick (2015: 83), I define a VI as given in (94).

(94) **Vocabulary Item (VI):**
A Vocabulary Item is a pairing between a phonological exponent and a set of [...] features that determine the privileges of occurrence of that exponent.
(Embick 2015: 83)

Ideally, the pairing between a phonological exponent and a set of features determining its insertion site should have the form of one-to-one mapping, i.e. one particular abstract morpheme would correspond to one particular phonological exponent, and vice versa. However, this ideal scenario is rarely or even never the case. In fact, natural languages exhibit a phenomenon that is typically referred to as **(contextual) allomorphy** (e.g. Halle and Marantz 1993, Marantz 2001, 2011, Embick 2003, 2010, 2012, 2015, Embick and Marantz 2008). Contextual allomorphy describes a situation where several exponents are potential realizations for a particular abstract morpheme and where the choice of the exponent depends on the local environment. We could also say that contextual allomorphy describes a situation where several exponents compete for insertion into a particular abstract morpheme and the winner is determined by the local environment. Consider the case of the past tense formation

[38]For representing phonological exponents, I use the International Phonetic Alphabet (IPA); cf. URL: `https://www.internationalphoneticassociation.org/` (27.06.2017). Appendix C provides a phoneme-grapheme mapping of the prepositions that are focused on in this thesis.

in English. All past tense verbs arguably comprise the abstract past tense morpheme T[+PAST]. This feature bundle is not uniformly realized by one particular exponent. In most cases, it is realized by the exponent *-ed*.[39] Nevertheless, there are verbs that form the past tense with the exponent *-t*, such as *lef-**t*** (*leave*) or *ben-**t*** (*bend*). Yet, other verbs form the past tense with the null exponent ∅. Examples are *hit-∅* (*hit*) or *sang-∅* (*sing*).[40] As the exponents *-t* and ∅ co-occur only with a limited set of verbs, while the exponent *-ed* co-occurs with the majority of verbs, we can say that *-t* and ∅ are inserted into past tense morphemes in specific contexts, while *-ed* is inserted into past tense morphemes in all unspecified contexts, as a so-called **elsewhere exponent** (or **elsewhere form**). Only certain verbs trigger the insertion of the special exponents instead of the elsewhere exponent. The difference between the respective verbs can be broken down into different Roots (or, ultimately into different Content features). In a VI, this is expressed such that various contexts triggering a special exponent are listed. The typical notation of a VI is illustrated in (95), which represents the VI for the English past tense morpheme.

(95) VI for the English past tense morpheme:

a.	T[+PAST]	↔	*-t*	/ {√bend, √leave, ...} __
b.		↔	∅	/ {√hit, √quit, ...} __
c.		↔	*-ed*	elsewhere

(adapted from Embick 2015: 93)

This is to be read as follows. The exponent *-t* is inserted into the past tense morpheme T[+PAST] iff it occurs in the context of the Roots √bend, √leave, etc. The null exponent ∅ is inserted into the past tense morpheme T[+PAST] iff it occurs in the context of the Roots √hit, √quit, etc. If none of these context are present, the elsewhere exponent *-ed* is inserted into the past tense morpheme T[+PAST].[41] The order of listing the contexts is crucial. The more specific ones must precede the less specific ones, and the generic context for the elsewhere

[39] For the sake of illustration, I use the orthographic forms of the exponents instead of the actual phonological exponents. Ultimately, this does not change anything.

[40] Note that 'irregular' past tense formation in English is often accompanied by morphophonological readjustment, e.g. *sing* → *s**a**ng*. Section 3.6 discusses such readjustment processes from a DM perspective.

[41] The VI for the English past tense morpheme in (95) is stated such that the 'entire' morpheme is looked at. An alternative would be to 'outsource' the past feature [+PAST] to the context side, which leads to a more general VI of the tense morpheme. This is illustrated in (96), which I consider here to be tantamount to (95).

(96) VI for tense morpheme:

a.	T	↔	*-t*	/ {√bend, √leave, ...} __ [+PAST]
b.		↔	∅	/ {√hit, √quit, ...} __ [+PAST]
c.		↔	*-ed*	/ __ [+PAST]
d.		↔	...	

Note, however, that the exponent *-ed* in (96) is not a real elsewhere exponent. Nevertheless, it could then be considered to be the 'elsewhere' exponent for past contexts. The choice between (95) and (96) relates to the question of how general a VI should/could be formulated. This is, of course, a question concerning the architectural design of the grammar.

exponent must come last. By checking the more specific contexts first, it is guaranteed that the less specific exponents and the elsewhere exponent are blocked in the respective context, which is what we want.

The VI schema given for the English past tense morpheme in (95) can be generalized as given in (97). The exponent $\wp_1$ is inserted into the morpheme M in the context C_1; the exponent $\wp_2$ is inserted into the morpheme M in the context C_2; etc. The exponent $\wp_n$ is the elsewhere exponent, and it is inserted into the morpheme M when all specified contexts (C_1 to C_{n-1}) are not present. The order of the contexts is such that C_1 is the most specific context, while C_{n-1} is the least specific context.

(97) General schema of a VI:

a.	M	$\leftrightarrow$	$\wp_1$	/ C_1
b.		$\leftrightarrow$	$\wp_2$	/ C_2
c.		$\vdots$		
d.		$\leftrightarrow$	$\wp_{n-1}$	/ C_{n-1}
e.		$\leftrightarrow$	$\wp_n$	elsewhere

The context specified on an exponent can, of course, be broader than the very local morphemic context. The size of a contextual domain is a question of locality. In this thesis, I do not want make a specific claim concerning the locality domain of contextual allomorphy. Instead, I refer the reader to Marantz (1997, 2013), Embick (2010), Anagnostopoulou (2014). As a working hypothesis, I assume that categorial domains qualify as interpretative domains.

Exponents are inserted into abstract morphemes according to the **Subset Principle** (Halle 1997). It is given in (98).

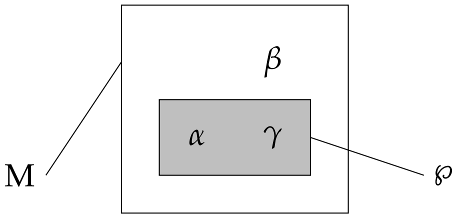
(98) **Subset Principle:**

The phonological exponent of a Vocabulary Item is inserted into a morpheme [...] if the item matches all or a subset of the grammatical features specified in the terminal morpheme. Insertion does not take place if the Vocabulary Item contains features not present in the morpheme. Where several Vocabulary Items meet the conditions for insertion, the item matching the greatest number of features specified in the terminal morpheme must be chosen.

(Halle 1997: 128)

Let us look at three aspects of the Subset Principle in more detail. First, an exponent must *match all or a subset of the grammatical features specified in the terminal morpheme*. Consider an abstract morpheme M with the feature specification M$[\alpha, \beta, \gamma]$ and a respective VI with the exponent $\wp$ specified for $[\alpha, \gamma]$. Assuming there is no other exponent in M's VI specified as $[\alpha, \beta, \gamma]$, the exponent $\wp$ is inserted into M, as it matches a subset of the features specified in M. This scenario is outlined in (99).

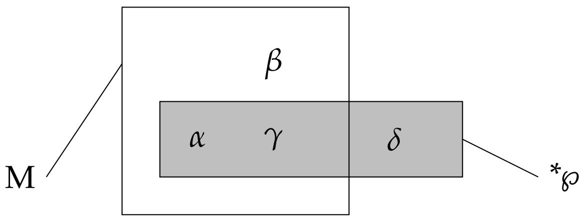
(99) a. Abstract morpheme M:
$M[\alpha,\beta,\gamma]$
b. Vocabulary Item:
M $\leftrightarrow$ $\wp$ / $[\alpha,\gamma]$
c. Specification of exponent $\wp$ matches a subset of M's features:



d. Insertion of exponent $\wp$ into morpheme M:
$M[\alpha,\beta,\gamma,\wp]$

Second, *insertion does not take place if the VI contains features not present in the morpheme.* Assume again the same morpheme M and the respective VI containing again the exponent $\wp$. Now assume that $\wp$ is additionally specified for the feature $[\delta]$, i.e. $[\alpha,\gamma,\delta]$. In this case, the exponent $\wp$ cannot be inserted into the morpheme M, because $\wp$ contains a feature in its specification, namely $[\delta]$, not present in the morpheme M. Inserting $\wp$ into M would lead to ungrammaticality. This scenario is outlined in (100).

(100) a. Abstract morpheme M:
$M[\alpha,\beta,\gamma]$
b. Vocabulary Item:
M $\leftrightarrow$ $\wp$ / $[\alpha,\gamma,\delta]$
c. Feature specification of exponent $\wp$ contains feature missing in M:



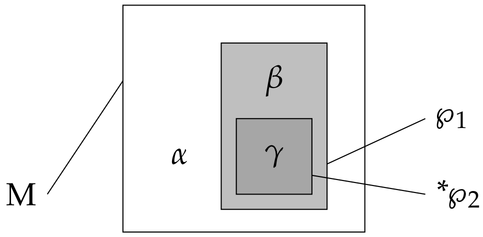
d. Insertion of exponent $\wp$ into morpheme M does not take place.

Third, *where several VIs meet the conditions for insertion, the item matching the greatest number of features specified in the terminal morpheme must be chosen.* Consider again the morpheme $M[\alpha,\beta,\gamma]$. Let us assume that two exponents, e.g. $\wp_1$ and $\wp_2$, are listed in the respective VI and are thus potential candidates for insertion into M. Assume that the exponent $\wp_1$ is specified as $[\beta,\gamma]$ and that the exponent $\wp_2$ is specified as $[\gamma]$. In this situation, the exponent $\wp_1$ is inserted, because it matches more features in the morpheme M than the exponent $\wp_2$. In particular, the specification of $\wp_1$ contains the feature β which is absent in the specification of $\wp_2$. This scenario is outlined in (101).

(101) a. Abstract morpheme M:
$M[\alpha, \beta, \gamma]$

b. Vocabulary Item:
(i) M $\leftrightarrow$ $\wp_1$ / $[\gamma, \beta]$
(ii) $\leftrightarrow$ $\wp_2$ / $[\gamma]$

c. Exponents $\wp_1$ and $\wp_2$ compete for insertion.
Feature specification of exponent $\wp_1$ matches more features in M:



d. Insertion of exponent $\wp_1$ into morpheme M:
$M[\alpha, \beta, \gamma, \wp_1]$

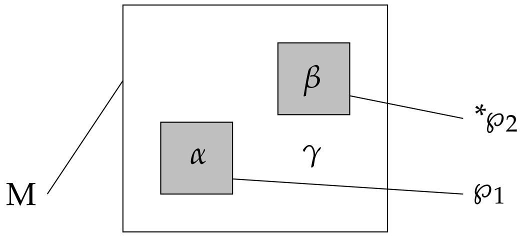
Another possible situation, although not covered by the Subset Principle, is that two exponents in a VIs match the same number of distinct features in a morpheme. Consider again the morpheme M with the feature specification $M[\alpha, \beta, \gamma]$. Let us assume again two exponents in the respective VI, namely the exponent $\wp_1$ with the feature specification $[\alpha]$, and the exponent $\wp_2$ with the feature specification $[\beta]$. As neither exponent comprises more matching features in their specifications than the respective other one, we face a standstill. A possible solution to this problem builds on the assumption of a hierarchical ordering of the respective features. If we have evidence to assume that one feature is hierarchically above the other, we can constrain Vocabulary Insertion such that the VI with the hierarchically higher feature wins. Let us assume in this example that the feature $[\alpha]$ is hierarchically above $[\beta]$, i.e. $[\alpha] > [\beta]$. In this case, the exponent with the higher ranked feature in its specification wins, i.e. $\wp_1$ is inserted into the morpheme M.

(102) a. Abstract morpheme M:
$M[\alpha, \beta, \gamma]$

b. Feature hierarchy:
$[\alpha] > [\beta]$

c. Vocabulary Item:
(i) M $\leftrightarrow$ $\wp_1$ / $[\alpha]$
(ii) $\leftrightarrow$ $\wp_2$ / $[\beta]$

d. Exponents $\wp_1$ and $\wp_2$ compete for insertion and match the same number of distinct features in M. The specification of $\wp_1$ consists of a feature that is hierarchically higher than the feature in the specification of $\wp_2$:



e. Insertion of exponent $\wp_1$ into morpheme M:
$M[\alpha, \beta, \gamma, \wp_1]$

Let us flesh out the considerations about Vocabulary Insertion with a concrete example. Take the agreement morphology of the German (weak) past tense conjugation illustrated in (103) with the verb *sag-en* ('say-INFINITIVE'). The suffix *-te* (/tə/) is arguably the realization of the past tense morpheme specified as T[+PAST].[42] With regard to person and number agreement, we can identify four different suffixes (exponents): (i) the null suffix ∅ for the first and third person singular, (ii) the suffix *-st* (/st/) for the second person singular, (iii) the suffix *-n* (/n/) for the first and third person plural, and (iv) the suffix *-st* (/t/) for the second person plural.

(103) German (weak) past tense agreement (*sagen* 'say'):

	singular	**plural**
first person	sag-te-∅	sag-te-*n*
second person	sag-te-*st*	sag-te-*t*
third person	sag-te-∅	sag-te-*n*

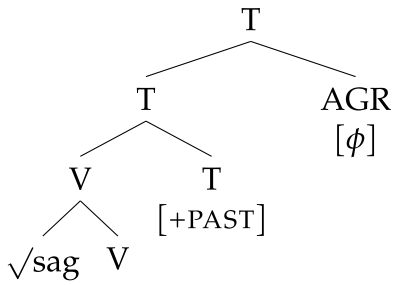
(Bobaljik 2015: 6)

A potential structural analysis of the verbs in (103) is sketched in (104). This complex head structure, which is parallel to Embick and Noyer's (2007: 316) structure of Huave verbs, involves the underlying Root √sag, the verb morpheme V, the past tense morpheme T, and the agreement morpheme AGR.[43] T contains the feature [+PAST] and AGR contains ϕ-features.

[42] Note that the 'e' on the past tense morpheme *-te* is typically assumed to be phonologically conditioned. The underlying realization is assumed to be *-t* (/t/). In traditional German linguistics, this is referred to as *e-Erweiterung* ('e-extension'), see Eisenberg et al. (1998). In this example, *e-Erweiterung* yields the realization *-te* (/tə/). In DM, e-Erweiterung can be modeled as a readjustment rule (Section 3.6).

[43] Note that the morpheme AGR is syntactically unmotivated. In fact, this morpheme is assumed to be a purely morphological feature-bundle. In DM, such types of morphemes are referred to as 'ornamental' or 'dissociated' morphology (Embick and Noyer 2007: 305) (cf. Section 3.3).

(104)



(adapted from Embick and Noyer 2007: 316)

Focusing on the agreement morpheme and its potential ϕ-feature manifestations, we could list the respective exponents as given in (105).

(105)

a.	AGR[+1, −2, −PL]	↔	∅
b.	AGR[−1, +2, −PL]	↔	/st/
c.	AGR[−1, −2, −PL]	↔	∅
d.	AGR[+1, −2, +PL]	↔	/n/
e.	AGR[−1, +2, +PL]	↔	/t/
f.	AGR[−1, −2, +PL]	↔	/n/

The listing in (105) is formed as full specification of the exponents. In particular, it contains two syncretisms, i.e. cases where the form-function relation is one-to-many. The null exponent ∅ realizes the first and third person singular; and the exponent /n/ realizes the first and third person plural. Listing these exponents multiple times leads to redundancy. Let us eliminate this in the following. The exponent /t/ is the most specific one, because it is specified for the second person and for plural number [+2, +PL]. The exponent /n/ is not specified for the second person, and it is also not specified for the first person, because it occurs with the first and the third person. This leads to the assumption that the exponent /n/ is specified only for plural number [+PL]. The exponent /st/ is not specified for number, but it is specified for the second person [+2]. The exponent ∅ is the least specific exponent. It is specified neither for person, nor for number. That is, we can consider the null exponent as being the elsewhere form. Eliminating redundancy in this way, we can restate the exponents for German (weak) past tense agreement as given in (106).

(106) German (weak) past tense agreement (AGR) exponents:

a.	AGR	↔ /t/	/ [+2, +PL]
b.		↔ /n/	/ [+PL]
c.		↔ /st/	/ [+2]
d.		↔ ∅	elsewhere

(adapted from Bobaljik 2015: 6)

In German, the AGR-morpheme can have the possible ϕ-feature specifications in (107).

(107) Possible specifications of the AGR-node, prior to Vocabulary Insertion:

	singular	**plural**
first person	AGR[+1, −2, −PL]	AGR[+1, −2, +PL]
second person	AGR[−1, +2, −PL]	AGR[−1, +2, +PL]
third person	AGR[−1, −2, −PL]	AGR[−1, −2, +PL]

With regard to the VI in (106), the Subset Principle regulates Vocabulary Insertion as follows. The exponent /st/, which is specified for [+2], qualifies as a potential realization for the second person singular and plural. However, as there is a more specific exponent, namely /t/ specified for [+2, +PL], /st/ is not inserted. Instead, /t/ is inserted for second person plural. The exponent /t/, on the other hand, is too specific for second person singular, which is why /st/ is inserted here. We are now left with the first and third person. Both exponents /t/ and /st/ are specified for [+2]; and as such, they are too specific. They cannot be inserted. The exponent /n/ serves to realize the positive plural feature. It is thus inserted for first and third person plural. Finally, there are no further exponents that match the feature specifications of the first and third person singular. Ergo, the elsewhere exponent ∅ is inserted in order to realize AGR. After Vocabulary Insertion, the AGR-morpheme has the possible forms in (108).

(108) Possible specifications of the AGR-node, after Vocabulary Insertion:

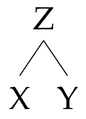
	singular	**plural**
first person	AGR[+1, −2, −PL, ∅]	AGR[+1, −2, +PL,/n/]
second person	AGR[−1, +2, −PL,/st/]	AGR[−1, +2, +PL,/t/]
third person	AGR[−1, −2, −PL, ∅]	AGR[−1, −2, +PL,/n/]

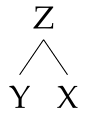
Enriched with the phonological exponents as given in (108), the AGR-morpheme can be processed at PF, that is, it can be pronounced respectively.

3.2 Linearization

In Minimalist Syntax, as well as in Distributed Morphology, it is typically assumed that linear order is not a property of the narrow syntax, but that an operation at PF linearizes hierarchically-organized syntactic structure to the effect that it can be processed serially at the A-P system (e.g Chomsky 1995, Embick and Noyer 2001, 2007, Hornstein et al. 2005, Bobaljik 2015). The hierarchical phrase structures generated by syntax are two-dimensional objects, as their buildings blocks are organized in terms of (i) dominance and (ii) sisterhood. Linear order, however, is not assumed to be a property of syntactic structures. For example, the two minimal structures given in (109) are identical at the level of narrow syntax, because in both structures Z directly dominates X and Y, and X is the sister of Y and vice versa.[44]

[44]Note that the sisterhood relation does not impose a linear order.

(109) a. 

b. 

The A-P system, however, requires a linear order, because the linguistic units must be processed in real time as a serial chain, which means that the output of PF must be a one-dimensional string of sounds or signs. Embick and Noyer (2001: 562) claim that “linear ordering is not a property of syntactic representations but is imposed at PF in virtue of the requirement that speech be instantiated in time (see Sproat 1985). It is therefore natural to assume that linear ordering is imposed on a phrase marker at the point in the derivation when phonological information is inserted, that is, at Vocabulary Insertion.” In particular, they formulate the Late Linearization Hypothesis given in (110).

(110) **The Late Linearization Hypothesis:**
The elements of a phrase marker are linearized at Vocabulary Insertion.
(Embick and Noyer 2001: 562)

In order to flatten a two-dimensional syntactic structure into a one-dimensional string, Embick and Noyer (2007: 562) propose an operation at PF, dubbed Lin (for linearization). This operation takes two syntactic sister nodes as input and imposes a binary concatenation operator on them. For the concatenation operator, I use the symbol $\frown$.[45] The relationship established by the concatenation operator is to be understood as *immediate precedence* (Embick 2015: 73). So, when Lin applies to the two sister nodes X and Y, then the result is either that X immediately precedes Y, or that Y immediately precedes X (111). Subsequent applications of Lin to all pairs of sister nodes in a binary branching tree results in a sequential ordering of all terminal nodes (Marantz 1984, Sproat 1985, Embick and Noyer 2007).

(111) **Linearization:**
Lin [X Y] → (X $\frown$ Y) or (Y $\frown$ X)
(Embick and Noyer 2007: 294)

Each language has a set of PF-rules that determine the linear order in which the syntactic objects are spelled out. Consider, as an example, the English sentence in (112a) and the Japanese sentence in (112b), both of which arguably have a comparatively parallel structure at the level of narrow syntax. However, the sentences are different with regard to the linear order of the constituents within the VP. In English, the verb precedes the direct object, while in Japanese the verb follows the direct object.

[45] Note that Embick and Noyer (2007) use the symbol $*$. In line with Embick (2015: 73), I represent concatenation with the symbol $\frown$.

(112) a. Norbert [$_{VP}$ ate bagels].

b. Jiro-ga [$_{VP}$ sushi-o tabeta].
Jiro-NOM sushi-ACC ate
'Jiro ate sushi.'

(Hornstein et al. 2005: 218)

Henceforth, I will represent syntactic structures – in particular in Chapter 5 – in the order as they are ultimately linearized. This is not a commitment to linear order in syntax, but rather for the sake of intelligibility.

3.3 Ornamental morphology

A fundamental assumption within Distributed Morphology (DM) is that syntactic structures are sent off from Spell-Out to PF, where they receive a phonological realization. So, ideally all morphemes would be syntactico-semantically grounded. However, there is apparently morphological material that is syntactico-semantically unmotivated. In particular, there is morphological material for which there is no reason to assume that its respective features are already present in the syntactic derivation. This means that some morphemes are added to a structure at PF – potentially due to language-specific well-formedness conditions. Embick and Noyer (2007: 305) refers to this kind of morphological material as **ornamental**, because it "merely introduces syntactico-semantically unmotivated structure and features which 'ornament' the syntactic representation." In particular, Embick and Noyer propose two types of insertion processes for inserting ornamental morphological material at PF: (i) the insertion of nodes and (ii) the insertion of features. Embick (1997, 1998), Embick and Noyer (2007) refer to nodes and features that are inserted at PF as **dissociated** (113). This term is supposed to emphasize "that such material is an indirect reflection of certain syntactic morphemes, features, or configurations, and not the actual spell-out of these" (Embick and Noyer 2007: 309).

(113) a. **Dissociated nodes:**
A node is dissociated if and only if it is added to a structure under specified conditions at PF.

b. **Dissociated features:**
A feature is dissociated if and only if it is added to a node under specified conditions at PF.

(Embick and Noyer 2007: 309)

Before I present examples of dissociated nodes and features, let me point to the distinction between copying (or sharing) of features and the introduction (or insertion) of features (114).

(114) a. **Feature copying:**
A feature that is present on a node *X* in the narrow syntax is copied onto another node *Y* at PF.

b. **Feature introduction:**
A feature that is not present in narrow syntax is added at PF.

(Embick and Noyer 2007: 309)

Features subject to morphological agreement or concord processes are typically copied, while case features – in morphological case theories (e.g. Marantz 1991, McFadden 2004, Bobaljik 2008, cf. Section 6.3.3) – are assumed to be introduced at PF. Note also that both copying and introducing features, which leads to ornamental morphology, are assumed to take place prior to Vocabulary Insertion (Section 3.1).

Dissociated nodes

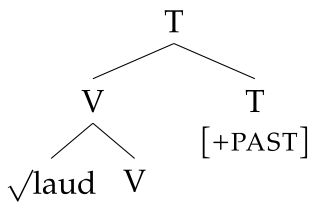
Let us now look at an example of a **dissociated node**, i.e. a node that is added under specified conditions at PF (Embick and Noyer 2007: 309). In many languages, the finite verb agrees with one of its arguments. In Latin, for example, the finite verb agrees with the subject, which is why this phenomenon is often referred to as subject-verb agreement. Consider the inflected form of the Latin verb *laudō* ('praise') in (115), which comprises (i) the verb stem *laud-*, (ii) the theme vowel *-ā*, (iii) the imperfective past tense suffix *-bā*, and (iv) the person and number agreement suffix *-mus* for first person plural.

(115) laud-ā-bā-mus
praise-TH-PAST-1.PL
'We were praising.'

(Embick and Noyer 2007: 305)

With regard to the suffix *-mus* for finite verb agreement, we can assume that this is hosted by a so-called AGR-node or AGR-morpheme (cf. also Section 3.1). In DM, however, it is commonly assumed that verbal AGR-morphemes are absent at the level of syntax – because they are syntacticosemantically unmotivated – and that they are inserted into the structure only at PF. A similar point can be made for the theme vowel morpheme TH hosting the suffix *-ā*. In (116), the complex head structure for the verb in (115) is given. It has the form as when it is sent off from Spell-Out to PF. The structure involves (i) the Root $\sqrt{}$laud, (ii) the verb morpheme V, (iii) and the past tense morpheme T[+PAST]. Crucially, the AGR-morpheme and the theme vowel morpheme TH are missing in (116). Note that the complex head is arguably derived via Head Movement (cf. Matushansky 2006 for a morphological approach to Head Movement that is compatible with Bare Phrase Structure).

(116)



(Embick and Noyer 2007: 306)

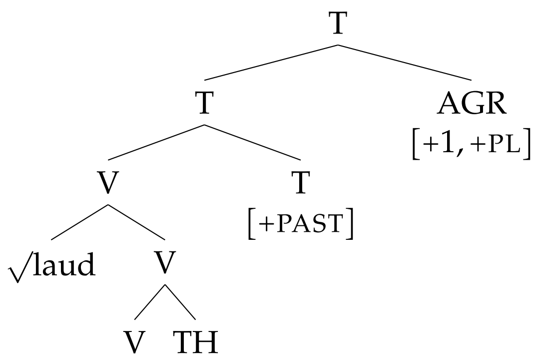
Embick and Noyer (2007) propose that the AGR-morpheme is inserted into the derivation at PF. This can be formulated by the insertion rule in (117), stating that finite T is structurally extended by the agreement morpheme AGR. Embick and Noyer take the view that this process has the same properties as adjunction.

(117) Insertion of AGR:
$T_{finite} \rightarrow$ [T AGR]

(Embick and Noyer 2007: 306)

Embick and Noyer further propose that the verb morpheme V is structurally extended in the same way by the theme vowel morpheme TH. The resulting structure is given in (118).

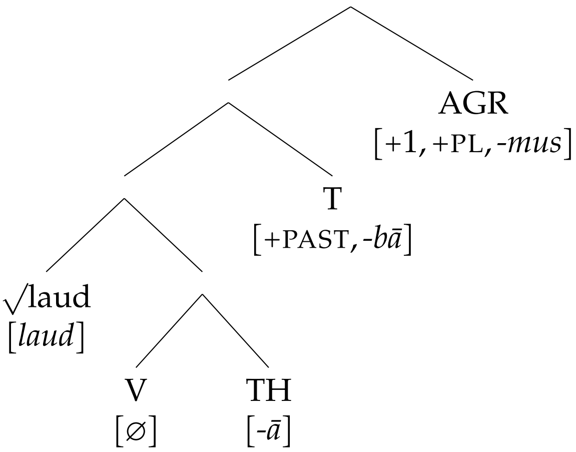
(118)



(Embick and Noyer 2007: 306)

The AGR-morpheme is then the target of finite verb agreement (Sigurðsson 2004, Bobaljik 2008). This means that the ϕ-features of the controller of finite verb agreement (here: the subject) are copied to – or shared with – the AGR-morpheme. In this example, the AGR-morpheme exhibits the ϕ-features for the first person plural. After Vocabulary Insertion has taken place (cf. Section 3.1), we obtain the feature structure in (119). Note that the exponents in (119) are represented orthographically and not phonologically, as usual.

(119)



(adapted from Embick and Noyer 2007: 306)

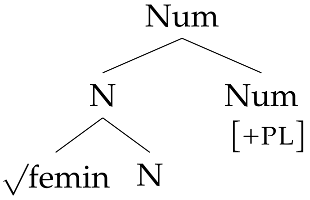
Dissociated features

Let us now look at an example of **dissociated features**, i.e. features that are added under specified conditions at PF (Embick and Noyer 2007: 309). In line with Marantz (1991), McFadden (2004), Embick and Noyer (2007), Bobaljik (2008), I assume that case does not have a repercussion in narrow syntax, but that it is a purely morphological phenomenon that is built on syntax; cf. Section 6.3.3. This basically means that case features are not assumed to be contained in structures sent off from Spell-Out. Instead, it is assumed that case features are inserted into structures at PF. Consider the the dative plural form of the Latin noun *fēmina* ('woman'), which is *fēminīs* (120). The nominal stem is *fēmin-*, and the suffix *-īs* marks plural dative.

(120) fēmin-īs
woman-PL.DAT
'for (the) women'

For this item, we can assume the complex head structure depicted in (121). Crucially, there are no case features in this structure at the point when it is sent off from Spell-Out to PF. We only have (i) the Root, (ii) the noun morpheme N, and (iii) the plural number morpheme Num[+PL].

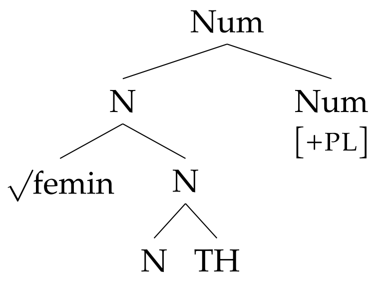
(121)



(Embick and Noyer 2007: 307)

As in the verbal example above, the theme vowel morpheme TH is added to the morpheme hosting the Lexical category feature.

(122)



(Embick and Noyer 2007: 307)

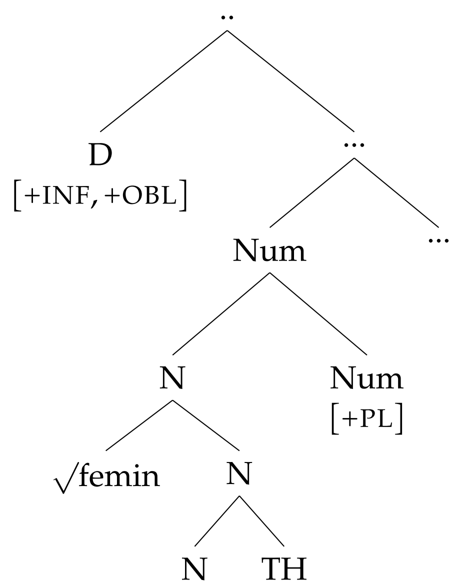
Suppose that the DP in which this sub-structure is embedded receives dative case features, viz. [+INF, +OBL].[46] Embick and Noyer (2007: 308) propose that case features are added to D. The respective morphological rule is depicted in (123).

(123) Insertion of case features:
D → D[case features]

(Embick and Noyer 2007: 308)

The addition of the dative case features [+INF, +OBL] to D yields the configuration in (124).

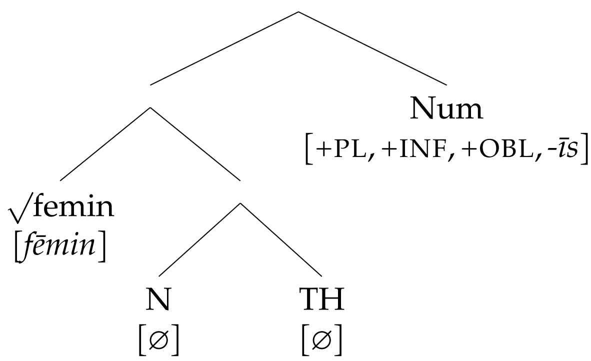
(124)



In Latin, case and number are typically realized in the same position. One way of dealing with this is to assume that the case features are copied to Num (Embick and Noyer 2007: 308), e.g. via DP-internal concord (Sigurðsson 2004, Kramer 2010, Norris 2014). Num is then augmented by the case features to Num[+PL, +INF, +OBL]. After Vocabulary Insertion has taken place, the respective feature structure looks as given in (125).

[46]Note that Embick and Noyer (2007) assume a slightly different set of morphological case features (Halle 1997). However, for the point being made here, this does not make a difference.

(125)



The Root √femin receives the exponent *fēmin*. N receives the null exponent ∅. Similarly, the morphological theme vowel TH receives the null exponent ∅.[47] And finally, Num[+PL, +INF, +OBL] receives the exponent -*īs*.

3.4 Operations on nodes

This section discusses several operations on terminal nodes at PF that are assumed to take place prior to Vocabulary Insertion. The following two sections discuss three of these operations. Section 3.4.1 discusses the operation Impoverishment, an operation where features are deleted from a morpheme within a certain context. Section 3.4.2 discusses the operations Fusion and Fission; these two operations respectively fuse or split terminal nodes in certain contexts.

3.4.1 Impoverishment

The morphological operation Impoverishment, which was first proposed by Bonet (1991), targets the feature content of a morpheme, i.e. terminal node, such that it deletes certain features from the respective morpheme. In order to constrain its application, Impoverishment is contextually conditioned. Typically, the effect of Impoverishment is that a more general (or less specific) exponent is inserted into a morpheme, which would otherwise be realized by a more specific (or less general) exponent. Impoverishment rules apply prior to Vocabulary Insertion. Embick (2015: 140) formalizes Impoverishment as given in (126), where the feature $[\alpha]$ deletes in the context C.

(126) **Impoverishment:**
$[\alpha] \rightarrow [] \quad / \ C$

(Embick 2015: 140)

[47] Meyer (1992: 10) assumes that the dative (and also the ablative) plural forms of nouns belonging to the First Declension (a), e.g. *fēmin-īs*, derive from forms involving a theme vowel, i.e. *fēmin-a-is*.

Let us now look at an example of Impoverishment. Take strong/week adjectival inflection in Norwegian as an example.[48] Consider the adjectival suffixes in the Norwegian DPs in (127)–(130). All examples contain the adjective *stor* ('big') in prenominal position. The examples in (127) and (128) are indefinite (indef), while the examples in (129) and (130) are definite (def). The examples in (127) and (129) are singular (sg), while the examples in (128) and (130) are plural (pl). The a.-examples contain the noun *bil* ('car') that has masculine (masc) gender, while the b.-examples contain the noun *vindu* ('window') that has neuter (neut) gender.

(127) a. en stor bil
a.SG.MASC big.SG.MASC car
'a big car'

b. et stor-**t** vindu
a.SG.NEUT big-SG.NEUT window
'a big window'

(128) a. stor-**e** bil-er
big-PL car-INDEF.PL
'big cars'

b. stor-**e** vindu-er
big-PL window-INDEF.PL
'big windows'

(129) a. den stor-**e** bil-en
the.SG.MASC big-SG.MASC car-DEF.SG.MASC
'the big car'

b. det stor-**e** vindu-et
the.SG.NEUT big-SG.NEUT window-DEF.SG.NEUT
'the big window'

(130) a. de stor-**e** bil-ene
the.PL big-PL car-DEF.PL
'the big cars'

b. de stor-**e** vindu-ene
the.PL big-PL window-DEF.PL
'the big windows'

The indefiniteness/definiteness distinction in Norwegian DPs normally follows the distinction between strong/weak adjectival inflection. The prenominal position in an indefinite DP normally constitutes an environment for strong adjectival inflection, while the prenominal position in a definite DP normally constitutes an environment for weak adjectival inflection. In the strong singular pattern in (127), the adjectival suffixes are ∅ for non-neuter and *-t* for neuter. In the strong plural pattern in (128), the adjectival suffix is *-e* for both non-neuter and neuter. In the weak pattern in (129) and (130), the adjectival suffix is also always *-e*. This is summarized in (131).

[48]Many Germanic languages show the phenomenon of strong/weak adjectival inflection. For German, however, the picture is much more complex than for Norwegian.

(131) a. Norwegian *strong* adjectival suffixes:

	non-neuter	**neuter**
singular	∅	-t
plural	-e	-e

b. Norwegian *weak* adjectival suffixes:

	non-neuter	**neuter**
singular	-e	-e
plural	-e	-e

(Sauerland 1996: 28)

In order to account for this, we can assume the plural number feature [±PL], and – for the sake of simplicity – the neuter gender feature [±NEUT]. We can further assume the dissociated AGR-morpheme that realizes adjectival inflection. The strong inflection pattern can be accounted for with the VI in (132). The exponent *-t* is inserted into neuter, non-plural AGR-morphemes, the null exponent ∅ is inserted into non-neuter, non-plural AGR-morphemes, and the elsewhere exponent *-e* is inserted into all other AGR-morphemes.

(132) Exponents of Norwegian adjectival inflection:

a. AGR ↔ *-t* / [−PL, +NEUT]
b. ↔ ∅ / [−PL, −NEUT]
c. ↔ *-e* elsewhere

(adapted from Sauerland 1996: 28)

The weak inflection pattern can also be accounted for with this VI, if we assume an Impoverishment rule operating on the adjectival AGR in weak contexts. The Impoverishment rule on AGR-morphemes, as formulated in (133), deletes the gender feature [±NEUT] in weak contexts. Note that I simply use 'weak' here as a cover term for such weak contexts. One of these is the prenominal position after a definite article.[49]

(133) Norwegian adjectival AGR-Impoverishment:

[±NEUT] → [] / 'weak'

With this Impoverishment rule, both the exponents *-t* and ∅ are too specific for insertion into the adjectival AGR-morpheme in weak contexts. Instead, the elsewhere exponent *-e* is inserted in weak contexts.

3.4.2 Fusion and Fission

Ideally, the correspondence between the syntactico-semantic/morphosyntactic structure and the surface realization is such that each abstract morpheme in the structure corresponds to one exponent on the surface. This idealization is weakened by several morphological

[49]Note that, in Norwegian, 'weak' could be characterized by definiteness. However, data from strong/weak adjectival inflection in German suggest that the picture is in fact more complex.

phenomena. For example, there is contextual allomorphy, i.e. the case that morphemes can have various context-dependent realizations. Furthermore, morphemes can be realized by the null exponent, i.e. these morphemes are silent. In addition to such irregularities, there are also cases (i) where one surface exponent corresponds to two (or more) abstract morphemes, or (ii) where one abstract morpheme corresponds to two (or more) surface exponents. These types of mismatches between structure and surface motivate the morphological operations Fusion and Fission, respectively. Take a look at Embick's (2015) considerations in (134).

(134) Two Types of Mismatches

a. **Case 1:** The morphosyntactic analysis motivates two distinct morphemes, X and Y. In some particular combination(s) of feature values for X and Y, though, there are no two distinct exponents realizing X and Y on the surface. Rather, there appears to be a "portmanteau" realization instead of the expected individual realizations of X and Y.
⇒ This case motivates **Fusion**.

b. **Case 2:** The morphosyntactic analysis motivates a single morpheme X, with features $[\pm\alpha]$ and $[\pm\beta]$. In particular combinations of feature values, though, there are two (or more) distinct exponents on the surface, corresponding to the different features $[\pm\alpha]$ and $[\pm\beta]$.
⇒ This case motivates **Fission**

(Embick 2015: 213)

Both the operation Fusion and the operation Fission apply prior to Vocabulary Insertion.

Fusion

In some situations, two abstract morphemes independently motivated are realized by one morphologically non-decomposable exponent. In DM, this type of morphological mismatch is typically accounted for with the operation Fusion, which creates – at PF – one morpheme out of two. In general, the operation Fusion can be defined as given in (135), where two abstract morphemes X$[\alpha]$ and Y$[\beta]$ fuse to one complex morpheme X/Y$[\alpha, \beta]$.

(135) **Fusion:**
X$[\alpha]$ Y$[\beta]$ → X/Y$[\alpha, \beta]$

Let us look at a textbook example of the PF-operation Fusion: Latin indicative present tense conjugation (Embick and Halle 2005b, Embick 2015) of the verb *laudāre* ('praise') given in (136).

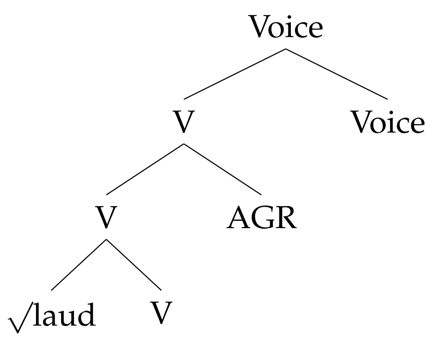
(136) Present indicative active and passive of Latin *laudāre* ('praise'):

		active	passive
singular	**first person**	laud-ō	laud-o-r
	second person	laud-ā-s	laud-ā-ri-s
	third person	laud-a-t	laud-ā-t-ur
plural	**first person**	laud-ā-mus	laud-ā-mu-r
	second person	laud-ā-tis	laud-ā-minī
	third person	laud-a-nt	laud-a-nt-ur

(Embick 2015: 214)

The verb forms in (136) comprise the verbal root *laud-*, in most cases the theme vowel *-ā* or *-a*, an agreement suffix indicating person and number, and an *r*-suffix indicating passive voice. A reasonable verb structure in terms of a complex head analysis is given in (137). It involves (i) the Root √laud, (ii) the verb morpheme V that is morphologically extended by the dissociated node AGR for finite verb agreement, and (iii) the voice morpheme Voice. Note that the structure in (137) differs in several respects from the comparable structure in (118). However, with regard to the argument to be made here, this difference does not matter.

(137)



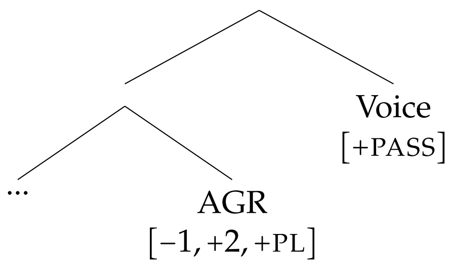
In all verb forms, the Root is realized by the exponent *laud-*. The theme vowel *-ā/-a* is assumed to be realization of V (Embick 2015: 215).[50] In the case of the first person singular, the theme vowel is deleted phonologically.[51] We can observe that the verb forms in the passive voice are, in most cases, morphologically marked with a so-called *r*-exponent. It has the allomorphs *-r* for the first person, *-ri* for the second person singular, and *-ur* for the third person. We can further observe that most verb forms in the active and passive voice share a common person/number agreement suffix, i.e. *-ō/-o* for the first person singular, *-s* for the second person singular, *-t* for the third person singular, *-mus/-mu* for the first person plural, and *-nt* for the third person plural. Crucially, only the agreement suffix of the second person plural in the active *-tis* is not preserved in the passive. Furthermore, the second person plural passive form does not involve an *r*-exponent. In the second person plural, the suffix *-minī* expresses

[50] This is, for instance, different in the analysis above. However, this difference is not crucial here.

[51] Meyer (1992: 27–28) assumes that the first person singular forms of verbs belonging to the First Conjugation (a), e.g. *laud-ō* and *laud-ō-r*, derive from forms involving a theme vowel, i.e. *laud-a-o* and *laud-a-o-r*, respectively.

both agreement and voice.[52] With respect to the feature structure of the second person plural passive, we can assume that it looks as given in (138), viz. AGR is valued as [−1, +2, +PL] for second person plural, and Voice is valued as [+PASS] for passive.

(138)



In all cases, except for the second person plural passive, the two morphemes, i.e. the AGR-morpheme and the passive voice morpheme, are realized separately. Instead of a hypothetical ending **-ri-tis* for the second person plural passive, the respective exponent is *minī*. This suffix contains neither a residue of the AGR-exponent *-tis* for the second person plural nor a residue of the passive Voice exponent, viz. some form of the *r*-exponent. In DM, this kind of morphological mismatch can be modeled with the operation Fusion. In particular, it is assumed that the AGR-morpheme and the Voice morpheme undergo Fusion in the context of second person plural passive. This yields a complex AGR/Voice-morpheme. Fusion for the second person plural passive in Latin can be formalized as given in (139). Note that the feature specifications of the AGR-morpheme and Voice morpheme suffice to trigger Fusion here, that is, we do not need to assume an 'external' context.

(139) Latin passive Fusion:
AGR[−1, +2, +PL] Voice[+PASS] → AGR/Voice[−1, +2, +PL, +PASS]
(adapted from Embick 2015: 215)

We can now state a VI for the fused AGR/Voice-morpheme, as given in (140). This VI applies to fused AGR/Voice-morphemes in the second person plural passive and realizes them with the suffix *-minī*. In particular, the VI in (140) is more specific than both the VI for AGR (141) and the VI for Voice in (143). As a result, VI in (140) takes precedence over the VIs in (141) and (143), and thus the exponents *-tis* and *-r* are blocked for insertion in the second person plural passive.

(140) VI for fused AGR/Voice-morpheme:
AGR/Voice ↔ *-minī* / [+2, +PL, +PASS]

[52] Note that there is a further complication in the second person concerning the Linearization of the exponents. While the dissociated AGR-morpheme and the Voice morpheme (*r*-exponent in the passive) are linearized as AGR–Voice in the first and third person, they are linearized in the reverse order as Voice–AGR in the second person singular. In line with Embick (2015: 214), I will put this aside, since it does not affect any point about the motivation of Fusion.

In the non-fused cases, the AGR-morpheme is straightforwardly realized by the exponents listed in the VI in (141). Subsequently, the exponents of the first person are subject to the morphophonological Readjustment rule (cf. Section 3.6) stated in (142). These rules yield the respective agreement suffixes in the plural.

(141) Exponents of Latin AGR:

a.	AGR	↔	*-tis*	/ [+2, +PL]
b.		↔	*-mus*	/ [+1, +PL]
c.		↔	*-s*	/ [+2]
d.		↔	*-ō*	/ [+1]
e.		↔	*-nt*	/ [+PL]
f.		↔	*-t*	elsewhere

(142) Latin AGR-Readjustment:

a.	*-ō*	→	*-o*	/ [+PASS]
b.	*-mus*	→	*-mu*	/ [+PASS]

For the realizations of the Voice-morpheme we can assume the VI in (143), yielding the *r*-exponent in the passive voice. Note that I refrain from specifying all potential realizations of the Voice-morpheme because this is not crucial here. Subsequently, the *r*-exponent is subject to a morphophonological Readjustment rule, which can be formulated as given in (144). This yields the respective suffixes.

(143) Exponents of Latin Voice:

a.	Voice	↔	*-r*	/ [+PASS]
b.		↔	...	

(144) Latin passive voice Readjustment:

a.	*-r*	→	*-ur*	/ [−1, −2]
b.	*-r*	→	*-ri*	/ [+2]

Fission

Normally, one abstract morpheme is realized by one exponent. There are, however, situations where features that are normally part of one morpheme are realized by two distinct exponents. In DM, this kind of morphological mismatch, is accounted for with the morphological operation Fission, which splits – at PF – one morpheme into two (or more). In general, the operation Fission, which can be considered to be the opposite operation of Fusion, can be defined as given in (145), where one abstract morpheme, say, $X[\alpha, \beta]$ split into the two morphemes $X_i[\alpha]$ and $X_j[\beta]$.

(145) **Fission:**

$$X[\alpha, \beta] \rightarrow X_i[\alpha] \; X_j[\beta]$$

Let us look at a textbook example of the PF operation Fission. Consider verbal conjugation in San Mateo Huave, a Mexican isolate language (Stairs and Hollenbach 1981). (146) illustrates the present (atemporal) tense agreement pattern containing the verbal root *-rang* ('make, do'). The example is taken from Embick and Noyer (2007: 315).

(146) Huave verbal conjugation: present (atemporal) tense of *-rang* ('make, do')

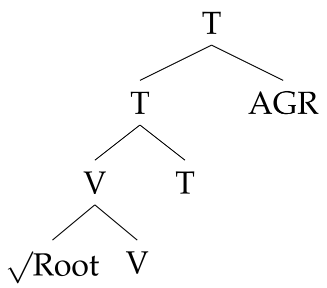
	non-plural	**plural**
first person exclusive	s-a-rang	s-a-rang-an
first person inclusive	a-rang-ar	a-rang-acc
second person	i-rang	i-rang-an
third person	a-rang	a-rang-aw′

(Embick and Noyer 2007: 315)

The conjugation pattern of the present (atemporal) tense of the verb *-rang* ('make, do') involves eight distinct verb forms. There are four singular (i.e. non-plural) forms and four plural forms. This cuts across four person specifications. The first person comes in two varieties: (i) in an exclusive version (i.e. speaker only) and (ii) in an inclusive version (i.e. speaker and addressee). Furthermore, there is the second person and the third person. All four persons have a singular form and a plural form. The verb forms comprise a verbal kernel which is *-rang* here. The verbal kernel is prefixed with a theme vowel that usually is *a-*, except for the second person, where it is *i-*. The first person exclusive is marked with the prefix *s-*. The suffix *-an* appears to be the default plural marker, while the suffixes *-acc* and *-aw′* are more specific plural markers for the first person inclusive and for the third person, respectively.

Embick and Noyer (2007) straightforwardly assume a complex head structure for the Huave verb forms illustrated in (147). The structure contains (i) a Root position, (ii) the verb morpheme V, (iii) the tense morpheme T, and (iv) the dissociated node AGR.

(147)



(Embick and Noyer 2007: 316)

Embick and Noyer assume that V hosts the theme vowel and is linearized to the left of the Root, i.e. the inverse image of (147); with regard to Linearization, I refer the reader to Section 3.2. T does not have an overt realization in this example, so we can ignore it here. The dissociated AGR-morpheme, which is inserted at PF, comprises person and number features and can have the ϕ-specification depicted in (148).

(148) Possible ϕ-specifications of Huave AGR:

	non-plural	**plural**
first person exclusive	AGR[+1, −2, −PL]	AGR[+1, −2, +PL]
first person inclusive	AGR[+1, +2, −PL]	AGR[+1, +2, +PL]
second person	AGR[−1, +2, −PL]	AGR[−1, +2, +PL]
third person	AGR[−1, −2, −PL]	AGR[−1, −2, +PL]

With regard to the verb forms presented in (146), we see that, in some cases, AGR is realized by one exponent, while in other cases AGR is realized by two distinct exponents. The forms with one exponent realizing AGR are (I.i) first person inclusive singular AGR[+1, +2, −PL] realized by the exponent *-ar*, (I.ii) first person inclusive plural AGR[+1, +2, +PL] realized by the exponent *acc*, (I.iii) third person singular AGR[−1, −2, −PL] realized by the null exponent ∅, and (I.iv) third person plural AGR[−1, −2, +PL] realized by the exponent *-aw'*. The forms with two exponents realizing AGR are (II.i) first person exclusive singular AGR[+1, −2, −PL], where person features are realized by the prefixed exponent *s-* and number features by the null exponent ∅; (II.ii) first person exclusive plural AGR[+1, −2, +PL], where person features are again realized by the prefixed exponent *s-* and number features by the suffixed exponent *-an*; (II.iii) second person singular AGR[−1, +2, −PL], where person features are realized by ablauting the prefixed theme vowel and number features by the null exponent ∅; and (II.iv) second person plural AGR[−1, +2, +PL], where person features are again realized by ablauting the prefixed theme vowel and number features by the suffixed exponent *-an*. That is, in the case of the first person exclusive and in the case of the second person, the person features are expressed at a different position than the number features. In particular, person features are realized to the left of the verbal kernel (the prefixed exponent *s-* realizes the first person exclusive and ablauting the theme vowel preceding the verbal kernel realizes the second person), while number features are realized to the right of the verbal kernel (the suffixed exponent *-an* realizes plural and the null exponent realizes singular). In fact, we can assume that the AGR-morpheme is split in the first person exclusive and in the second person. In DM, this can be accounted for by the morphological operation Fission. A potential formulation of Huave AGR-Fission is given in (149).

(149) Huave AGR-Fission:

a. $\text{AGR}[+1, -2, \alpha_{\text{number}}] \rightarrow \text{AGR}_i[+1, -2]\ \ \text{AGR}_j[\alpha_{\text{number}}]$

b. $\text{AGR}[-1, +2, \alpha_{\text{number}}] \rightarrow \text{AGR}_i[-1, +2]\ \ \text{AGR}_j[\alpha_{\text{number}}]$

These Fission rules split AGR into two morphemes iff the person features have distinct values. The result of these Fission rules are two AGR-morphemes: AGR_i containing person features and AGR_j containing number features. These two AGR-morphemes are then subject to a Linearization rule to the effect that AGR_i precedes the verbal kernel, while AGR_j follows it. Taking these considerations into account, we can formulate the VI of Huave AGR as given in (150). Note that the 'exponent' [−BACK] is supposed to be a floating phonological feature triggering the ablaut of the theme vowel (Embick and Noyer 2007: 315).[53]

(150) VI of Huave verbal AGR:

a.	AGR	↔	*-aw'*	/	[−1, −2, +PL]
b.		↔	*-acc*	/	[+1, +2, +PL]
c.		↔	*-ar*	/	[+1, +2]
d.		↔	*s-*	/	[+1]
e.		↔	[−BACK]	/	[+2]
f.		↔	*-an*	/	[+PL]
g.		↔	∅	elsewhere	

(adapted from Embick and Noyer 2007: 317)

The non-fissioned overt realizations of AGR are specified in (150a)–(150c). The exponents that apply in the fissioned forms are less specific and specified as given in (150d)–(150f). The null exponent ∅ can then be assumed to be the elsewhere form.

3.5 Morphological Merger

In some cases, the ultimate morphological structure seems to be derived from syntactic structure via movement operations at PF. Marantz (1984, 1988) provides a general formulation for such displacement processes in terms of Morphological Merger (151).

(151) **Morphological Merger:**
At any level of syntactic analysis (D-Structure, S-Structure, phonological structure), a relation between X and Y may be replaced by (expressed by) the affixation of the lexical head of X to the lexical head of Y.

(Marantz 1988: 261)

In DM, it is typically assumed that Vocabulary Insertion and concomitant Linearization takes place late at PF. With regard to movement at PF, Embick and Noyer (2001, 2007) propose that there are at least two varieties of Morphological Merger: (i) one taking place before Vocabulary Insertion and Linearization (152a) and (ii) one taking place after, or concomitant with, Vocabulary Insertion and Linearization (152b).

[53]Considering the assumptions concerning Linearization made above, the feature [−BACK] triggering ablaut is adjacent to the position hosting the theme vowel. This yields the shift from *a-* to *i-*.

(152) Two movement operations at PF:

a. **Before Linearization:** The derivation operates in terms of hierarchical structures. Consequently, a movement operation that applies at this stage is defined hierarchically. This movement is Lowering; it lowers a head to the head of its complement.

b. **After Linearization:** The derivation operates in terms of linear order. The movement operation that occurs at this stage, Local Dislocation, operates in terms of linear adjacency, not hierarchical structure.

(Embick and Noyer 2007: 319)

In the following, I briefly discuss these two morphological movement operations.

The motivation of **Lowering**, i.e. the morphological movement operation taking place prior to Vocabulary Insertion, is that syntactic terminals can unite and be spelled out together, even if they do not join in narrow syntax. Lowering has the form depicted in (153). Here, the head X° lowers to Y°, the head of its complement. The docking of X° at its landing site Y° takes the form of adjunction.

(153) **Lowering of X° to Y°:**

$[_{XP} \ldots X^{\circ} [_{YP} \ldots Y^{\circ} \ldots]] \rightarrow [_{XP} \ldots [_{YP} \ldots [_{Y^{\circ}} Y^{\circ} X^{\circ}] \ldots]]$

(Embick and Noyer 2001: 561)

A paradigmatic example of Lowering is the realization of the English past tense morpheme. Based on observations of adverb placement, it is assumed that in English, unlike in several other languages, verbs do not move to the tense head in the narrow syntax. Nonetheless, tense morphology is typically realized on the verb when it is not prevented by negation, for instance. Embick and Noyer (2001: 562) thus propose that English T undergoes Lowering to the head of its complement, which is the verb. Consider the respective examples (154).

(154) a. Mary $[_{TP}$ t_i $[_{vP}$ loudly play-ed$_1$ the trumpet]]

b. *Mary did loudly play the trumpet.

(Embick and Noyer 2001: 562)

The respective English Lowering rule can be formulated as in (155).

(155) English T Lowering:

T lowers to V

(Embick and Noyer 2007: 319)

Lowering has a non-local (non-adjacent) character. As can be seen in (154a), an intervening adverb such as *loudly* does not prevent Lowering of T to V.

The morphological movement operation **Local Dislocation** applies after Vocabulary Insertion and Linearization. Thus, it does not make reference to hierarchical order but to linear order, which I represent with ⌢ in this thesis. A general formalization is given in (156), where the morphemes X and Y, which are assumed to contain morphophonological material already, are linearized such that X precedes Y. Local Dislocation re-orders them to the effect that ultimately Y precedes X.

(156) **Local Dislocation:**
X ⌢ Y → Y–X

(Embick and Noyer 2007: 319)

Local Dislocation can, for instance, target affixation. As an example, consider the verbal suffixes in Huave (Stairs and Hollenbach 1981) in (157).[54] As a general rule, the reflexive (refl) suffix *-ay* appears directly before the final inflectional suffix of a verb – if any is present (Embick and Noyer 2007: 319). Person is expressed as a prefix, while plural number can be expressed as a suffix

(157) a. s-a-kohč-**ay**
1-TH-cut-REFL
'I cut myself'
b. s-a-kohč-**ay**-on
1-TH-cut-REFL-PL
'we cut ourselves'

(Embick and Noyer 2007: 320)

The examples in (158) and (159) are in the past tense, which is expressed by means of the prefix *t-*. Number and person is expressed as suffixes following the verb stem. In the singular (158), the reflexive suffix *-ay* precedes the person suffix. In the plural (159), however, the reflexive suffix *-ay* follows the person suffix and precedes the number suffix. Crucially, it does not precede the person suffix and thus is adjacent to the verb stem.

(158) a. t-e-kohč-**ay**-os
PAST-TH-cut-REFL-1
'I cut (past) myself'
b. *t-e-kohč-as-**ay**
PAST-TH-cut-1-REFL

(Embick and Noyer 2007: 320)

(159) a. t-e-kohč-as-**ay**-on
PAST-TH-cut-1-REFL-PL
'we cut (past) ourselves'
b. *t-e-kohč-**ay**-os-on
PAST-TH-cut-REFL-1-PL

(Embick and Noyer 2007: 320)

[54] The affixes *-a-* in (157) and *-e-* in (158) and (159) are considered to be theme vowels (glossed with TH). They, however, are of no interest here.

These data can be explained if we assume that *-ay* is linearized peripheral to the verb+inflection complex. Embick and Noyer (2007) assume that the exponent *-ay* in the respective linearized structures undergoes Local Dislocation to the effect that it occurs in the penultimate position. The verb forms in (158a) and (159a) are derived in (160a) and (160b), respectively.

(160) a. (((t-e-kohč) ⌢ os) ⌢ ay) → ((t-e-kohč) ⌢ ay-os)
b. ((((t-e-kohč) ⌢ as) ⌢ on) ⌢ ay) → (((t-e-kohč) ⌢ as) ⌢ ay-on)

3.6 Readjustment Rules

Distributed Morphology (DM) is a piece-based morphological framework. However, there are situations in which the syntactic structure is morphologically not only reflected by (the concatenation of) individual pieces, i.e. exponents, but by non-concatenative morphological processes, e.g. stem alternation. In DM, such non-concatenative morphological processes can be accounted for with so-called **Readjustment rules** that operate on certain morphophonological exponents in specified contexts to the effect that the respective exponent is changed into a morphophonologically-cognate exponent. The general form of a morphophonological Readjustment rule is given in (161), where the exponent $\wp$ is morphophonologically changed into the cognate exponent $\wp'$ in the context C.

(161) **Readjustment Rule:**
$\wp \rightarrow \wp' \; / \; C$

By hypothesis, morphophonological Readjustment rules operate on morphophonological exponents in specified contexts. Thus, these rules are assumed to apply after Vocabulary Insertion.

Let us look at a paradigmatic example of a morphophonological Readjustment rule. Consider the irregular past tense formation of English verbs like *sing*, which is *sang* and not **sing-ed* (Embick and Halle 2005a, Embick 2015). The morphophonological Readjustment rule in (162) changes the vowel /ɪ/ in the phonological exponent /sɪŋ/ to the vowel /æ/ in the context of the past tense feature [+PAST], which results in the exponent /sæŋ/.

(162) /sɪŋ/ → /sæŋ/ / [+PAST]

The phonologically regular pattern underlying this kind of Readjustment rule is ablauting.[55] Consider the following verbs, which are subject to the same phonological Readjustment: *begin*, *give*, *ring*, *sink*, *sit*, *spring*, *stink*, *swim*, etc. What is crucial here is the assumption that Readjustment rules and Vocabulary Insertion are distinct morphophonological operations (Embick 2015: 204). In particular, it is not assumed that Readjustment blocks Vocabulary

[55] For a potential modeling of the phonological Readjustment rule changing the stem vowel in the past tense of verbs like *sing*, I refer the reader to Halle and Mohanan (1985: 107–108).

Insertion in any way. That is, Readjustment of /sɪŋ/ to /sæŋ/ does not block the realization of the past tense morpheme T[+PAST] as *-ed*. The reason for this assumption is that both morphological processes can apparently co-occur. In past tense forms like *tol-d* (from *tell*) or *froz-en* (from *freeze*), for example, the respective suffixes are arguably a realization of the past tense morpheme T[+PAST], even though the exponent of the verbal kernel is subject to Readjustment.

3.7 Summary

This chapter explored the morphological branch of the Y-model of grammar, that is Phonological Form (PF). In this thesis, I adopted the tenets of Distributed Morphology (DM) (Halle and Marantz 1994, Embick 2015).

Section 3.1 presented the operation Vocabulary Insertion. In DM, morphophonological exponents are inserted late, i.e. after the syntactic derivation, into the terminal nodes of syntax, which are considered to be abstract morphemes. Vocabulary Insertion is controlled by the Subset Principle (Halle 1997: 128); according to the Subset Principle, the phonological exponent of a Vocabulary Item (VI) is inserted into a morpheme if the item matches all or a subset of the grammatical features specified in the terminal node. Insertion does not take place if the VI contains features that are not present in the morpheme. Where several VIs meet the conditions for insertion, the item matching the greatest number of features specified in the terminal node is chosen. Then, Section 3.2 discussed the Late Linearization Hypothesis according to which the elements of a phrase marker are linearized at Vocabulary Insertion (Embick and Noyer 2001: 562). In the Minimalist Program (MP), it is typically assumed that syntax does not commit to a inherent serialization of the terminal nodes (Chomsky 1995, Embick and Noyer 2001, 2007, Hornstein et al. 2005, Bobaljik 2015). At PF, the two-dimensional, hierarchical structure generated by syntax is flattened to a one-dimensional string by the morphological operation Lin (linearization) (Embick and Noyer 2007: 294).

Section 3.3 discussed two instances of ornamental morphology (Embick and Noyer 2007: 305): (i) dissociated nodes, i.e. nodes that are added to a structure under specified conditions at PF; and (ii) dissociated features, i.e. features that are added to a node under specified conditions at PF.

Section 3.4 presented morphological operations on nodes. Section 3.4.1 presented the operation Impoverishment, where certain features are deleted from a node under specified conditions (Bonet 1991, Embick 2015). Section 3.4.2 presented two morphological operations with which one can account for syntax/morphology mismatches: (i) Fusion, where two abstract morphemes fuse to one abstract morpheme, under specified conditions; and (ii) Fission, where one abstract morpheme splits into two abstract morphemes, under specified conditions.

Section 3.5 addressed morphological displacement operations generally referred to as Morphological Merger (Marantz 1988: 261). Two such movement operations at PF, were briefly presented: (i) Lowering, which takes place before Linearization (Embick and Noyer 2001: 561); and (ii) Local Dislocation, which takes place after Linearization (Embick and Noyer 2007: 319).

Section 3.6 presented Readjustment Rules with which one can account for (minor) changes of morphophonological exponents in certain contexts (Embick 2015: 204).

Chapter 4

Semantics

This chapter explores the branch from Spell-Out to the Conceptual-Intentional (C-I) system in the Y-model of grammar (**Semantics**) depicted in Figure 6.

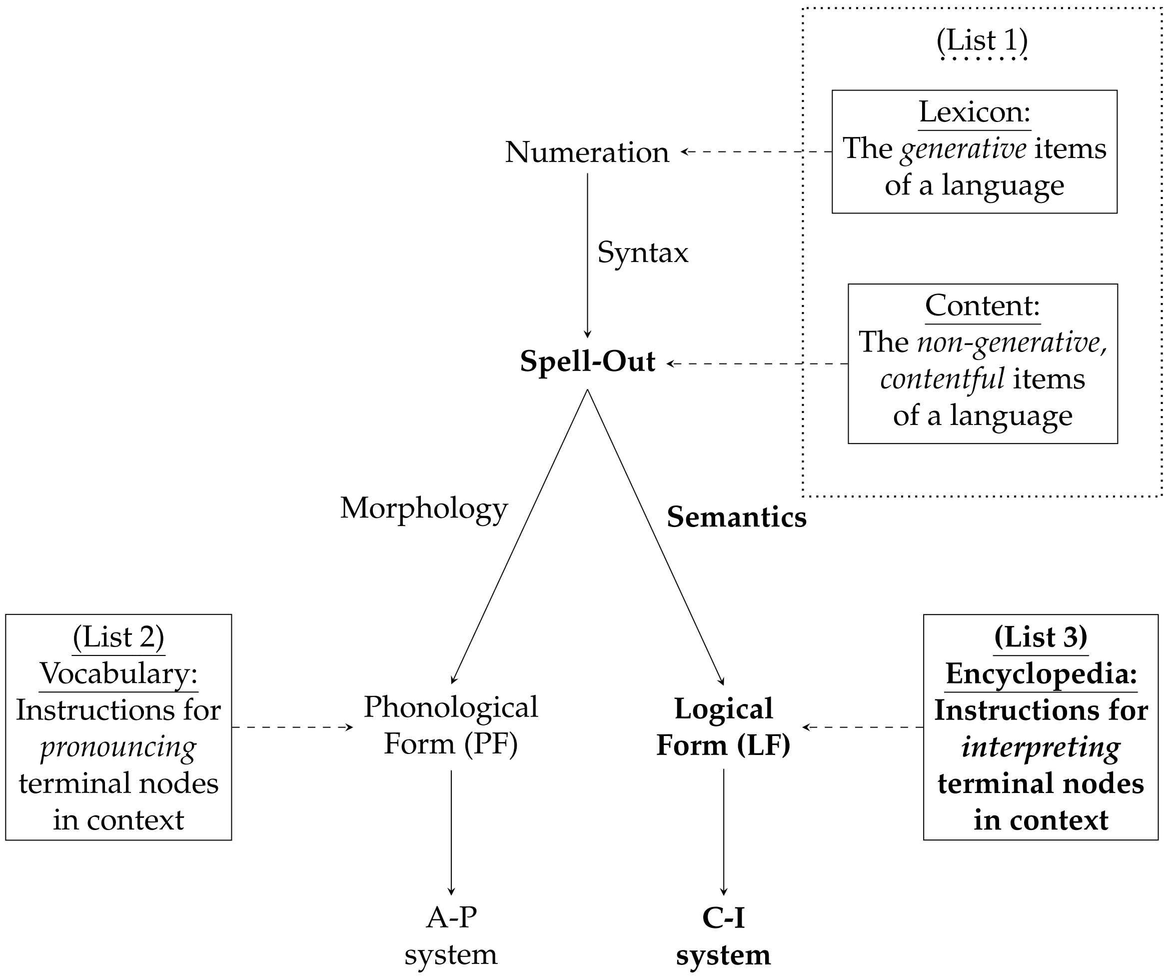


Figure 6: Semantics in the Y-model of grammar

At Spell-Out, syntactic structures generated by Syntax (cf. Chapter 2) are sent off to be interpreted at the interfaces. **Logical Form (LF)** is the interface representation of the C-I systems. At LF, each terminal node of a syntactic structure receives a context-sensitive semantic interpretation. As for the LF-representation formalism, I use **Discourse Representation**

Theory (DRT) (Kamp and Reyle 1993, 2011, Kamp 2010, 2015, Kamp et al. 2011, a.o.). In particular, I assume that each terminal node receives a semantic representation in the form of a **Discourse Representation Structure (DRS)**, the choice of which depends on its context. The DRSs of the terminal nodes are composed bottom-up along the syntactic structure, leading to semantic representations of larger linguistic units, viz. phrases, clauses, etc. (see Section 4.1 for the semantic construction algorithm).

One of the motives for using DRT is that it separates the semantic representation from its model-theoretic interpretation. DRT offers a controlled way to ask and answer the question of what an expressive, and yet parsimonious, formalism has to be like in order to adequately represent natural language. In particular, it allows a language-driven representation of the cognitively relevant relations that are expressed by sentences containing spatial prepositions.

4.1 Semantic construction algorithm

At LF, each terminal node of a syntactic structure receives a context-dependent semantic interpretation (Encyclopedia Item, EI), which takes the form of a (fragmental) DRS. Compositionally, these DRSs are combined by means of unification-based composition rules. This happens bottom-up along the syntactic structure. The following section presents the semantic construction algorithm.

4.1.1 Context-sensitive interpretation

At LF, terminal nodes are semantically interpreted depending on their context. In particular, I assume that a terminal node X can be assigned different **Encyclopedia Items (EIs)** depending on X's local environment (context). That is, terminal nodes may not only have a set of PF-instructions for their phonological realizations, but also a set of LF-instructions for their semantic interpretations. This operationalizes contextual allosemy (Marantz 2013), namely that the choice of the meaning of X depends on its local environment (cf. Anagnostopoulou 2014: 305).

(163) **Generalized LF-instruction:**

	Terminal node		Encyclopedia Items	Context
a.	X	↔	ℓ_1	/ C_a
b.		↔	ℓ_2	/ C_b
c.		↔	...	/ ...
d.		↔	ℓ_n	elsewhere

The generalized LF-instructions in (163) are to be read as follows. X receives the EI ℓ_1 if it occurs in the context C_a. If X occurs in the context C_b, it receives the EI ℓ_2, and so on. If X occurs in none of the specified contexts, then there is normally an EI that serves as the elsewhere interpretation of X (here ℓ_n). The relevant contexts triggering different EIs are normally ordered according to specificity, starting with C_a as being the most specific context. In particular, the respective EIs compete for being the assigned to X at LF. More specific contexts win over less specific contexts.

In line with Harley (2014), I assume that not only functional material, but also contentful features can receive various EIs. In the framework advocated here, these are (bundles of) Content features occurring in Root positions – Roots, in Harley's terms. In order to illustrate this, I adopt Harley's (2014) example for what she labels as $\sqrt{}_{77}$ underlying the verb *throw*.[56] The PF-instructions for $\sqrt{}_{77}$ are given in (164a). As /θroʊ/ is the only possible Vocabulary Item (VI) (pronunciation) for $\sqrt{}_{77}$, no contextual specification is needed; note that this is under the assumption that the past tense form *threw* /θruː/ is formed by the application of a morphophonological Readjustment Rule (cf. Section 3.6). The VI /θroʊ/ is thus the phonological 'elsewhere' pronunciation that applies everywhere for $\sqrt{}_{77}$. In contrast, the LF-instructions for $\sqrt{}_{77}$ in (164b) comprise different EIs (interpretations) depending on different contexts. Here, the most specific context is the construction with the particle *up*, resulting in the interpretation »vomit« (164b-i).[57] The next context in which $\sqrt{}_{77}$ can appear is a nominal context. Here, $\sqrt{}_{77}$ receives the EI »a light blanket«. As given in (164b-iii), other EIs could be assigned to $\sqrt{}_{77}$ in other contexts. Ultimately, the 'literal' or 'transparent' interpretation of $\sqrt{}_{77}$ as »throw« is assumed to be the elsewhere EI, as given in (164b-iv).

(164) Interface instructions for Harley's (2014: 244) Root $\sqrt{}_{77}$

a. PF-instructions

$\sqrt{}_{77} \leftrightarrow$ /θroʊ/

b. LF-instructions

(i) $\sqrt{}_{77} \leftrightarrow$ »vomit« / $[\, v\, [\, [\_\_]_{\surd}\, [up]_{P}\,]\,]_{vP}$

(ii) $\leftrightarrow$ »a light blanket« / $[\, n\, [\_\_]_{\surd}\,]$

(iii) $\leftrightarrow$ {...other meanings in other contexts...}

(iv) $\leftrightarrow$ »throw« elsewhere

(Harley 2014: 244)

Indeed, we find more possible interpretations for the verb *throw*, as we can see in (165), where the choice of the complement leads to different interpretations of the verb *throw*. In fact, Marantz (1984: 25) notes that "every simple transitive English verb expresses a wide range of predicates depending on the choice of direct object."

(165) a. throw a baseball
→ 'throw a baseball' (literal meaning)

[56]Note at this point that I do not commit to all the details of Harley's syntactic analyses, in particular to the claim that Roots are supposed to take complements.

[57]For the sake of illustration, I reproduce Harley's informal semantic notation here. Ultimately, I represent EIs as (fragmental) DRSs.

b. throw support behind a candidate
→ 'support a candidate'

c. throw a boxing match (i.e., take a dive)
→ 'surrender in a boxing match'

d. throw a party
→ 'arrange a party'

e. throw a fit
→ 'go crazy'

(cf. Marantz 1984: 25; glosses are mine)

It seems tempting to model this variety of idiomatic interpretations that depend on the complement of the verb in terms of LF-instructions as described above. However, we have to be careful here. LF-instructions model a decision process for semantic interpretation, based on competition between several possible EIs. If we identify a particular context, the die is cast for the respective EI. Focusing on PF-instructions of functional material (Vocabulary Insertion), Embick and Marantz (2008: 7) describe this competition-based process as one in which the various possible interpretations "are [...] competing with one another, and when one wins this competition, it prevents others from doing so." This means that if the verb *throw* takes the DP *party* as its complement, it receives the interpretation 'arrange'. All other interpretations are then blocked. At first glance, this seems reasonable. Nevertheless, consider the idiomatic expression *kill an audience* (meaning 'to wow them', cf. Marantz 1984: 25) in (166), or the German idiomatic expressions *jdm. den Kopf waschen* ('to give sb. a telling-off', lit. 'to wash sb.'s head') in (167) and *jdm. einen Korb geben* ('to turn sb. down', lit.: 'to give sb. a basket') in (168).

(166) Hans killed an audience.

(167) Maria wusch Hans den Kopf.
Maria washed Hans the head

a. 'Maria gave Hans a telling-off.'

b. 'Maria washed Hans' head.'

(168) Hans gab Maria einen Korb.
Hans gave Maria a basket

a. 'Hans turned Maria down.'

b. 'Hans gave Maria a basket.'

The important observation in all these idiomatic examples is that the verbs combined with the respective direct objects can be interpreted idiomatically (a) or, crucially, also literally (b). This is, however, not expected if these idiomatic expressions are modeled in terms of LF-instructions because the special idiomatic interpretation would block the elsewhere interpretation, i.e. the so-called literal interpretation. In order to obtain the literal interpretations, we would need to assume some semantic coercion process from the special idiomatic to the regular elsewhere interpretation – which is obviously counterintuitive. I thus assume that idiomatic meaning of the examples in (165)–(168) is not achieved by means of LF-instructions as presented above, but by some other semantic (re)interpretation process. This is in line with Anagnostopoulou and Samioti (2014) who also claim that contextual allosemy (i.e. sets of LF-instructions for terminal nodes) must be separated from idiom formation. Note that I follow Marantz (1997), Harley and Schildmier Stone (2013), Anagnostopoulou (2014), a.o., and assume that the external-argument-introducing head, i.e. Voice (Kratzer 1996), constitutes a domain for idiom formation.

Let us now look at the **locality domain** of LF-instructions. I adopt the locality condition in (169) (Bobaljik 2012, Alexiadou 2014). It states that the feature $[\beta]$ may condition the feature $[\alpha]$ only if the two features are not separated by a phrase boundary.

(169) **Locality:**
$[\beta]$ may condition $[\alpha]$ in (a), not in (b):

a. $[\beta]$ ... $[_{X^\circ}$ ... $[\alpha]$ ...]
b. *$[\beta]$ ... $[_{XP}$ ... $[\alpha]$ ...]

(adopted from Bobaljik 2012: 12–13)

With regard to the LF-instructions of P, this means that features within a PP, e.g. P's synsem features or features within the complement of P, can influence the interpretation of P. Features outside a PP cannot influence the interpretation of P.

Let us now look at the locality domain of the contextual allosemy of Content features in Root positions, i.e. Roots. For that, we have to determine the notions of **inner derivation** (Root attaching) and **outer derivation** (lexically typed/categorized stem-attaching) (Marantz 1997, Embick and Marantz 2008, Embick 2010, Marantz 2013). Inner derivation (or inner cycle) refers to the first categorization step of a Root, i.e. to the domain of Primary Merge in the sense of De Belder and Van Craenenbroeck (2015). Consider (170a) as an instance of inner derivation with X. Outer derivation (or outer cycle) refers to successive derivational steps. Consider (170b) as an instance of outer derivation with X.

(170) a. Inner derivation: $[\ \surd\ X\ ]$
b. Outer derivation: $[\ [\ \surd\ Y\ ]\ X\ ]$

Anagnostopoulou and Samioti (2013, 2014), Anagnostopoulou (2014) investigate what they dub the **Marantz/Arad Hypothesis** (Marantz 2001, 2007, Arad 2003, 2005), given in (171). It basically states that inner derivation constitutes the interpretative domain for Roots, i.e. Content features in Root positions.

(171) **The Marantz/Arad Hypothesis:**
Roots are assigned an interpretation in the context of the first category assigning head/phase head merged with them, which is then fixed throughout the derivation.
(Anagnostopoulou and Samioti 2014: 81)

In particular, Anagnostopoulou and Samioti (2013, 2014), Anagnostopoulou (2014) examine Greek participle morphology involving two adjectival suffixes: (i) *-tos* that is assumed to serve, a.o., as the phonological realization of a Root adjectivizer, i.e. inner derivation and thus local to a Root; and (ii) *-menos* that is assumed to derive deverbal adjectives, i.e. outer derivation, and thus not local to a Root. Consider the Greek Root √SPAS with the conceptual content "break". Inner derivation with *-tos* yields the special interpretation "folding" of √SPAS, as given in (172a). Deverbal outer derivation with adjectival *-menos* preserves the verbal interpretation "break", yielding the the interpretation "broken" for the participles in (172b).

(172) a. spas-ti ombrella / spas-to trapezi
break-tos.FEM umbrella / break-tos.NEUT table
'folding umbrella' 'folding table'

b. spas-meni ombrella / spas-meno trapezi
break-menos.FEM umbrella / break-menos.NEUT table
'broken umbrella' 'broken table'

(Anagnostopoulou 2014: 305)

While the data in (172) are in line with the Marantz/Arad Hypothesis, the data in (173) pose a potential problem. Consider the Root √KOKIN with the conceptual content "red" and inner derivation with the verbalizer *-iz* in both (173a) and (173b). While outer derivation with *-menos* in (173b) preserves the verbal meaning ('make red') in the participle ('made red'), outer derivation with *-tos* in (173a) yields the special interpretation 'cooked with a red sauce'. This is unexpected considering the Marantz/Arad Hypothesis. Outer derivation with the adjectivizer *-tos* triggers special meaning of the Root *through* the verbalizer. It seems as if the verbalizer is 'ignored' with respect to interpretation in (173a).

(173) a. kokin-is-to kreas / kotopoulo / *magoulo
red-V-tos.NEUT meat / chicken / *cheek
'meat/chicken with a red sauce'

b. kokin-iz-meno derma / magulo / mati / xroma
red-V-menos.NEUT skin / cheek / eye / color
'skin/cheek/eye/color that has turned red as a result of an event'

(Anagnostopoulou 2014: 308)

In order to account for this observation, Anagnostopoulou and Samioti (2013) propose that the verbalizing head (i.e. *-iz*) in *-tos* participles is a semantically-empty head. Following Embick (2010), who proposes that phonologically-empty heads are ignored for contextual allomorphy (i.e. the morphological parallel for contextual allosemy), Anagnostopoulou and Samioti (2013) assume that semantically-empty heads are respectively ignored for contextual allosemy; see also Marantz (2013).

Finally, a word on the representation of the EIs is in order. In (164b), Harley (2014) uses an informal representation with quotes, which I have adapted here for the sake of illustration. Harley (2014: 243) notes that her "informal representations [are] model-theoretic interpretations along the lines proposed by Doron (2003)." For example, »vomit« in (164b-i) "stands for whatever function will produce the correct predicate of [events] in [the respective verbal] syntactic environment". In this thesis, I do not apply Doron's formalism as proposed by Harley. Instead, I apply DRT, where "interpretation involves a two stage process: first, the construction of semantic representations, referred to as Discourse Representation Structures, [...] and, second, a model-theoretic interpretation of those DRSs" (Kamp et al. 2011: 9). For the approach advocated here, this means that Harley's »vomit« in (164b-i) stands for an EI represented as a (fragmental) DRS, which is then interpreted model-theoretically. DRT is addressed in Section 4.1.2 below.

4.1.2 Discourse Representation Theory

This thesis uses Discourse Representation Theory (DRT) (Kamp and Reyle 1993, 2011, Kamp et al. 2011) for the representation of the LF-interface. A key feature of DRT is that it is representational. It promotes a language-driven representation of the cognitively relevant relations that can be verified model-theoretically. DRT includes a level of abstract mental representations, so-called **Discourse Representation Structures (DRSs)**. This section introduces the DRS-language that serves as the representation language at LF. The DRS-language can be defined as given in (174).

(174) **The DRS-language:**

a. A DRS K is a pair

U_K
Con_K

where

(i) U_K is a (possibly empty) set discourse referents, the universe, and

(ii) Con_K is a set of DRS-conditions.

b. A DRS-condition is an expression of one of the following forms:

(i) If P in an n-place predicate and $x_1, ..., x_n$ are discourse referents, then $\mathsf{P}(x_1, ..., x_n)$ is a DRS-condition.

(ii) If x_1, x_2 are discourse referents, then $x_1 = x_2$ is a DRS-condition.

(iii) If K is a DRS, then $\neg K$ is a DRS-condition.

(iv) If K_1 and K_2 are DRSs, then $K_1 \Rightarrow K_2$ is a DRS-condition.

(v) If K_1 and K_2 are DRSs, then $K_1 \vee K_2$ is a DRS-condition.

(vi) If K_1 and K_2 are DRSs, and x is a discourse referent, then $K_1 \langle \overset{\forall}{x} \rangle K_2$ is a DRS-condition.

U_K is referred to as the **universe** of K and Con_K is referred to as the **condition set** of K. In this thesis, I adopt the usual graphical representation for DRSs as box diagrams. The universe is displayed at the top of the diagram, while the set of DRS-conditions is typically displayed below the universe (Kamp and Reyle 1993: 63). The DRS-conditions described in (174b-i) and (174b-ii) are **atomic** DRS-conditions, while those described in (174b-iii) (negation), (174b-iv) (implication), (174b-v) (disjunction), and (174b-vi) (universal quantification) are **complex** (or non-atomix) DRS-conditions. In an implicational DRS-condition $K_1 \Rightarrow K_2$, the DRS K_1 is referred to as the antecedent DRS and the DRS K_2 as the consequent DRS. In a disjunctive DRS-condition $K_1 \vee K_2$, the DRSs K_1 and K_2 are referred to as disjunct DRSs. In a quantificational complex DRS-condition $K_1 \langle \overset{\forall}{x} \rangle K_2$ (for some discourse referent x), the DRS K_1 is referred to as the restrictor DRS and the DRS K_2 as the nuclear scope DRS.

In order to define what is a proper DRS, we need to look at relations that can hold between DRSs in complex DRS-structures. Two such relations are important: (i) subordination and (ii) accessibility. They are defined in the following.

Let us first look at **subordination** of DRSs in (175). The basic relation is the one of *immediate subordination* as defined in (175a). Based on this, we can recursively define the relation of *subordination* in (175b) and, based on that, we can define the relation of *weak subordination* in (175c).

(175) **Subordination of DRSs:**

a. K_1 is *immediately subordinate* to K_2 if and only if either
   (i) Con_{K_2} contains the condition $\neg K_1$; or
   (ii) Con_{K_2} contains a condition of the form $K_1 \Rightarrow K_3$ or one of the form $K_3 \Rightarrow K_1$ for some K_3; or
   (iii) Con_{K_2} contains a condition of the form $K'_1 \vee ... \vee K'_n$ and for some $i \leq n$ $K_1 = K'_i$; or
   (iv) Con_{K_2} contains a condition of the form $K_1 \langle \overset{\forall}{x} \rangle K_3$ or one of the form $K_3 \langle \overset{\forall}{x} \rangle K_1$ for some K_3 and some discourse referent x.

b. K_1 is *subordinate* to K_2 if and only if either
   (i) K_1 is immediately subordinate to K_2 or
   (ii) there is a K_3 such that K_3 is subordinate to K_2 and K_1 is immediately subordinate to K_3.

c. K_1 is *weakly subordinate* to K_2 (i.e. $K_1 \leq K_2$) if and only if either

(i) $K_1 = K_2$ or
(ii) K_1 is subordinate to K_2.

(Kamp and Reyle 1993: 230;
(a-iv) adapted from Kamp 2010: 48)

Sometimes a DRS K_1 that is weakly subordinate to a DRS K_2 is referred to as a **sub-DRS** of K_2. It is often convenient to distinguish a DRS K from various subordinate DRSs. Commonly this is done by referring to K itself as the **main** or **principal** DRS (Kamp and Reyle 1993: 110–111).

Let us now look at **accessibility** of DRSs in (176). Accessibility is basically a three-place relation between two sub-DRSs K_1 and K_2 in a given DRS K, with K itself also counting as an (improper) sub-DRS of K. The basic relation is *immediate accessibility* as defined in (176a). With this, we can define the relation of *accessibility* as the transitive closure of the relation of immediate accessibility in (176b). Sometimes, the fact that K_1 is (immediately) accessible from K_2 in K is simply stated as "K_1 is (immediately) accessible from K_2."

(176) **Accessibility or DRSs:**

a. K_1 is *immediately accessible* from K_2 in K if and only if
K_1 and K_2 are sub-DRSs of K and
(i) Con_{K_1} contains the condition $\neg K_2$; or
(ii) Con_K contains the condition $K_1 \Rightarrow K_2$, or
Con_{K_1} contains the condition $K_2 \Rightarrow K_3$ for some DRS K_3; or
(iii) K_1 is immediately subordinate to K and
Con_{K_1} contains the condition $K_2 \vee K_3$ or $K_3 \vee K_2$ for some K_3; or
(iv) Cond_K contains the condition $K_1 \langle \substack{\forall \\ x'} \rangle K_2$
for some discourse referent x', or
Con_{K_1} contains the condition $K_2 \langle \substack{\forall \\ x''} \rangle K_3$
for some DRS K_3 and for some discourse referent x''.

b. K_1 is *accessible* from K_2 if and only if
(i) $K_1 = K'_1$ and $K_2 = K'_n$ and
(ii) K'_i is immediately accessible from K'_{i+1} for $1 \leq i \leq n-1$.

(adapted from Kamp 2010: 48–49)

We can state the following example accessibility relations (Kamp and Reyle 2011: 888). The DRS K_1 of a DRS-condition $\neg K_1$ belonging to Con_{K_2} is not accessible from another DRS-condition belonging also to Con_{K_2}. The antecedent DRS K_1 is accessible from the consequent DRS K_2 in an implicational DRScondition $K_1 \Rightarrow K_2$, but not conversely. The two disjunct DRSs K_1 and K_2 of a disjunctive DRS-condition $K_1 \vee K_2$ are not accessible from one another. The restrictor DRS K_1 is accessible from the nuclear scope DRS K_2 in an quantificational DRS-condition $K_1 \langle \substack{\forall \\ x} \rangle K_2$ (for some discourse referent x), but not conversely.

With the subordination and accessibility relations, we can state under which conditions an occurrence of a discourse referent is bound or free in a given DRS; see the definitions in (177) for this.

(177) **Bound and free occurrences of discourse referents in a DRS:**

a. Let α be an occurrence of the discourse referent x within the atomic DRS-condition γ occurring somewhere in the DRS K. Then α is *bound* in K if and only if there are sub-DRSs K_1 and K_2 of K such that

(i) x belongs to U_{K_1} (x is existentially bound),

(ii) γ belongs to Con_{K_2}, and

(iii) K_1 is accessible from K_2 in K.

(iv) A discourse referent occurrence α in K is *free* in K if and only if it is not bound in K.

(adapted from Kamp 2010: 49)

With that, we can now define proper and improper DRSs in (178).

(178) **Properness of a DRS:**
A DRS K is proper if and only if all occurrences of discourse referents in K are bound in K; otherwise K is improper.

(Kamp 2010: 49)

At various levels of a derivation, two proper DRSs can merge into one DRS. For this, we can define the operation of (symmetric) DRS-Merge in (179).[58]

(179) **DRS-Merge:**

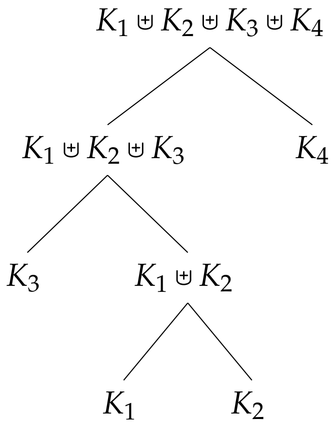
$$\begin{array}{|c|}\hline U_{K_1} \\ \hline Con_{K_1} \\ \hline \end{array} \uplus \begin{array}{|c|}\hline U_{K_2} \\ \hline Con_{K_2} \\ \hline \end{array} = \begin{array}{|c|}\hline U_{K_1} \cup U_{K_2} \\ \hline Con_{K_1} \cup Con_{K_2} \\ \hline \end{array}$$

(Kamp et al. 2011: 140)

Assuming a bottom-up construction algorithm, I take the view that DRS-Merge can take place along syntactic structure, as illustrated in the sample structure in (180).

[58]For discussion on various strategies of merging DRSs, I refer the reader to Fernando (1994), Vermeulen (1995), Van Eijck and Kamp (1997, 2011).

(180) **Sample DRS-Merge along syntactic structure:**



It is crucial to note here that compositionality in a DRT-based syntax-semantics interface cannot be boiled down to DRS-Merge only. In fact, more operations need to be assumed for an exhaustive modeling of the syntax-semantics interface. For instance, at some points of a derivation, the introduction of additional predicates could be required, which extends beyond simple DRS-Merge.

Take, as a case in point, Roßdeutscher and Kamp's (2010) analysis of German *ung*-nominalizations. Roßdeutscher and Kamp argue that a bi-eventive structure is a licensing condition for verbs forming *ung*-nominalizations in German. Consider, as an illustrative example, the contrast in (181), where the *ung*-nominalization *Säuberung* ('cleaning') in (181a) is grammatical, while the *ung*-nominalization **Wischung* (intended: 'wiping') in (181b) is not.

(181) a. die Säuberung eines Tischs
the cleaning a.GEN table.GEN
'the cleaning of a table'

b. *die Wischung a Tischs
the wiping a.GEN table.GEN
intended: 'the wiping of a table'

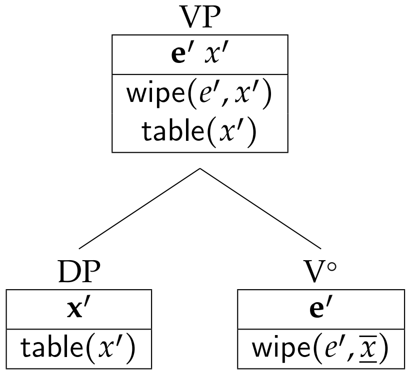
Roßdeutscher and Kamp claim that this contrast corresponds to the underlying verbal constructions, which are given in (182).

(182) a. einen Tisch säubern
a.ACC table clean
'to clean a table'

b. einen Tisch wischen
a.ACC table wipe
'to wipe a table'

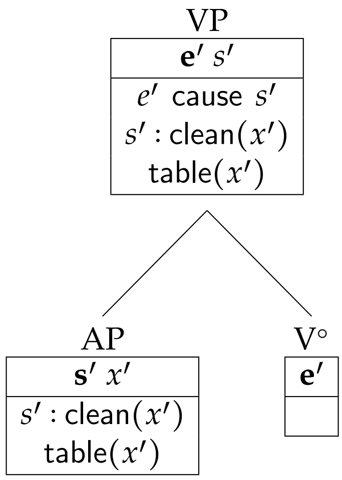
The VP given in (182b) is argued to instantiate a mono-eventive, transitive structure involving the inherently atelic manner verb *wischen* ('wipe') without a result state entailment as depicted in (183). The verb contributes the eventive manner predicate wipe with an open argument slot for a nominal argument (cf. the anticipated discourse referent $\overline{x}$), which is saturated by the referential argument of the DP-complement (cf. the discourse referent x').

(183)



In contrast, the VP given in (182a) is argued to instantiate a bi-eventive structure where the verbal kernel is morphophonologically and semantically empty to begin with – semantically, it only contributes the discourse referent e' for the event –, while the complement AP contributes the stative predication that the table is clean. Morphophonologically, the underlying adjectival head *sauber* ('clean') can be considered to conflate with the morphophonologically empty verb leading to the surface verb *säubern* ('[to] clean'); for the notion of 'conflation' I refer the reader to Hale and Keyser (2002). With regard to semantics, Roßdeutscher and Kamp (2010: 191) argue that both AP and V° have representations with referential arguments. For the AP this is s', and for V° it is the event discourse referent e'. In order to combine these two representations, a relation must be introduced between these two arguments. In this case, it is the relation that Kamp and Roßdeutscher refer to as cause. It relates e' to s' as the causing event and the result state, i.e. e' causes s', and s' is the result state of e'. This is illustrated in (184).

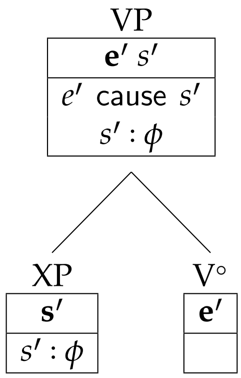
(184)



Roßdeutscher and Kamp (2010: 187) assume that the input structure to the operator forming *ung*-nominalizations must contain a condition of the form e' cause s'. In this way, they account predict the grammaticality of (181a) and the ungrammaticality of (181b).

For a generalized account to *ung*-nominalizations, Roßdeutscher and Kamp (2010: 183) propose the LF-interface rule depicted in (185). Crucially, the DRS-condition e' cause s' does not stem from the DRSs of the daughters of the VP, but it is introduced at the level of VP – an operation that extends beyond the plain DRS-Merge as depicted in (179).

(185)



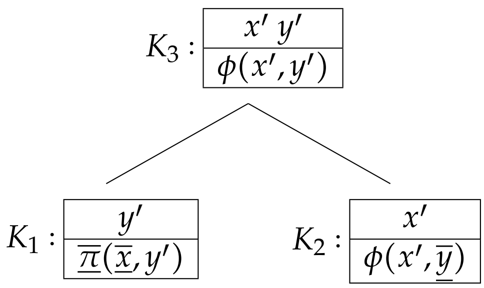
(Roßdeutscher and Kamp 2010: 183)

However, plain DRS-Merge along the syntactic structure suffices for deriving most of the German spatial prepositions at the LF-interface. Nevertheless, in Section 5.5.3, which focuses on the aspectual structure of spatial prepositions, I will also propose an LF-instruction that goes beyond plain DRS-Merge. In order to account for the idea that the unbounded goal circumposition *auf ... zu* ('towards') is derived from the bounded goal preposition *zu* ('to'), I assume that the functional head Q – a light preposition in the extended projection of prepositions that contributes goal semantics – can be reinterpreted in certain syntacticosemantic contexts. In particular, see the reinterpretation rules in (476) on page 275. In addition, I will assume an LF-operation that adjusts the semantic contribution of the terminal node Dx° (functional category for for deixis) in order to account for postpositional deictic elements of route prepositions, e.g. *hin-durch* ('thither-through'); cf. the so-called Dx-Adjustment at LF formulated (465) on page 271.

I assume **unification-based semantic construction rules** (Kamp 2015). In particular, I assume that semantic structure can be anticipated in the course of derivation such that it awaits instantiation through unification under DRS-Merge. Anticipated semantic structure is indicated by both over- and underlining it; semantic structure of various size can be anticipated. Furthermore, only free discourse referents can be anticipated. Consider the example in (186). In the DRS K_1, the predicate $\overline{\underline{\pi}}$ and the discourse referent $\overline{\underline{x}}$ are anticipated, while the discourse referent y' is existentially bound. The two-place predicate $\overline{\underline{\pi}}$ establishes a relation between the discourse referents $\overline{\underline{x}}$ and y'. In the DRS K_2, the discourse referent $\overline{\underline{y}}$ is anticipated, while the discourse referent x' is existentially bound. The predicate two-place predicate ϕ establishes a relation between the discourse referents x' and $\overline{\underline{y}}$. Under DRS-Merge of K_1 and K_2 to the DRS K_3, the anticipated predicate $\overline{\underline{\pi}}$ from K_1 unifies with the predicate ϕ from K_2 and the anticipated discourse referent $\overline{\underline{x}}$ from K_1 unifies with the discourse referent x'

from K_2. Furthermore, the anticipated discourse referent $\underline{y}$ from K_2 unifies with the discourse referent y' from K_1.

(186) **Instantiation through unification:**



With regard to semantic arguments, I distinguish between referential and non-referential arguments (Williams 1977, Kamp and Reyle 2011, a.o.). The **referential argument** of some linguistic unit is the semantic argument that this linguistic unit refers to. In the case of verbs, the referential argument is normally the event or the state the verb describes. In the case of nouns, the referential argument is normally the individual the noun describes. In addition, a linguistic unit can also have **non-referential arguments** which are those semantic arguments that are not the referential argument. In the case of an active transitive verb, for instance, the semantic argument denoted by subject of this verb and the semantic argument denoted by the direct object of this verb are non-referential arguments, while the referential argument of the verb is the event it describes. Note that I indicate referential arguments in the universe of a DRS with bold typeface.

4.1.3 Reproducing a textbook example

This section illustrates the construction algorithm described above, by reproducing a textbook example. The proper treatment of tense and aspect information, not only within a sentence but also across sentences in discourse, is one of the strengths of DRS. Consider the French sentence in (187) and potential subsequent sentences in (188a) and (188b). If the sentence following (187) is in *passé simple* (ps), which is comparable to simple past in English, the event denoted by (188a) is understood as a reaction to the event denoted by (187), i.e. the event where Alain opened his eyes. However, if the sentence following (187) is in *imparfait* (imp), which is comparable to past progressive in English, the event denoted by (188b) is understood as a 'background' state holding temporally around the event denoted by (187). The same difference is observed in its English equivalents with simple past and past progressive.

(187) Quand Alain ouvrit les yeux, il vit sa famme qui était debout près
when Alain open.PS the eyes he see.PS his wife who be.IMP standing next to
de son lit.
of his bed
'When Alain opened his eyes he saw his wife who was standing by his bed.'

(188) a. Elle lui sourit.
she him smile.PS
'She smiled at him.'

b. Elle lui souriait.
she him smile.IMP
'She was smiling at him.'

(Kamp and Reyle 2011: 873)

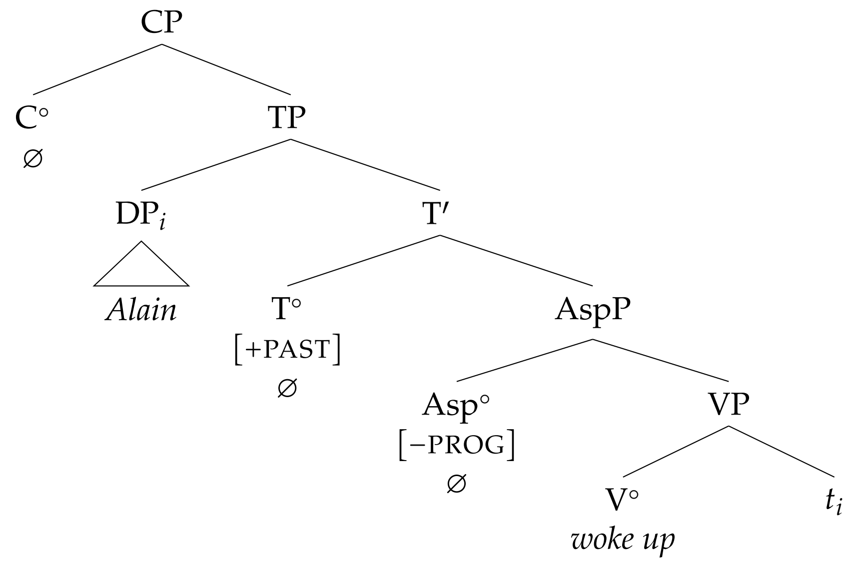
In order to illustrate the DRS-construction algorithm, consider the simplified sentences in (189) and (190), which show the same phenomenon as the French sentences above.

(189) Alain woke up.

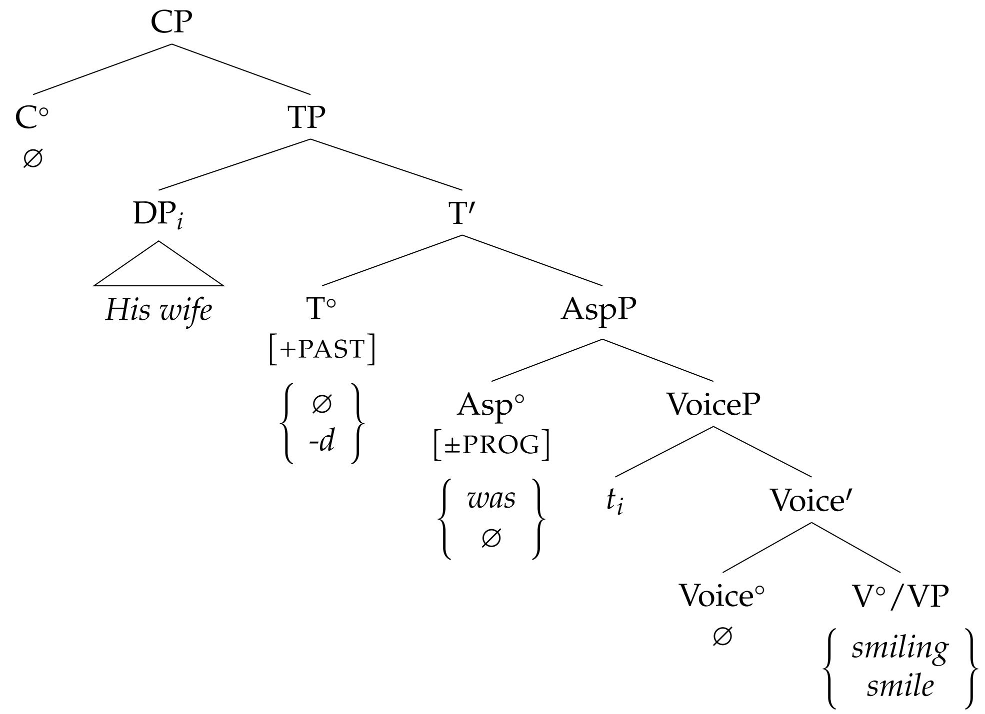
(190) a. His wife smiled.
b. His wife was smiling.

Some syntactic remarks on these examples are in order. The verbs in both (189) and (190) are intransitive, i.e. they have one non-referential argument. However, the verb *wake up* in (189) is assumed to give rise to an unaccusative structure as depicted in (191), while the verb *smile* in (190) is assumed to give rise to an unergative structure as depicted in (192). That is, the DP *Alain* is base-generated as an internal argument of the verb *wake up* and then moves to the subject position, i.e. the specifier of TP. In contrast, the DP *his wife* is not base-generated within the VP of the verb *smile*, but as an external in the specifier of VoiceP (Kratzer 1996) and then moves to the subject position.

(191)



(192)

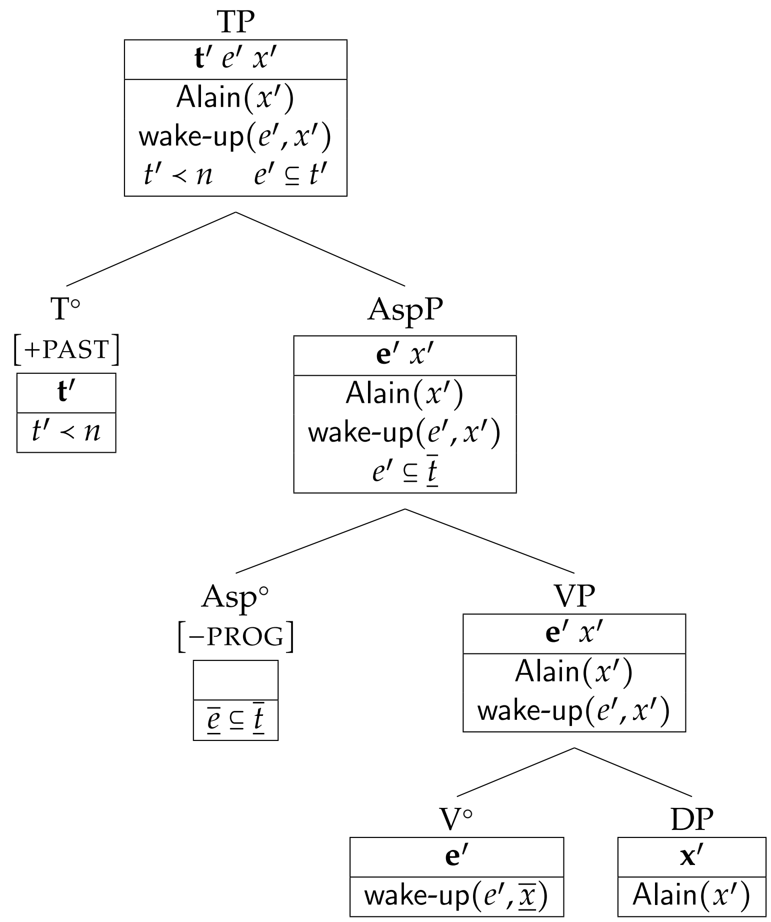


All clauses in (189) and (190) are in the past, thus we can assume T[+PAST]. Furthermore, the clause in (190b) is marked with progressive (prog) aspect. For this, we can assume Asp[+PROG]. In contrast, the clauses in (189) and (190a) are non-progressive, that is, they have Asp[−PROG]. The structure in (192) gives both potential pronunciations for the respective nodes. The upper line in the curly brackets represents the case of [+PROG], while the top line represents the case of [−PROG]. Note that I illustrate the DRS-construction algorithm with the DP-arguments in their base positions and only up to TP.

Let us first look at (189), i.e. *Alain woke up*. The respective structure is semantically fleshed out in (193). The referential argument x' of the DP *Alain* fills the open argument slot of the two-place predicate wake-up contributed by the verb *wake up*.[59] The DRS of V° and the DRS of DP merge to the DRS of VP. As the verb projects, the referential argument of V°, which is e', becomes the referential argument of VP. The clause has non-progressive aspect and hence we can assume that the event e' is temporally included in the time point or interval t'. Accordingly, Asp[−PROG] is interpreted to the effect that an anticipated event is temporally included in an anticipated time point $\underline{e} \subseteq \underline{t}$. By merging Asp° with VP, the anticipated event $\underline{e}$ unifies with e'. As the clause is in the past, the time point t', which is the referential argument of T°, precedes the utterance time n (now) (Kamp et al. 2011: 201). When merging T° and AspP to TP, the anticipated time $\underline{t}$ unifies with t'.

[59] For the sake of illustration, I leave the morphologically complex predicate *wake up* unanalyzed; it consists of a base verb and a particle.

(193)



Ultimately, this leads to the DRS K_1 in (194b) for the clause in (189); this clause is repeated in (194a).

(194) a. Alain woke up.

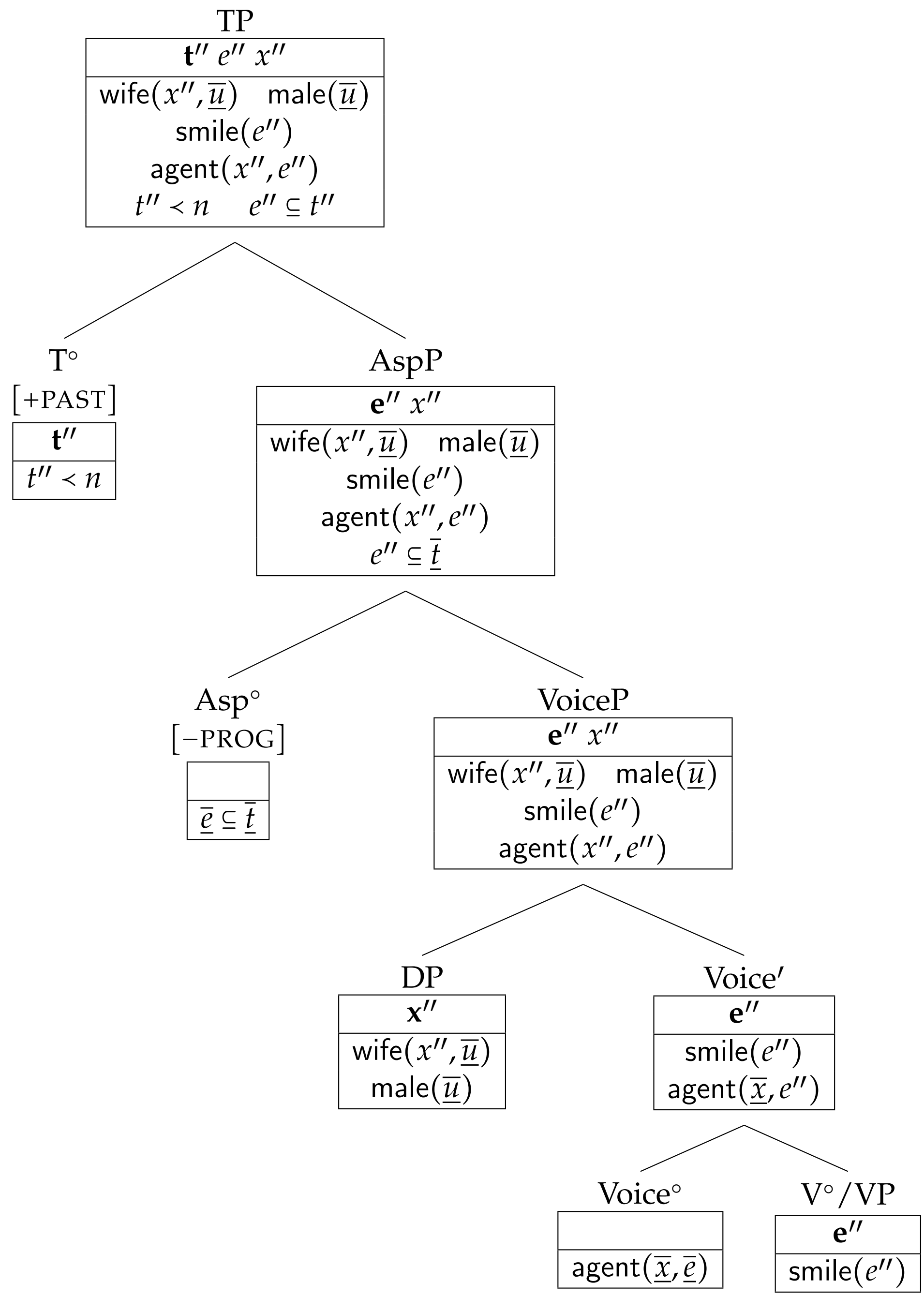
b. $K_1 : \begin{array}{|c|} \hline t' \; e' \; x' \\ \hline \mathsf{Alain}(x') \\ \mathsf{wake\text{-}up}(e', x') \\ t' \prec n \quad e' \subseteq t' \\ \hline \end{array}$

(Kamp and Reyle 2011: 875)

Let us now look at the clause in (190a), i.e. *his wife smiled*, and its semantically fleshed-out-structure in (195). Unlike the verb *wake up*, the verb *smile* gives rise to an unergative structure, as sketched in (192). That is, the subject is base-generated as an external argument of the verb by means of a Voice projection (Kratzer 1996). V°/VP contributes the verbal predicate smile, with e'' being the referential argument. Voice° licenses an agent $\underline{\overline{x}}$ of an anticipated event $\underline{\overline{e}}$. In particular, the agent DP, *his wife*, is base-generated in the specifier position of VoiceP. Kinship-terms typically denote relations between individuals. Thus, I assume that the noun *wife* contributes the two-place predicate wife. It establishes a relation between the referential argument of the DP x'', i.e. the wife, and an anticipated individual $\underline{\overline{u}}$. The possessive pronoun *his* contributes the information that the anticipated individual is male, i.e. male($\underline{\overline{u}}$).[60] When Voice° and V°/VP merge to Voice′, the anticipated event $\underline{\overline{e}}$ unifies with e'', the referential argument of V°/VP. When Voice′ and the DP merge into VoiceP, the referential argument of DP x'' fills in the argument slot of the predicate agent. With regard to the functional structure above VoiceP, the derivation is parallel to (193). The clause has non-progressive aspect and, therefore, the event e'' is temporally included in the time point t''. Asp[−PROG] contributes the condition $\underline{\overline{e}} \subseteq \underline{\overline{t}}$. Anticipated $\underline{\overline{e}}$ unifies with the referential argument of VoiceP e'', while anticipated $\underline{\overline{t}}$ unifies with the referential argument contributed by T°, namely t''. As the clause is in the past, T[+PAST] contributes the condition $t'' \prec n$, i.e. that the time point/interval t'' precedes the utterance time n.

[60]Note that a common way of treating anaphoric elements, such as *his*, is in terms of presupposition (Van der Sandt 1992, Geurts 1999, Kamp 2001, a.o.). To a certain extent, the mechanism of instantiation through unification (anticipation) is in fact similar to presupposition justification. One difference is, however, that presupposition justification can take the form of accommodation, while anticipated structure must be justified by contextual material that is typically available below the sentence level.

(195)



Ultimately, this leads to the DRS K_{2a} in (196b) for the clause in (190a); this clause is repeated in (196a).

(196) a. His wife smiled.

b. K_{2a} :

$e'' \; t'' \; x''$
wife$(x'',\overline{u})$ male$(\overline{u})$
smile(e'')
agent(x'',e'')
$t'' \prec n \quad e'' \subseteq t''$

(deduced from Kamp and Reyle 2011: 883)

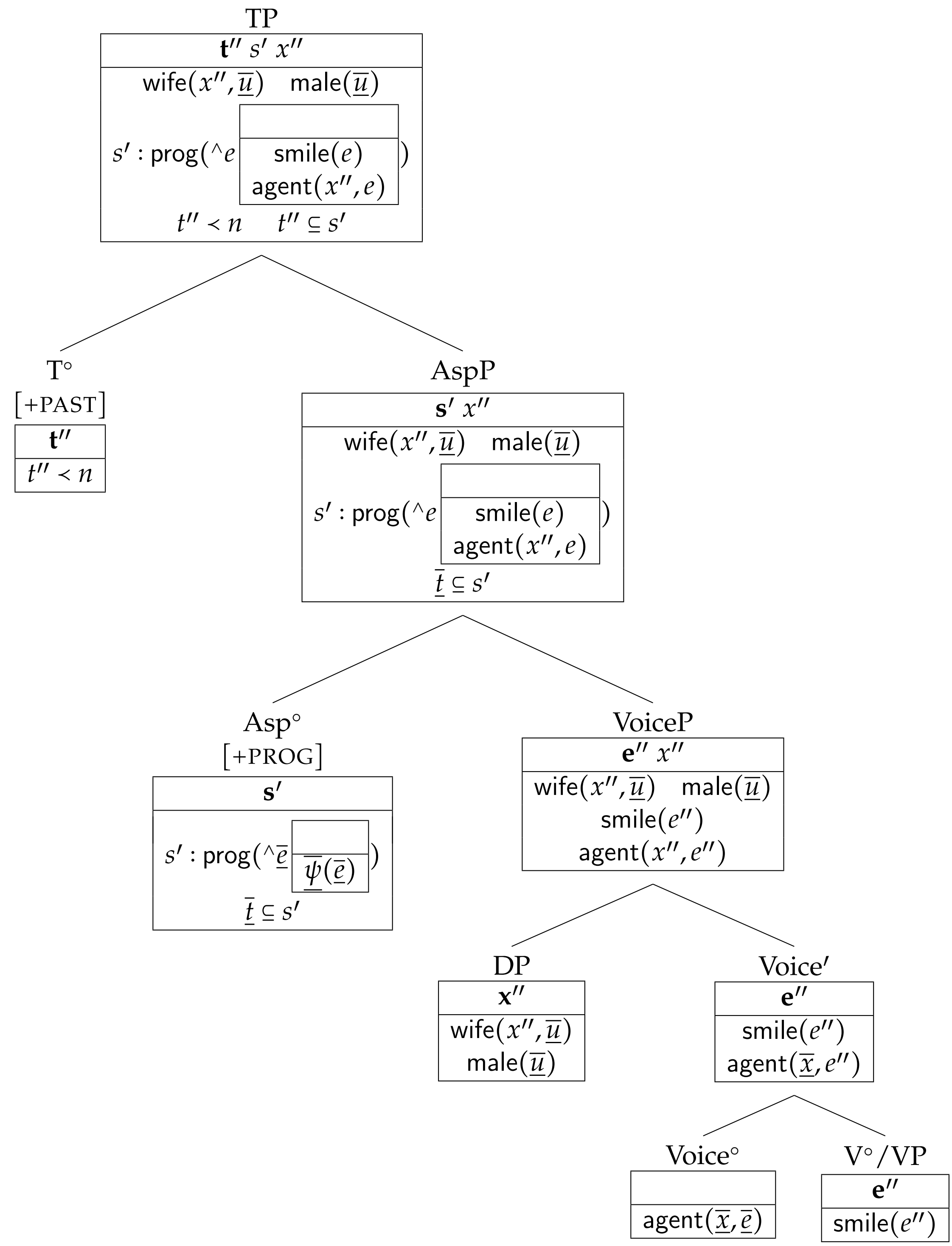
Let us now look at the clause in (190b), i.e. *his wife was smiling*, and its semantically-fleshed-out structure in (198). For the sake of parallelism, we can straightforwardly assume that the derivations of (190a) and (190b) are parallel up to VoiceP. Further, both (190a) and (190b) are in the past tense. Therefore, we can assume that T[+PAST] is again interpreted as contributing the relation $t'' < n$ with t'' as the referential argument. However, the clauses in (190a) and (190b) differ with respect to aspect. The former has non-progressive aspect, while the latter has progressive aspect. This is morphologically marked with the auxiliary *was* and the *ing*-suffix on the verb. For (190b), we can assume Asp[+PROG]. That means that we have now two contrasting feature bundles for Asp°, Asp[−PROG] for non-progressive aspect and Asp[+PROG] for progressive aspect. With that said, we can formulate a context-sensitive interpretation rule for the interpretation of the feature Asp at the LF-interface. Asp[−PROG] is interpreted as in (193) and (195), viz. that an anticipated event $\underline{\bar{e}}$ is simply included in an anticipated time $\underline{\bar{t}}$; that is $\underline{\bar{e}} \subseteq \underline{\bar{t}}$. In contrast, Asp[+PROG] receives a progressive interpretation. For the progressive, Kamp et al. (2011: 205) propose a progressive operator prog that turns an event type into a state type. In particular, it characterizes a state s' to the effect that it holds during the run time of some anticipated event $\underline{\bar{e}}$. Note that ^ denotes an intensional abstraction operator of Intensional Logic (Kamp et al. 2011: 162–163). In this example, it abstracts over an anticipated event. Further, an anticipated time point/interval $\underline{\bar{t}}$ is included in or equal to the described state s', that is $\underline{\bar{t}} \subseteq s'$ (Kamp et al. 2011: 200). I thus propose the LF-instructions for Asp in (197).

(197) a. Asp ↔ $\begin{array}{|c|}\hline \mathbf{s'} \\ \hline s' : \text{prog}(^\wedge\underline{\bar{e}} \begin{array}{|c|}\hline \\ \hline \underline{\bar{\psi}}(\underline{\bar{e}}) \\ \hline \end{array}) \\ \underline{\bar{t}} \subseteq s' \\ \hline \end{array}$ / [+PROG]

b. ↔ $\begin{array}{|c|}\hline \\ \hline \underline{\bar{e}} \subseteq \underline{\bar{t}} \\ \hline \end{array}$ / [−PROG]

The interpretation of Asp gives rise to the semantically-fleshed-out structure in (198) for the past progressive clause in (190b), i.e. *his wife was smiling*.

(198)



This leads to the DRS K_{2b} in (199b) for the clause in (190b), repeated in (199a).

(199) a. His wife was smiling.

b. K_{2b} :

$s'\ t''\ x''$
wife$(x'',\underline{u})$ male$(\underline{u})$
s' : prog$(\wedge e$ [smile(e) agent(x'',e)]$)$
$t'' \prec n$ $t'' \subseteq s'$

Let us now go back to the discourses in (189)/(190a) and (189)/(190b). On the one hand, the non-progressive clause in (190a) could be the follow-up sentence to (189), or, on the other hand, the follow-up sentence could be the progressive clause in (190b). Let us first consider the case where (189) is followed by (190a). This discourse is repeated in (200a). As illustrated in (200b), the DRSs K_1 and K_{2a} undergo DRS-Merge into K_{3a}. This means that the universe of K_{3a} is the union of the universe of K_1 and the universe of K_{2a}. Likewise, the condition set of K_{3a} is the union of the condition set of K_1 and the condition set of K_{2a}. Further, the anticipated discourse referent $\overline{\underline{u}}$ for the pronoun *his* from K_{2a} unifies with the discourse referent x' for *Alain* from K_1 ($\overline{\underline{u}} = x'$). Furthermore, we can assume that the rhetorical relation *Narration* holds between the two sentences in (200a) (Mann and Thompson 1988, Zeevat 2011). This gives rise to a temporal ordering where t' from K_1 precedes t'' from K_{2a}; cf. the precedence condition $t' \prec t''$ in K_{3a}.

(200) a. Alain woke up. His wife smiled.

b. K_1 : $\uplus$ K_{2a} :

$$K_1: \begin{array}{|c|}\hline e'\ t'\ x' \\ \hline \text{Alain}(x') \\ \text{wake-up}(e', x') \\ t' \prec n \quad e' \subseteq t' \\ \hline \end{array} \quad \uplus \quad K_{2a}: \begin{array}{|c|}\hline e''\ t''\ x'' \\ \hline \text{wife}(x'', \overline{\underline{u}}) \quad \text{male}(\overline{\underline{u}}) \\ \text{smile}(e'') \\ \text{agent}(x'', e'') \\ t'' \prec n \quad e'' \subseteq t'' \\ \hline \end{array}$$

$$= \; K_{3a}: \begin{array}{|c|}\hline e'\ e''\ t'\ t''\ x'\ x'' \\ \hline \text{Alain}(x') \\ \text{wake-up}(e', x') \\ t' \prec n \quad e' \subseteq t' \\ \text{wife}(x'', x') \quad \text{male}(x') \\ \text{smile}(e'') \\ \text{agent}(x'', e'') \\ t'' \prec n \quad e'' \subseteq t'' \\ t' \prec t'' \\ \hline \end{array}$$

Let us now consider the case when (190b) follows (189). This discourse is repeated in (201a). Here, the DRSs K_1 and K_{2b} merge into K_{3b}. Again, the anticipated discourse referent $\overline{\underline{u}}$ for the pronoun *his* from K_{2b} unifies with the discourse referent x' for *Alain* from K_1 ($\overline{\underline{u}} = x'$). Progressive in English typically provides some stative background information for some particular time. Hence, we can unify the time t'' from K_{2b} with the time t' from K_1, cf. $t' = t''$ in K_{3b} (Kamp and Reyle 2011: 881–882).

(201) a. Alain woke up. His wife was smiling.

b. K_1 : $\uplus$ K_{2b} :

$$\begin{array}{|c|}\hline e'\ t'\ x' \\ \hline \text{Alain}(x') \\ \text{wake-up}(e',x') \\ t' < n \quad e' \subseteq t' \\ \hline \end{array} \quad \uplus \quad \begin{array}{|c|}\hline s'\ t''\ x'' \\ \hline \text{wife}(x'',\overline{u}) \quad \text{male}(\overline{u}) \\ s' : \text{prog}(\hat{}e \begin{array}{|c|}\hline \\ \hline \text{smile}(e) \\ \text{agent}(x'',e) \\ \hline \end{array}) \\ t'' < n \quad t'' \subseteq s' \\ \hline \end{array}$$

= K_{3b} :

$$\begin{array}{|c|}\hline e'\ s'\ t'\ t''\ x'\ x'' \\ \hline \text{Alain}(x') \\ \text{wake-up}(e',x') \\ t' < n \quad e' \subseteq t' \\ \text{wife}(x'',x') \quad \text{male}(x') \\ s' : \text{prog}(\hat{}e \begin{array}{|c|}\hline \\ \hline \text{smile}(e) \\ \text{agent}(x'',e) \\ \hline \end{array}) \\ t'' < n \quad t'' \subseteq s' \\ t' = t'' \\ \hline \end{array}$$

For the sake of completeness, let me close this section with a note on the interpretation of T. The examples here are all in the past tense, which is expressed with the condition $t < n$, i.e. that the respective time point or interval precedes the utterance time n (now) (Kamp et al. 2011: 201). It should be clear that this correlates to T[+PAST]. For future tense, we can equally assume that T[+FUTURE] is interpreted to the effect that the respective time point/interval succeeds the utterance time, i.e. $n < t$. For convenience, let us assume that present tense corresponds to the absence of the features [+PAST] and [+FUTURE]. That means that present tense is the elsewhere tense. These considerations give rise to the LF-instruction for T in (202).

(202) a. T $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{t'} \\ \hline t' < n \\ \hline \end{array}$ / [+PAST]

b. $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{t'} \\ \hline n < t' \\ \hline \end{array}$ / [+FUTURE]

c. $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{t'} \\ \hline t' = n \\ \hline \end{array}$ elsewhere

(cf. Kamp et al. 2011: 201)

4.2 Figure and Ground

This thesis focuses on prepositions that typically express spatial relations between two entities. Conceptually, these two entities play asymmetrical roles. Adopting the terms from Gestalt psychology, Talmy (1975, 1978, 2000: 311) posits

> [...] two fundamental cognitive functions, that of the **Figure**, performed by the concept that needs anchoring, and that of the **Ground**, performed by the concept that does the anchoring. This pair of concepts can be of two objects relating to each other in space in an event of motion or location—and represented by nominals in a single clause. [...]

That is, the stationary or dynamic position of the Figure is described relative to the Ground.[61] Consider the examples in (203), where in both sentences the position of *the pen* (Figure) is expressed relative to *the table* (Ground), either in a stationary situation (203a) or in a dynamic one (203b).

(203) a. [$_{Figure}$ The pen] lay on [$_{Ground}$ the table].
b. [$_{Figure}$ The pen] fell off [$_{Ground}$ the table].

(Talmy 2000: 311)

Talmy characterizes Figure and Ground as given in (204).

(204) **The general conceptualization of Figure and Ground in language**

a. The **Figure** is a moving or conceptually movable entity whose path, site, or orientation is conceived as a variable, the particular value of which is the relevant issue.
b. The **Ground** is a reference entity, one that has a stationary setting relative to a reference frame, with respect to which the Figure's path, site, or orientation is characterized.

(Talmy 2000: 312)

It is important to emphasize that Grounds are typically conceptualized as stationary relative to a reference frame, even if they are in motion. Consider, for instance, the sentences in (205).

(205) a. Throughout the entire race, [$_{Figure}$ Häkkinen] was driving **in front of** [$_{Ground}$ Schumacher's car].

(Kracht 2002: 194)

b. [$_{Figure}$ The bird] is flying **around** [$_{Ground}$ the rising balloon].

(adopted from Zwarts 2005b: 743)

In (205a), Häkkinen's position is understood as a constant position (expressed by the stative preposition *in front of*) in terms of the reference frame set by Schumacher's car. The same reasoning applies to (205b), where the bird's movement along a spatial path (expressed by the directional preposition *around*) is understood in terms of the relative frame set by the balloon, and not in terms of an absolute frame. I follow Zwarts (2005b: 743) in assuming that

[61] Note that Figures are sometimes referred to as Trajectors, and Grounds as Landmarks.

"this idealization is somehow part of the relativistic way in which we conceptualize position and motion in space."

With regard to the structure of spatial prepositions, Svenonius (2003) proposes that the Figure/Ground relation is reflected syntactically in much the same way as it has been proposed for the Agent/Patient relation. In particular, he formulates the so-called **Split P Hypothesis**, stating that the light preposition "little *p*" introduces the Figure as the external argument of the preposition; little *p* is above PP, which has the Ground as the internal argument. This is parallel to the Voice Hypothesis formulated by (Kratzer 1996), which states that the light verb Voice introduces the Agent as the external argument of the verb; Voice is above VP, which has the Patient as the internal argument. For further discussion, I refer the reader to Section 2.1.2; see page 26.

Let me close this section with a comment on the relation between spatial prepositions and the Figure/Ground relation. Arguably, spatial prepositions are often the linguistic means of choice for expressing a Figure/Ground relation. However, it should be clear that this is not the only way. Consider the clause (206), where a Figure/Ground relation is established solely with the verb *climb*.

(206) [$_{Figure}$ The monkey] climbed [$_{Ground}$ the tree].

On the other hand, if we assume that the complement of a spatial preposition is always a Ground, following Svenonius (2003), then we cannot help but assume also that there is a Figure corresponding to that Ground.[62] Otherwise the notion of Ground by itself would not be adequate. We can conclude that a spatial preposition is a sufficient, but not a necessary condition for establishing a Figure/Ground relation.

4.3 Space as seen through the eyes of natural language

This thesis models the interface representation Logical Form (LF) in terms of Discourse Representation Theory (DRT) (Kamp and Reyle 1993, 2011), cf. Section 4.1.2. One key feature of DRT is that it distinguishes between representation and model-theoretic interpretation. DRT thereby offers a controlled way to ask and answer the question of what an expressive, and yet parsimonious, formalism requires, in order to be able to adequately represent natural language. However, Discourse Representation Structures (DRSs) are the formulas of a formal language that comes with a model-theoretic semantics. The models for this language must permit the correct semantic evaluations. For the DRS-language used in this thesis, this means that the spatial representations on which this thesis focuses are represented in the models by the right spatial relations. The natural way to satisfy this desideratum is to assume that the

[62] Note that the Figure does not need to be an entity. Consider, as a case in point, PPs that serve as frame-setting modifiers in the sense of Maienborn (2001). For instance, in the sentence "***In*** [$_{\text{Ground}}$ *Argentina*], [$_{\text{Figure}}$ *Eva is still very popular*]", it is reasonable to assume that the entire proposition *Eva is still very popular* serves as the Figure.

models contain three-dimensional geometric space as part of their ontologies. However, this still leaves room for variation. Two conceptions of such spaces are of particular relevance for the present investigation: (i) the traditional concept of three-dimensional Euclidean space – I will refer to this model as a **vector space model** – and (ii) a **perception-driven model** that more naturally reflects the expressive constraints that can be observed for a substantial part of the space-related (prepositional) repertoire of German and many other human languages. There are various ways in which three-dimensional Euclidean space can be defined and represented. One is a real-based three-dimensional vector space with an inner product operation. It is an essential feature of vector spaces that they are closed under certain operations, in particular under the operation of vector sum. This is an essential difference with a perception-based model of space I referred to above as the alternative option. Primary Perceptual Space (as defined by Kamp and Roßdeutscher 2005) also is three-dimensional in that is starts from the assumption of three orthogonal axes – an 'absolute' axis, the vertical, which is given by gravity, and two orthogonal, horizontal axes whose orientation varies with context. Vectors along these axes can be of arbitrary sizes. But – this is the crucial point – there is **no** closure under vector sums. For instance, while there is a unit vector in the direction of the vertical and two unit vectors in the direction of the horizontal axes, there is no diagonal vector that is to be found as the vector sum of the first vector and one of the latter two. Non-closure is a central feature of cognitively-relevant subsystems of our spatial cognition.

A vector space model of three-dimensional space

Zwarts (1997, 2003b, 2005b), and Zwarts and Winter (2000) advocate a model of three-dimensional space based on a vector space that is closed under vector addition. The principles of such a vector space model are formally grounded in Euclidean geometry and motivated independently from natural language, which leads to an immense expressiveness of the formalism.

Take the modeling of spatial paths (SPs) as a case in point. Zwarts (2005b: 743) assumes that SPs are "directed stretches of space" that geometrically correspond to a curve with an arrow at one end. In particular, he (2005b: 748) defines SPs as "continuous functions from the real unit interval $[0,1]$ to positions in some model of space.[63] The relation between SPs and positions is straightforward: the starting point of a spatial path p is $p(0)$, the end point is $p(1)$; and for any $i \in [0,1]$, $p(i)$ is the corresponding point of the spatial path." He (2005a: 748) further argues that such "positions and other spatial properties are best understood as *relative positions*, modeled by *vectors* (Zwarts 1997, 2003b, Zwarts and Winter 2000)." Equipped with this, Zwarts can model SPs as directed curves that can have virtually any shape. Consider, for instance, the SP p depicted in Figure 7 below. Zwarts (2005b: 748) further argues that this

[63] For further discussion of spatial paths, I refer the reader to Section 4.5.

way of constructing SPs "has the advantage of making the relation between [spatial] paths and places maximally explicit and of being closer to our geometric intuitions."

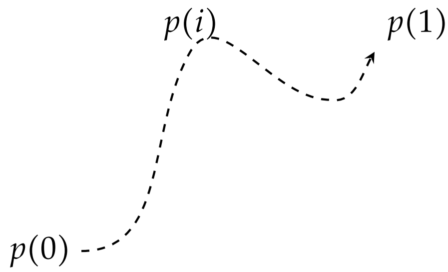


Figure 7: Spatial path p as a directed curve (cf. Zwarts 2005b: 744)

In fact, adopting a Euclidean vector space as a model of three-dimensional space leads to an immense expressiveness of the formalism, because, for instance, every point in $\mathbb{R}^3$ can be identified by a unique coordinate on the three axes x, y, and z. Take, e.g., the point Q in the Cartesian coordinate system in Figure 8, which can be identified with the position vector $\vec{v}_Q = (-6, 7, -5)$.

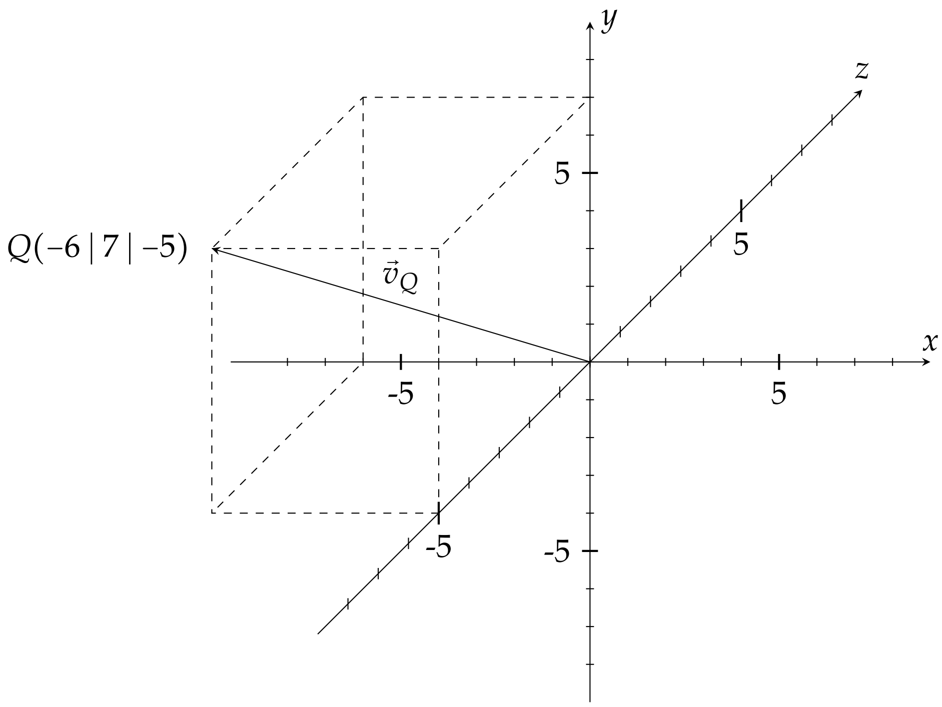


Figure 8: Euclidean vector space

However, the question is whether this kind of expressiveness is required – or even adequate – for a formalism representing the semantics of (spatial prepositions in) natural language. I believe that such models of three-dimensional space are generally too explicit and thus too liberal, as they allow natural language descriptions to express SPs with shapes of any kind. SPs, as referred to by basic prepositional expressions, can apparently not have any kind of shape. Consider the examples of the route preposition *over* in (207).[64]

[64]Note that I discuss route prepositions in Section 5.4.3 in more detail.

(207) a. John jumped **over** the fence.
b. John hit the ball **over** the net.
c. John ran **over** the bridge.

Zwarts (2005b: 763) proposes that the denotation of the PP in (207a) is as in (208). This means that the set of SPs denoted by *over the fence* is such that the starting points $p(0)$ and the end points $p(1)$ of the SPs are 'not on/above the fence', while the points $p(i)$ in-between the starting and the end points are 'on/above the fence'.

(208) $[\![$ over the fence $]\!] = \{p:$ there is an interval $I \subset [0,1]$ that includes neither 0 nor 1 and that consists of all the $i \in [0,1]$ for which $p(i)$ is on/above the fence$\}$

(Zwarts 2005b: 763)

This can be schematized as in (209), where the line of pluses and minuses represents the points of the interval $[0,1]$ where the SP is 'on/above the fence' (+) or not (–).

(209) – – – – + + + + – – – –
0 1

(Zwarts 2005b: 760)

However, without further geometric rectilinearity constraints on SPs, the semantic representation of (207a) in (208) does not exclude the interpretation where John does not cross the fence.[65] Consider (207b). This clause would be an infelicitous description of a situation where the ball does not reach the other side of the net. Imagine a solo table tennis training where John plays on a table with one half folded up. Here, the net is taut along the side of the table in an upright position. On such a tennis table, the ball bounces back when it is right above the net. That is, the SPs, along which a ball in this configuration typically moves, fall under the denotation in (208) (though with 'net', instead of 'fence'); the starting and end points are not above the net, while there is a subpart of the SP in between that is above the net. Nevertheless, such a scenario cannot felicitously be described with (207b). From that observation, I conclude that the SPs denoted by *over* (and German *über*, which behaves identically in this respect) come with a certain rectilinearity constraint – a fact that Zwarts' (2005b) approach to SPs, although geometrically explicit, does not inherently account for.

A further prediction that straightforwardly follows from Zwarts' (2005b) geometrically explicit approach to SPs is that SPs cannot but have an inherent direction. Recall that Zwarts (2005b: 748) defines SPs as continuous functions from the real unit interval $[0,1]$ to locations in some model of space. The starting point of a SP p is then $p(0)$, while the end point is $p(1)$. That is, the real unit interval $[0,1]$ imposes a direction on SPs. However, not all path prepositions apparently commit to directed SPs. Consider again route prepositions as a case

[65] Note that this entailment is not related to the achievement predicate *jump*. In fact, (207c) with the manner of motion predicate *run* has the same entailment, viz. namely that John has crossed the street.

in point. Compare the German route prepositions *durch* ('through') and *um* ('around') in (210) with the goal prepositions *in* ('into') and *an* ('onto') in (211). The route prepositions in (210) can serve as felicitous modifiers of underived nominals not conceptualized as having an inherent direction, such as *wall* or *fence*, while the goal prepositions in (211) are odd as modifiers of these nouns.

(210) a. [Die Mauer **durch** die Stadt] wurde niedergerissen.
the wall through the.ACC city was torn down

b. [Der Zaun **um** das Gebäude] war blutverschmiert.
the fence around the.ACC building was blood-smeared

(211) a. [Die Mauer ??**in** die Stadt] wurde niedergerissen.
the wall into the.ACC city was torn down

b. [Der Zaun ??**an** das Gebäude] war blutverschmiert.
the fence onto the.ACC building was blood-smeared

Compare the data in (210) and (211) with the data in (212) and (213), both containing the same prepositions. The difference is, however, that the nouns being modified in the latter examples can be conceptualized as having an inherent direction: creeks have flow direction, and roads typically have one (or two) driving direction(s). The examples containing route prepositions in (212) are felicitous, and, crucially, so are the examples containing goal prepositions in (213).

(212) a. [Der Bach **durch** den Wald] wurde begradigt.
the creek through the.ACC forest was rectified

b. [Die Straße **um** den See] wurde erneuert.
the road around the.ACC lake was renewed

(213) a. [Der Bach **in** den Wald] wurde begradigt.
the creek into the.ACC forest was rectified

b. [Die Straße **an** den See] wurde erneuert.
the road to the.ACC lake was renewed

This different behavior of route and goal prepositions points to a difference with regard to their conceptualizations. I take this to mean that goal (and source) prepositions commit to SPs that relate to direction (cf. Section 5.4.2), while route prepositions commit to SPs that do not necessarily relate to direction (cf. Section 5.4.3). This means that SPs denoted by route prepositions can do just fine without direction. Taking this into account, I take the view that direction built into the representation of SPs as it is in Zwarts' approach, is appropriate for directed prepositions such as goal (and source) prepositions, but that it does not appear to be appropriate for undirected prepositions, viz. route prepositions.

Summarizing, we can say that, by adopting a vector space model (Zwarts 1997, 2003b, Zwarts and Winter 2000), Zwarts (2005b) barters the restrictiveness and the underspecification that seem to be appropriate in the semantic representation of spatial prepositions for maximal geometric expressiveness. Instead of adopting a vector space model for modeling three-dimensional space, I adopt a geometrically more sparse, yet adequately expressive, perception-driven model of space (Kamp and Roßdeutscher 2005). I will address this in the following.

A perception-driven model of space

Basing their account on cognitive principles, Kamp and Roßdeutscher (2005) develop a perception-driven model of three-dimensional space that is **tailored to natural language**. Their approach is in the spirit of Lang (1990), who studies the conceptualization of spatial objects. A fundamental principle on which Kamp and Roßdeutscher build their approach is the idea that the semantic representation should formalize what natural language expressions minimally commit to. That is, the model of three-dimensional space should account for the **minimal commitments of spatial expressions**. Kamp and Roßdeutscher's perception-driven model of three-dimensional space is more restrictive and sparse, as compared to the vector space model advocated by Zwarts (1997, 2003b, 2005a), Zwarts and Winter (2000). I take the view that a more restrictive and sparse model of three-dimensional space is more appropriate for the modeling of spatial prepositions. Take again spatial paths (SPs) as a case in point. What should a minimal model of SPs look like? To begin with, a minimal model of a spatial path (SP) arguably corresponds to a rectilinear and undirected line segment. Note that Section 4.5 addresses SPs in more detail. Consider again the route preposition *over* as used in the examples in (207). For convenience, (207a) is repeated in (214).

(214) John jumped **over** the fence.

Zwarts' (2005b: 763) semantic representation of (214) does not exclude the interpretation where John did not land on the other side of the fence. This is because Zwarts' model of SPs does not exclude non-rectilinear SPs. However, if we assume a minimal model that takes SPs as being rectilinear line segments, this problem will no longer arise. Consider also the examples in (210), which show that route prepositions typically can serve as felicitous modifiers of underived nominals that are not conceptualized with an inherent direction. The respective example in (210a) is repeated here in (215).

(215) [Die Mauer **durch** die Stadt] wurde niedergerissen.
the wall through the.ACC city was torn down

Zwarts (2005b)' defines SPs as continuous functions from the real unit interval $[0, 1]$ to the locations in some model of space.[66] Hence, SPs inevitably impose, in one way or another, a direction on undirected entities in examples like (215). Although this does not affect the validity of the semantic representation of the clause as a whole, it is nevertheless unintuitive. I think that a more intuitive semantic representation of the PPs in (215) should be based on SPs that are undirected in the first place. These considerations lead to the conviction that a

[66] For further discussion of spatial paths, I refer the reader to Section 4.5.

perception-driven and parsimonious model of three-dimensional space is more adequate, while being equally sufficient, for modeling the spatial prepositions in focus here.

A fundamental assumption of the perception-driven model of three-dimensional space by Kamp and Roßdeutscher is that orthogonality (and parallelism) are primary geometric relations "constitut[ing] a cognitively and lexically important subsystem of a fuller conceptualization of space in which there is full range of orientations" (Kamp and Roßdeutscher 2005: 7). A further assumption they make is that the three axes (i) orthogonal to one another and (ii) determined on the basis of perceptual input (Lang 1990) span a three-dimensional space, referred to as **Primary Perceptual Space (PPS)**. The first axis of PPS is the vertical axis determined by equilibrioception, i.e. the perception of gravity that manifests itself in the sense of balance. The second axis of PPS is the observer axis determined by the visual perception of an observer, the viewing direction to be precise; it is orthogonal to the vertical axis. The third axis of PPS is the transversal (or horizontal) axis identified as that axis that is orthogonal to both the vertical and the observer axis. As stated above, orthogonality is considered to be a primary geometric relation. In particular, Kamp and Roßdeutscher (2005: 7) state the principle of POSC as formulated in (216).

(216) **Primacy of Orthogonality in Spatial Conceptualization (POSC):**
Spatial orientations are perceived as much as possible in such a way that all relevant directions are parallel to one of the axes of PPS.
(Kamp and Roßdeutscher 2005: 7)

This limits the total number of orientations in the PPS to six, i.e. two on each axis. Note that this is unlike how it is commonly assumed by those who model space as Euclidean space, where, in principle, infinitely many different orientations are available. These six orientations are 'up' and 'down' on the vertical axis, 'fore' and 'back' on the observer axis, and 'left' and 'right' on the transversal axis.[67] Consider Figure 9 as an illustration of a PPS. Section 4.3.3 addresses the PPS in more detail.

4.3.1 Material objects

Material objects correspond to the real world entities with respect to which we compute spatial relations. Strictly speaking, material objects are not part of the spatial ontology, but they are mapped to spatial regions that are part of PPS. In order to achieve this mapping, we first have to assume that material objects can be conceived as being either one-, two-, or three-dimensional. The different dimensionalities in the conceptualization of material objects are mutually exclusive.[68]

[67] I use the label 'fore' for forward orientation.

[68] Note that the axioms for material objects, as given in (217), show some redundancy. In general, a more economic formulation is possible.

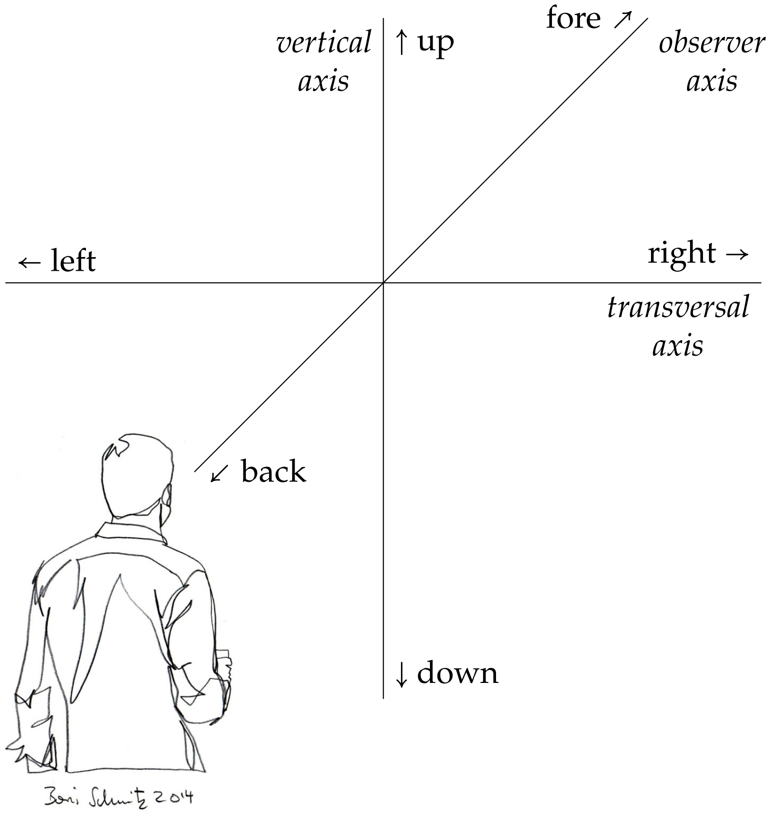


Figure 9: Primary Perceptual Space (PPS)

(217) Axioms for **material objects (**obj**):**

a. $\forall x[\mathsf{obj}(x) \rightarrow \mathsf{1D}(x) \vee \mathsf{2D}(x) \vee \mathsf{3D}(x)]$

b. $\forall x[\mathsf{obj}(x) \wedge \mathsf{1D}(x) \rightarrow \neg[\mathsf{2D}(x) \vee \mathsf{3D}(x)]]$

c. $\forall x[\mathsf{obj}(x) \wedge \mathsf{2D}(x) \rightarrow \neg[\mathsf{1D}(x) \vee \mathsf{3D}(x)]]$

d. $\forall x[\mathsf{obj}(x) \wedge \mathsf{3D}(x) \rightarrow \neg[\mathsf{1D}(x) \vee \mathsf{2D}(x)]]$

The distinction between one-, two-, or three-dimensionality is a matter of conceptualization within a certain type of context. For instance, a *house* is a material object that is typically conceptualized as three-dimensional, which fits the fact that houses are three-dimensional material objects in the real world. In contrast, take a *tile* or a *whiteboard*. Such material objects are canonically conceptualized as two-dimensional (i.e. as the surface of the tile or as the white plane to write on), even though in the real world they are basically three-dimensional material objects, too. Nevertheless, all material objects allow for conceptualization as three-dimensional, in addition to their typical conceptualization. For example, in some situations it might be relevant to conceptualize a tile as three-dimensional, e.g. when measuring the thickness of tiles in order to decide whether they are suitable for laying them on a certain floor. An example of a material object that is typically conceptualized as one-dimensional is a *rod*. Again, a *rod* can be conceptualized both as one-dimensional (in its typical usage) or as three-dimensional.

Of course, material objects come in a multitude of shapes and sizes. While this issue might be crucial for other domains of natural language semantics, it plays a minor role in the analysis of spatial prepositions. Thus, I presume to abstract over shapes and sizes of material objects in this thesis.

4.3.2 Spatial ontology

This section addresses the primes of the spatial ontology that are relevant with respect to the spatial configurations expressed by the prepositions in focus here.

Regions

Spatial regions, or henceforth simply **regions**, are primitives of the model of space that I adopt here. In particular, I take regions as locations that can come in several categories: zero-dimensional, one-dimensional, two-dimensional, or three-dimensional (Kamp and Roßdeutscher 2005: 19–20). The mereological structure of space that I assume is given in (218). In fact, it is similar to Krifka's (1998: 199) part structure, but without the adjacency relation, the proper part relation, and the remainder principle.

(218) $S = \langle U_S, \oplus_S, \leq_S, \otimes_S \rangle$ is a **space structure** iff

- a. U_S is the **set of spatial regions**
- b. $\oplus_S$, the **spatial sum operation**, is a function from $U_S \times U_S$ to U_S that is
  - (i) idempotent, i.e. $\forall x \in U_S[x \oplus_S x = x]$
  - (ii) commutative, i.e. $\forall x, y \in U_S[x \oplus_S y = y \oplus_S x]$
  - (iii) associative, i.e. $\forall x, y, z \in U_S[x \oplus_S (y \oplus_S z) = (x \oplus_S y) \oplus_S z]$
- c. $\leq_S$, the **spatial part relation**, defined as:
  $\forall x, y \in U_S[x \leq_S y \leftrightarrow x \oplus_S y = y]$
- d. $\otimes_S$, the **spatial overlap relation**, defined as:
  $\forall x, y \in U_S[x \otimes_S y \leftrightarrow \exists z \in U_S[z \leq_S x \wedge z \leq_S y]]$

Conveniently, I refer to the spatial part relation $\leq_S$ as (spatial) inclusion, for which I use the symbol $\subseteq$. We can formulate the axioms pertaining to regions, given in (219). Regions are identified with the predicate reg.

(219) Axioms for **regions (**reg**):**

- a. $\forall x[\mathsf{reg}(x) \rightarrow \mathsf{0D}(x) \vee \mathsf{1D}(x) \vee \mathsf{2D}(x) \vee \mathsf{3D}(x)]$
  "every region is either zero-dimensional (i.e. points), one-dimensional, two-dimensional, or three-dimensional"
- b. $\forall x[\mathsf{obj}(x) \rightarrow \exists! y[\mathsf{reg}(y) \wedge \mathsf{occ}(x, y)]]$
  "for every material object x there is exactly one region y such that y is the region that is **occupied by** x"

c. $\forall x, y[\mathsf{occ}(x,y) \rightarrow [\mathsf{1D}(x) \leftrightarrow \mathsf{1D}(y) \wedge \mathsf{2D}(x) \leftrightarrow \mathsf{2D}(y) \wedge \mathsf{3D}(x) \leftrightarrow \mathsf{3D}(y)]]$
"the dimensionality of a material object and the dimensionality of the region occupied by the material object are the same"
(cf. Kamp and Roßdeutscher 2005: 19)

For every material object, there is one particular region that the material object occupies. I refer to this region as the 'occupied region' or as the 'region occupied by the (material) object.' Depending on the conceptualization of a material object, the region occupied by it can be the exact physical *eigenspace* (or *eigenplace*) of the object (Wunderlich 1991, Zwarts and Winter 2000, Svenonius 2010) or its convex hull. In this regard, I refer the reader to Herskovits's (1986) discussion concerning the geometric conceptualizations of material objects. A case in point here is the geometric conceptualization of a *vase*. Compare the two usages of the PP *in the vase* in (220).

(220) a. the water in the vase
b. the crack in the vase
(Herskovits 1986: 41)

In (220a), the water is within the volume of containment defined by the concavity of the vase – a volume delimited by the interior of the vase. Here, the region occupied by the vase is understood as the three-dimensional convex hull of the vase, including its volume of containment; while the physical vase is understood, I suppose, as the two-dimensional skin that defines this volume of containment. In (220b), in contrast, the crack is within what Herskovits calls the normal volume of the vase; that is, within the part of space the vase would occupy if it had no crack, seeing the crack as a negative part. In this case, the region occupied by the vase is understood as being the *eigenspace* of the vase. In this thesis, however, I have nothing more to say about such variable conceptualizations of material objects.

Lines, directions, and points

Let us first look at one-dimensional spatial entities. They come in several varieties. An important type of one-dimensional spatial entity is characterized by rectilinearity. Two types of rectilinear one-dimensional spatial entities primarily figure in the geometric model pursued here: (i) undirected rectilinear one-dimensional spatial entities, which I refer to as lines, and (ii) directed rectilinear one-dimensional spatial entities, which I refer to as directions.

Orthogonality ($\perp$) and parallelism ($\parallel$) are primary relations between rectilinear one-dimensional spatial entities. Therefore, let us first look at the orthogonality and parallelism axioms pertaining to lines in (221).

(221) Axioms for **lines** (lin):
a. $\forall x[\mathsf{lin}(x) \rightarrow x \parallel x]$
"every line is parallel to itself"

b. $\forall x,y[\mathsf{lin}(x) \wedge \mathsf{lin}(y) \wedge x \parallel y \rightarrow y \parallel x]$
"if line x is parallel to line y, then line y is also parallel to line x"

c. $\forall x,y,z[\mathsf{lin}(x) \wedge \mathsf{lin}(y) \wedge \mathsf{lin}(z) \wedge x \parallel y \wedge y \parallel z \rightarrow x \parallel z]$
"if line x is parallel to line y and line y is parallel to line z, then line x is also parallel to line z"

d. $\forall x[\mathsf{lin}(x) \rightarrow \neg x \perp x]$
"every line is not orthogonal to itself"

e. $\forall x,y[\mathsf{lin}(x) \wedge \mathsf{lin}(y) \wedge x \perp y \rightarrow y \perp x]$
"if line x is orthogonal to line y, then line y is also orthogonal to line x"

f. $\forall x,y,z[\mathsf{lin}(x) \wedge \mathsf{lin}(y) \wedge \mathsf{lin}(z) \wedge x \parallel y \wedge y \perp z \rightarrow x \perp z]$
"if line x is parallel to line y and line y is orthogonal to line z, then line x is orthogonal to line z"

g. $\forall x,y[\mathsf{lin}(x) \wedge \mathsf{lin}(y) \wedge x \parallel y \rightarrow \neg x \perp y]$
"if two lines are parallel to one another, then they are not orthogonal to one another"

(cf. Kamp and Roßdeutscher 2005: 8)

In addition to lines (undirected one-dimensional spatial entities), I assume directed one-dimensional spatial entities. I refer to them as directions. Directions are one-dimensional and rectilinear, and thus the axioms for lines in (221) also hold for directions. Directions come with an inherent orientation. I use the two-place predicate align, in order to express the fact that two directions share the same orientation. We can formulate axioms pertaining to directions as in (222).

(222) Axioms for **directions** (dir):

a. $\forall x,y[\mathsf{align}(x,y) \rightarrow \mathsf{dir}(x) \wedge \mathsf{dir}(y)]$
"only two directions can be aligned"

b. $\forall x[\mathsf{dir}(x) \rightarrow \mathsf{align}(x,x)]$
"every direction is aligned with itself"

c. $\forall x,y[\mathsf{dir}(x) \wedge \mathsf{dir}(y) \wedge \mathsf{align}(x,y) \rightarrow \mathsf{align}(y,x)]$
"if direction x is aligned with direction y, then direction y is also aligned with direction x"

d. $\forall x,y[\mathsf{dir}(x) \wedge \mathsf{dir}(y) \wedge \mathsf{align}(x,y) \rightarrow x \parallel y]$
"if direction x is aligned with direction y, then direction x is also parallel to y"

(cf. Kamp and Roßdeutscher 2005: 9)

It is convenient to have a predicate for opposed directions, i.e. directions that are parallel but do not share the same orientation. For this, I use the two-place predicate opp, as defined in (223).

(223) Opposed directions (opp):

a. $\forall x,y[\mathsf{opp}(x,y) \rightarrow \mathsf{dir}(x) \wedge \mathsf{dir}(y)]$
"if opp holds between x and y, then x and y are directions"

b. $\forall x,y[\mathsf{dir}(x) \wedge \mathsf{dir}(y) \rightarrow [\mathsf{opp}(x,y) \rightarrow x \parallel y \wedge \neg\,\mathsf{align}(x,y)]]$
"direction x is opposed to direction y if x and y are parallel to one another but not aligned with one another"

c. $\forall x,y[\mathsf{dir}(x) \wedge \mathsf{dir}(y) \wedge \mathsf{opp}(x,y) \rightarrow \mathsf{opp}(y,x)]$
"if direction x is opposed to direction y, then direction y is also opposed to direction x"

Let us now look at zero-dimensional spatial entities, viz. at points. A points can lie on a line or direction. Then, the point is incident with the line or direction. For the incidence relation, I use the two-place predicate inc, as axiomatized in (224).

(224) Axioms for **points** (poi):

a. $\forall x,y[\mathsf{inc}(x,y) \rightarrow \mathsf{poi}(x) \wedge [\mathsf{lin}(y) \vee \mathsf{dir}(y)]]$
"points can be incident with lines or with directions"

b. $\forall x,y,z[\mathsf{poi}(x) \wedge \mathsf{lin}(y) \wedge \mathsf{lin}(z) \wedge \mathsf{inc}(x,y) \wedge \mathsf{inc}(x,z) \wedge y \parallel z \rightarrow y = z]$
"if point x is incident with line y and with line z and line y is parallel to line z, then line y is identical with line z"

c. $\forall x,y,z[\mathsf{poi}(x) \wedge \mathsf{dir}(y) \wedge \mathsf{dir}(z) \wedge \mathsf{inc}(x,y) \wedge \mathsf{inc}(x,z) \wedge \mathsf{align}(y,z) \rightarrow y = z]$
"if point x is incident with direction y and with direction z and direction y is aligned with direction z, then direction y is identical with direction z"

d. $\forall x,y[[\mathsf{lin}(x) \vee \mathsf{dir}(x)] \wedge [\mathsf{lin}(y) \vee \mathsf{dir}(y)] \wedge x \parallel y \rightarrow$
$\neg\exists z[\mathsf{poi}(z) \wedge \mathsf{inc}(z,x) \wedge \mathsf{inc}(z,y)]]$
"for every two lines or directions x,y that are parallel to one another, there is no point z that is incident with both x and y"

(cf. Kamp and Roßdeutscher 2005: 9)

Line segments

Up to now, I have more or less implicitly assumed that lines (and directions) are unbounded one-dimensional spatial entities. However, for SPs it is necessary to have the notion of a finite line segment (lis), that is, a one-dimensional spatial entity (line) that is delimited by two zero-dimensional spatial entities (points). Line segments are determined by (i) a line and (ii) a pair of points that are each incident with that line. These two points are referred to as endpoints of the line segment. Furthermore, line segments should be closed, which means that they should include their endpoints. In order to make these considerations explicit, Kamp and Roßdeutscher (2005: 13) introduce a four-place predicate that cuts out a finite line segment from a line between two distinct points on that line. While Kamp and Roßdeutscher refer to this four-place predicate as LS, I refer to it as cutout. We can axiomatize line segments as given in (225).

(225) Axioms for **line segments** (lis):

a. $\forall x,y,z,u[\mathsf{cutout}(x,y,z,u) \rightarrow \mathsf{lin}(x) \wedge \mathsf{poi}(y) \wedge \mathsf{poi}(z) \wedge y \neq z \wedge \mathsf{lis}(u)]$
"if u is cut out from x between y and z, then x is a line, y and z are distinct points, and u is a line segment"

b. $\forall x,y,z,u[\mathsf{cutout}(x,y,z,u) \rightarrow \mathsf{endpoi}(y,u) \wedge \mathsf{endpoi}(z,u)]$
"if u is cut out from x between y and z, then y,z are the endpoints of the line segment u"

c. $\forall x,y,z,u[\mathsf{cutout}(x,y,z,u) \rightarrow \mathsf{inc}(x,u) \wedge \mathsf{inc}(z,u)]$
"if u is cut out from x between point y and point z, then both y and z are incident with u"

d. $\forall x,y,z[\mathsf{lin}(x) \wedge \mathsf{poi}(y) \wedge \mathsf{poi}(z) \wedge \mathsf{inc}(y,x) \wedge \mathsf{inc}(z,x) \wedge y \neq z \rightarrow$
$\exists u[\mathsf{lis}(u) \wedge \mathsf{cutout}(x,y,z,u) \wedge \forall v[\mathsf{lis}(v) \wedge \mathsf{cutout}(x,y,z,v) \rightarrow v = u]]]$
"for every line x and every two distinct points y,z on the line x, there is a line segment u such that u is cut out from x between y and z, and for all line segments v that are cut out from x between y and z it is the case that v and u are identical"

(cf. Kamp and Roßdeutscher 2005: 13)

Directed line segments

Just as we can cut out line segments from lines, we can also cut out directed line segments (dls) from directions. Unlike (plain) line segments that are delimited by two tantamount end points, directed line segments are delimited by two points x,y that are in an ordered relation, say $\overrightarrow{xy}$, to the effect that x is the initial point of the directed line segment, and y the terminal point of the directed line segment.[69] In order to account for directed line segments, we can extend the axiom for line segments (225a) to directed line segments (226a).

(226) Axioms for **directed line segments** (dls):

a. $\forall x,y,z,u[\mathsf{cutout}(x,y,z,u) \rightarrow$
$[\mathsf{lin}(x) \wedge \mathsf{poi}(y) \wedge \mathsf{poi}(z) \wedge y \neq z \wedge \mathsf{lis}(u)] \vee [\mathsf{dir}(x) \wedge \mathsf{poi}(y) \wedge \mathsf{poi}(z) \wedge \mathsf{dls}(u)]]$
"if u is cut out from x between y and z, then x is a line, y and z are distinct points, and u is a line segment, or x is a direction, y and z are points, and u is a directed line segment"

b. $\forall x,y,z,u[\mathsf{cutout}(x,y,z,u) \wedge \mathsf{dir}(x) \rightarrow \mathsf{dls}(u) \wedge$
$[\mathsf{inipoi}(y,u) \wedge \mathsf{termpoi}(z,u)] \vee [\mathsf{inipoi}(z,u) \wedge \mathsf{termpoi}(y,u)]]$
"if u is cut out from x between y and z and x is a direction, then u is a directed

[69] Note at this point that this conception of a directed line segment comes quite close to the concept of a Euclidean vector in the narrow sense.

line segment such that y is the initial point of the directed line segment u and z is the terminal point of the directed line segment u or that z is the initial point of the directed line segment u and y is the terminal point of the directed line segment u"

c. $\forall x, y, z, u[\mathsf{cutout}(x, y, z, u) \wedge \mathsf{dir}(x) \wedge \mathsf{dls}(u) \rightarrow \mathsf{align}(x, u)]$
"if u is cut out from x between y and z and x is a direction and u a directed line segment, then the directed line segment u is aligned with the direction x"

d. $\forall x[\mathsf{dls}(x) \rightarrow \exists y[\mathsf{dir}(y) \wedge \mathsf{align}(x, y)]]$
"if x is a directed line segment, then there is a direction y with which the directed line segment x is aligned"

e. $\forall x[\mathsf{dls}(x) \rightarrow \exists! y, z[\mathsf{poi}(y) \wedge \mathsf{poi}(z) \wedge \mathsf{inipoi}(y, x) \wedge \mathsf{termpoi}(z, x)]]$
"if x is a directed line segment, then there is exactly one point y and exactly one point z, such that y is the initial point of the directed line segment x and z is the terminal point of the directed line segment x"

f. $\forall x, y[\mathsf{inipoi}(x, y) \rightarrow \mathsf{poi}(x) \wedge \mathsf{dls}(y) \wedge \mathsf{inc}(x, y) \wedge$
$\exists! z[\mathsf{poi}(z) \wedge \mathsf{inc}(z, y) \wedge \mathsf{termpoi}(z, y) \wedge \overrightarrow{xz}]]$
"if x is the initial point of y, then x is a point, y is a directed line segment, and x is incident with y, and there is exactly one point z that is also incident with the directed line segment y and that is the terminal point of the directed line segment y"

g. $\forall x, y[\mathsf{termpoi}(x, y) \rightarrow \mathsf{poi}(x) \wedge \mathsf{dls}(y) \wedge \mathsf{inc}(x, y) \wedge$
$\exists! z[\mathsf{poi}(z) \wedge \mathsf{inc}(z, y) \wedge \mathsf{inipoi}(z, y) \wedge \overrightarrow{zx}]]$
"if x is the terminal point of y, then x is a point, y is a directed line segment, and x is incident with y, and there is exactly one point z that is also incident with the directed line segment y and that is the initial point of the directed line segment y"

h. $\forall x, y, z, u, a, b, c, d[\mathsf{cutout}(x, y, z, u) \wedge \mathsf{cutout}(a, b, c, d) \wedge$
$\mathsf{dir}(x) \wedge \mathsf{dir}(a) \wedge \mathsf{align}(x, a) \rightarrow \mathsf{align}(u, d)]$
"if u is cut out from direction x between y and z, and if d is cut out from direction a between a and b, and if directions x, a are aligned, then the directed line segments u, d are also aligned"

Note at this point that the axioms for lines (221) also hold for (directed) line segments. In addition, the axioms for directions (222) also hold for directed line segments. Moreover, the axioms for (239) also hold for (directed) line segments. Furthermore, the predicate opp for opposed directions extends to directed lines segments.

Planes

Let us now look at two-dimensional spatial entities. An important type of two-dimensional spatial entities are flat planes. In the same way as we can say that zero-dimensional spatial entities (points) can lie on one-dimensional spatial entities (lines and directions), we can also say that one-dimensional spatial entities lie on two-dimensional spatial entities (e.g. planes). In that case, the two-dimensional spatial entity contains the one-dimensional spatial entity, or, the other way round, the one-dimensional spatial entity is contained within the two-dimensional spatial entity. For the containment relation, I use the two-place predicate con. Planes, as defined below, are flat two-dimensional spatial entities – a property that can be derived from the assumptions that planes contain at least two lines that are orthogonal to one another and that lines are, by definition, rectilinear. To a certain extent we can transfer the relations of orthogonality (⊥) and parallelism (‖) to planes. In particular, lines can be orthogonal to planes, and vice versa. Furthermore, planes can be parallel to one another. Moreover, points can be incident with planes. However, there is a problem when it comes to parallelism between planes and lines. A plane can be parallel to two lines without entailing that the two lines are parallel to one another. In order to retain the structural properties of the 'default' relation of parallelism, Kamp and Roßdeutscher (2005: 11) introduce the predicate $\|_{\text{PL}}$ for parallelism between lines and planes. These considerations are axiomatized in (227).

(227) Axioms for **planes** (pla):

a. $\forall x[\mathsf{pla}(x) \rightarrow \exists y,z[\mathsf{lin}(y) \wedge \mathsf{con}(x,y) \wedge \mathsf{lin}(z) \wedge \mathsf{con}(x,z) \wedge z \perp y]]$
"if x is a plane, then there are two lines y,z that are both contained in plane x and that are orthogonal to one another"

b. $\forall x,y,z[\mathsf{pla}(x) \wedge \mathsf{lin}(y) \wedge \mathsf{lin}(z) \wedge x \perp y \wedge x \perp z \rightarrow y \parallel z]$
"if x is a plane and y,z are lines that are both orthogonal to plane x, then the lines y,z are parallel to one another"

c. $\forall x,y,z[\mathsf{lin}(x) \wedge \mathsf{pla}(y) \wedge \mathsf{pla}(z) \wedge x \perp y \wedge x \perp z \wedge y \neq z \rightarrow$
$\neg\exists w[\mathsf{lin}(w) \wedge \mathsf{con}(y,w) \wedge \mathsf{con}(z,w)]]$
"if x is a line and y,z are planes that are both orthogonal to line x and that are not identical, then there is no line w that is contained in both planes y and z"

d. $\forall x,y[\mathsf{pla}(x) \wedge \mathsf{pla}(y) \wedge x \parallel y \wedge x \neq y \rightarrow \neg\exists z[\mathsf{poi}(z) \wedge \mathsf{inc}(z,x) \wedge \mathsf{inc}(z,y)]]$
"if x,y are planes that are parallel to one another and that are not identical, then there is no point z that is incident with both planes x and y"

e. $\forall x,y[\mathsf{pla}(x) \wedge \mathsf{lin}(y) \wedge x \|_{\text{PL}}\, y \rightarrow \exists! z[\mathsf{pla}(z) \wedge \mathsf{con}(z,y) \wedge z \parallel x]]$
"if x is a plane and y is a line and x and y are parallel to one another, then there is exactly one plane z that contains line y and that is parallel to plane x"

f. $\forall x,y,z[\mathsf{pla}(x) \wedge \mathsf{poi}(y) \wedge \mathsf{lin}(z) \wedge \mathsf{con}(x,z) \wedge \mathsf{inc}(y,z) \rightarrow \mathsf{inc}(y,x)]$
"if x is a plane and y is a point and z is a line and plane x contains line z and point y is incident with line z, then point y is incident with plane x"

g. $\forall x,y[\mathsf{pla}(x) \wedge \mathsf{pla}(y) \wedge \neg x \parallel y \rightarrow \neg\exists z[\mathsf{lin}(z) \wedge \mathsf{con}(x,z) \wedge \mathsf{con}(y,z)]]$
"if x,y are planes that are not parallel to one another, then there is no line z that is contained in both planes x and y"

(cf. Kamp and Roßdeutscher 2005: 11–12)

4.3.3 Primary Perceptual Space

A core device of the spatial model advocated by Kamp and Roßdeutscher (2005) is the **Primary Perceptual Space (PPS)**, which spans a three-dimensional space on the basis of "categorized sensory input delivered by our biological equipment" (Lang 1990: 135). In particular, "PPS draws on perceptual input available from the organ of equilibrium, from upright walk, from vision, and from eye level, each of which contributes a specific interpretation of external physical space" (Lang 1990: 135). Like a Cartesian coordinate system, PPS consists of three axes that are orthogonal to one another. However, PPS differs from a Cartesian coordinate system in at least two respects: (i) PPS is not closed under vector addition, while vector spaces in a Cartesian space are typically closed under vector addition; and (ii) the axes of PPS have an unequal status and are motivated perceptually. The three axes of PPS are the vertical axis, the observer axis, and transversal (or horizontal) axis. Consider Lang's (1990) definition of these three axes in (228).

(228) a. **Vertical axis**:
Due to its origin in gravitation as perceived by the organ of equilibrium, the vertical axis is constant and ubiquitous; upright walk assigns it a foot and a fixed (geofugal) direction. These properties make the vertical axis superior to the other axes, which in a way are defined in relation to it.

b. **Observer axis**:
Originating in the visual organ, the observer axis has an anatomically determined pivot allowing for a 180° turn; the position of the eyes determine its direction (away from the observer) and its orthogonality to the vertical axis.

c. **Transversal** (or horizontal) **axis**:
This third axis has no endpoints and no direction; it is not an axis we are equipped to identify by primary perceptual information, but is derived from the two others just to fill the gap determined by the properties of the latter.
(Lang 1990: 135–136)

Note that Lang conceives the vertical and the observer axes as inherently directed. I assume that these axes are inherently undirected, but that they have a primary orientation, which ultimately amounts to the same thing.

Axes are one-dimensional, rectilinear lines constitutive of equivalence classes in PPS. Using the predicate axi for axes, we can identify the three axes described by Lang (1990) in (228) as the equivalence classes that axes in PPS can instantiate. For the three possible axes in PPS, I use the predicate VERT for the vertical axis, OBS for the observer axis, and TRANS for the transversal axis.

(229) $\forall x[\mathsf{axi}(x) \rightarrow \mathsf{VERT}(x) \vee \mathsf{OBS}(x) \vee \mathsf{TRANS}(x)]$
"every x that is an axis is either a vertical axis, an observer axis, or a transversal axis"

As axes are essentially lines, the axioms for lines in (221) also pertain to axes. In addition, we can formulate the axioms pertaining to axes, as in (230). These axioms guarantee that there are exactly three orthogonal axes in PPS.

(230) Axioms for **axes** (axi):

a. $\exists x, y[\mathsf{axi}(x) \wedge \mathsf{axi}(y) \wedge \neg x \parallel y]$
"there are at least two axes that are orthogonal to one another"

b. $\forall x, y[\mathsf{axi}(x) \wedge \mathsf{axi}(y) \wedge x \perp y \rightarrow \exists! z[\mathsf{axi}(z) \wedge z \perp x \wedge z \perp y]]$
"for every two axes x, y that are orthogonal to one another, there is exactly one third axis z that is orthogonal to both axes x, y"

c. $\forall x, y[\mathsf{axi}(x) \wedge \mathsf{axi}(y) \rightarrow x \parallel y \vee x \perp y]$
"for every two axes x, y are parallel or orthogonal to one another"

d. $\forall x, y, z, u[\mathsf{axi}(x) \wedge \mathsf{axi}(y) \wedge \mathsf{axi}(z) \wedge \mathsf{axi}(u) \wedge$
$x \perp y \wedge x \perp z \wedge y \perp z \wedge u \perp x \wedge u \perp y \rightarrow u \parallel z]$
"for all axes x, y, z, u, if axis x is orthogonal to axes y, z, and u, and if axis y is orthogonal to axes z and u, then axis u parallel to axis z"

e. $\forall x, y[\mathsf{axi}(x) \wedge \mathsf{axi}(y) \wedge x \parallel y \rightarrow x = y]$
"all axes that are parallel are identical"

(cf. Kamp and Roßdeutscher 2005: 8,10)

The three equivalence classes of axes described above extend to lines in PPS. That is, lines can also instantiate these three equivalence classes.

(231) a. $\forall x, y[\mathsf{axi}(x) \wedge \mathsf{lin}(y) \wedge x \parallel y \wedge \mathsf{VERT}(x) \rightarrow \mathsf{VERT}(y)]$
"every line y that is parallel to a vertical axis x is a vertical line"

b. $\forall x, y[\mathsf{axi}(x) \wedge \mathsf{lin}(y) \wedge x \parallel y \wedge \mathsf{OBS}(x) \rightarrow \mathsf{OBS}(y)]$
"every line y that is parallel to an observer axis x is an observer line"

c. $\forall x, y[\mathsf{axi}(x) \wedge \mathsf{lin}(y) \wedge x \parallel y \wedge \mathsf{TRANS}(x) \rightarrow \mathsf{TRANS}(y)]$
"every line y that is parallel to a transversal axis x is a transversal line"

What directions are to lines, orientations are to axes; namely they are constitutive of equivalence classes. With regard to the perceptually grounded system established here, we can identify six distinct orientations: upward, downward, forward, backward, rightward, and leftward. These orientations are identified with the predicates UP for upward, DOWN for downward, FORE for forward, BACK for backward, RIGHT for rightward, and LEFT for leftward.

(232) $\forall x[\mathsf{ori}(x) \rightarrow \mathsf{UP}(x) \vee \mathsf{DOWN}(x) \vee \mathsf{FORE}(x) \vee \mathsf{BACK}(x) \vee \mathsf{RIGHT}(x) \vee \mathsf{LEFT}(x)]$
"every x that is an orientation is either upward, downward, forward, backward, rightward, or leftward"

Orientations are basically directions. Thus, we can assume that the axioms pertaining to directions in (222), and also those pertaining to lines, also pertain to orientations. In addition, we can formulate the axioms in (233) that guarantee exactly six orientations in PPS.

(233) Axioms for **orientations** (ori):

a. $\forall x,y,z[\mathsf{ori}(x) \wedge \mathsf{ori}(y) \wedge \mathsf{ori}(z) \wedge$
$x \parallel y \wedge x \parallel z \wedge \neg\,\mathsf{align}(x,y) \wedge \neg\,\mathsf{align}(x,z) \rightarrow \mathsf{align}(y,z)]$
"for all orientations x,y,z, if x is parallel to both y and z, and if x is neither aligned with y nor with z, then y and z are aligned"

b. $\forall x[\mathsf{ori}(x) \rightarrow \exists! y[\mathsf{axi}(y) \wedge y \parallel x]]$
"for every orientation x, there is exactly one axis y such that x and y are parallel"

c. $\forall x[\mathsf{axi}(x) \rightarrow \exists y,z[\mathsf{ori}(y) \wedge \mathsf{ori}(z) \wedge y \parallel x \wedge z \parallel x \wedge \neg\,\mathsf{align}(y,z) \wedge$
$\forall w[\mathsf{ori}(w) \wedge w \parallel x \rightarrow w = y \vee w = z]]]$
"for every axis x, there are two orientations y,z such that they are both parallel to x but not aligned with one another, and for all other orientations w that are parallel to axis x it is such that w is either identical with y or with z"

d. $\forall x,y[\mathsf{ori}(x) \wedge \mathsf{ori}(y) \wedge \mathsf{align}(x,y) \rightarrow x = y]$
"all orientations that are aligned with one another are identical"

(Kamp and Roßdeutscher 2005: 9,10)

The six equivalence classes of orientations extend to directions in PPS. That is, directions can also instantiate the six equivalence classes.

(234) a. $\forall x,y[\mathsf{ori}(x) \wedge \mathsf{dir}(y) \wedge \mathsf{align}(x,y) \wedge \mathsf{UP}(x) \rightarrow \mathsf{UP}(y)]$
"every direction y that is aligned with an upward orientation x is an upward direction"

b. $\forall x,y[\mathsf{ori}(x) \wedge \mathsf{dir}(y) \wedge \mathsf{align}(x,y) \wedge \mathsf{DOWN}(x) \rightarrow \mathsf{DOWN}(y)]$
"every direction y that is aligned with a downward orientation x is a downward direction"

c. $\forall x,y[\mathsf{ori}(x) \wedge \mathsf{dir}(y) \wedge \mathsf{align}(x,y) \wedge \mathsf{FORE}(x) \rightarrow \mathsf{FORE}(y)]$
"every direction y that is aligned with a forward orientation x is a forward direction"

d. $\forall x,y[\mathsf{ori}(x) \wedge \mathsf{dir}(y) \wedge \mathsf{align}(x,y) \wedge \mathsf{BACK}(x) \rightarrow \mathsf{BACK}(y)]$
"every direction y that is aligned with a backward orientation x is a backward direction"

e. $\forall x,y[\mathsf{ori}(x) \wedge \mathsf{dir}(y) \wedge \mathsf{align}(x,y) \wedge \mathsf{RIGHT}(x) \rightarrow \mathsf{RIGHT}(y)]$
"every direction y that is aligned with a rightward orientation x is a rightward direction"

f. $\forall x,y[\mathsf{ori}(x) \wedge \mathsf{dir}(y) \wedge \mathsf{align}(x,y) \wedge \mathsf{LEFT}(x) \rightarrow \mathsf{LEFT}(y)]$
"every direction y that is aligned with a leftward orientation x is a leftward direction"

Let us now link the six orientations with the three axes. The vertical axis is determined by gravity, and it is linked to the orientations upward and downward. Upward orientation is opposed to downward orientation.

(235) a. $\forall x[\mathsf{ori}(x) \land \mathsf{UP}(x) \to \exists! y[\mathsf{axi}(y) \land x \parallel y \land \mathsf{VERT}(y)]]$
"for every upward orientation x, there is exactly one axis y that is parallel to x and that is vertical"

b. $\forall x[\mathsf{ori}(x) \land \mathsf{DOWN}(x) \to \forall y[\mathsf{axi}(y) \land x \parallel y \to \mathsf{VERT}(y)]]$
"for every downward orientation x, there is exactly one axis y that is parallel to x and that is vertical"

c. $\forall x[\mathsf{ori}(x) \land \mathsf{UP}(x) \to \exists! y[\mathsf{ori}(y) \land \mathsf{opp}(x,y) \land \mathsf{DOWN}(y)]]$
"for every upward orientation x, there is exactly one orientation y that is opposed to x and that is downward"

d. $\forall x[\mathsf{ori}(x) \land \mathsf{DOWN}(x) \to \forall y[\mathsf{ori}(y) \land \mathsf{opp}(x,y) \to \mathsf{UP}(y)]]$
"for every downward orientation x, there is exactly one orientation y that is opposed to x and that is upward"

The observer axis is determined by the viewing direction of the observer, and it is linked to the orientations forward and backward. Forward orientation is opposed to backward orientation.

(236) a. $\forall x[\mathsf{ori}(x) \land \mathsf{FORE}(x) \to \exists! y[\mathsf{axi}(y) \land x \parallel y \land \mathsf{OBS}(y)]]$
"for every forward orientation x, there is exactly one axis y that is parallel to x and that is the observer axis"

b. $\forall x[\mathsf{ori}(x) \land \mathsf{BACK}(x) \to \exists! y[\mathsf{axi}(y) \land x \parallel y \land \mathsf{OBS}(y)]]$
"for every forward orientation x, there is exactly one axis y that is parallel to x and that is the observer axis"

c. $\forall x[\mathsf{ori}(x) \land \mathsf{FORE}(x) \to \exists! y[\mathsf{ori}(y) \land \mathsf{opp}(x,y) \land \mathsf{BACK}(y)]]$
"for every forward orientation x, there is exactly one orientation y that is opposed to x and that is backward"

d. $\forall x[\mathsf{ori}(x) \land \mathsf{BACK}(x) \to \exists! y[\mathsf{ori}(y) \land \mathsf{opp}(x,y) \land \mathsf{FORE}(y)]]$
"for every backward orientation x, there is exactly one orientation y that is opposed to x and that is forward"

The transversal axis is orthogonal to both the vertical axis and the observer axis. We can identify the two orientations on the transversal axis as rightward and leftward. Rightward orientation is opposed to leftward orientation.

(237) a. $\forall x[\mathsf{ori}(x) \land \mathsf{RIGHT}(x) \to \exists! y[\mathsf{axi}(y) \land x \parallel y \land \mathsf{TRANS}(y)]]$
"for every rightward orientation x, there is exactly one axis y that is parallel to x and that is transversal"

b. $\forall x[\mathsf{ori}(x) \wedge \mathsf{LEFT}(x) \rightarrow \exists! y[\mathsf{axi}(y) \wedge x \parallel y \wedge \mathsf{TRANS}(y)]]$
"for every leftward orientation x, there is exactly one axis y that is parallel to x and that is transversal"

c. $\forall x[\mathsf{ori}(x) \wedge \mathsf{RIGHT}(x) \rightarrow \exists! y[\mathsf{ori}(y) \wedge \mathsf{opp}(x,y) \wedge \mathsf{LEFT}(y)]]$
"for every rightward orientation x, there is exactly one orientation y that is opposed to x and that is leftward"

d. $\forall x[\mathsf{ori}(x) \wedge \mathsf{LEFT}(x) \rightarrow \exists! y[\mathsf{ori}(y) \wedge \mathsf{opp}(x,y) \wedge \mathsf{RIGHT}(y)]]$
"for every leftward orientation x, there is exactly one orientation y that is opposed to x and that is rightward"

At least for the vertical and the observer axis, it makes sense to assume a primary orientation; I identify this orientation with the two-place predicate priori. This models Lang's (1990) idea that axes have an inherent direction. For the vertical axis, the upward orientation is primary; and for the observer axis, the forward orientation is primary. For the transversal axis the rightward orientation is primary, which can, at worst, be considered to be a convention.

(238) a. $\forall x[\mathsf{axi}(x) \wedge \mathsf{VERT}(x) \rightarrow \exists! y[\mathsf{ori}(y) \wedge \mathsf{priori}(y,x) \wedge \mathsf{UP}(y)]]$
"for every vertical axis x, there is exactly one orientation y that is primary to x and that is upward"

b. $\forall x[\mathsf{axi}(x) \wedge \mathsf{OBS}(x) \rightarrow \exists! y[\mathsf{ori}(y) \wedge \mathsf{priori}(y,x) \wedge \mathsf{FORE}(y)]]$
"for every observer axis x, there is exactly one orientation y that is primary to x and that is forward"

c. $\forall x[\mathsf{axi}(x) \wedge \mathsf{TRANS}(x) \rightarrow \exists! y[\mathsf{ori}(y) \wedge \mathsf{priori}(y,x) \wedge \mathsf{RIGHT}(y)]]$
"for every transversal axis x, there is exactly one orientation y that is primary to x and that is rightward"

As axes are instances of lines and orientations are instances of directions, we can assume the axioms for points in (224). In addition, we can formulate the axioms (239) for points in PPS, and the axioms in (240) for lines and directions in PPS.

(239) Axioms for **points** (poi) in a PPS:

a. $\forall x,y[\mathsf{axi}(x) \wedge \mathsf{poi}(y) \rightarrow \exists z[\mathsf{lin}(z) \wedge \mathsf{inc}(y,z) \wedge z \parallel x]]$
"for every axis x and every point y, there is a line z such that y is incident with z and z is parallel to x"

b. $\forall x,y[\mathsf{ori}(x) \wedge \mathsf{poi}(y) \rightarrow \exists z[\mathsf{dir}(z) \wedge \mathsf{inc}(y,z) \wedge \mathsf{align}(z,x)]]$
"for every orientation x and every point y, there is a direction z such that y incident with z and z is aligned with x"

c. $\forall x[\mathsf{poi}(x) \rightarrow \exists y,z[\mathsf{pla}(y) \wedge \mathsf{axi}(z) \wedge \mathsf{inc}(x,y) \wedge y \perp \mathsf{VERT}(z)]]$
"for every point x, there is a plane y and an axis z in a PPS such that point x is incident with plane y and plane y is orthogonal to z, which is the vertical axis"
(cf. Kamp and Roßdeutscher 2005: 9,11)

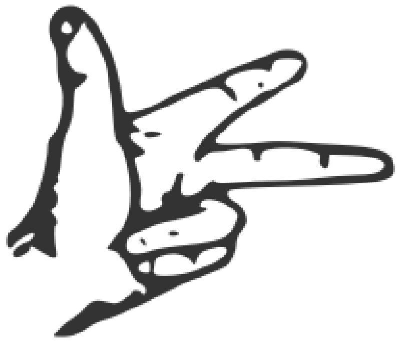


Figure 10: Left-handed coordinate system

(240) Axioms for **lines** (lin) and **directions** (dir) in a PPS:

a. $\forall x[\mathsf{lin}(x) \rightarrow \exists y[\mathsf{axi}(y) \wedge x \parallel y]]$
"for every line x, there is an axis y in a PPS and line x is parallel to axis y"

b. $\forall x[\mathsf{dir}(x) \rightarrow \exists y[\mathsf{ori}(y) \wedge \mathsf{align}(y,x)]]$
"for every direction x, there is an orientation y in a PPS and direction x is aligned with orientation y"

(cf. Kamp and Roßdeutscher 2005: 9)

We can now formally define the PPS. This definition of PPS includes the notion of a point where all orientations, and thus all axes, intersect. This point is typically referred to as the origin o. The location of the origin depends on the perspective-taking strategy of the speaker (cf. Levelt 1996). With a deictic perspective-taking strategy, speakers locate themselves at the origin. That is, the speaker and the observer physically coincide. In contrast, with an intrinsic perspective-taking strategy, speakers locate the reference object at the origin.[70] In that case, the reference object is understood as an 'observer'; that is the speaker takes the perspective as if she were at the position of the reference object.[71]

(241) **Primary Perceptual Space (PPS):**
$\exists! x,y,z[\mathsf{ori}(x) \wedge \mathsf{ori}(y) \wedge \mathsf{ori}(z) \wedge \mathsf{UP}(y) \wedge \mathsf{FORE}(y) \wedge \mathsf{RIGHT}(z)$
$x \perp y \wedge x \perp z \wedge y \perp z \wedge \exists! o[\mathsf{poi}(o) \wedge \mathsf{inc}(o,x) \wedge \mathsf{inc}(o,y) \wedge \mathsf{inc}(o,z)]]$

(cf. Kamp and Roßdeutscher 2005: 10)

The PPS defined (241) can be visualized as a left-handed coordinate system. To do this, take your left hand and form a three-dimensional axial system with your thumb, index finger, and middle finger. Let the thumb point upward, the index finger in your viewing direction, and the middle finger rightward. That gives you a PPS with the center of your left hand as the origin; this is depicted in Figure 10.

[70]Note that an intrinsic perspective-taking strategy is felicitous only if the reference object has an intrinsic front by which one can determine (i) the observer axis and (ii) its orientation.

[71]Note that perspective taking plays a minor part with respect to topological prepositions. With projective prepositions and expressions, however, perspective taking is of major importance in order to be able to determine, e.g., *left* and *right*.

4.3.4 Boundaries of material objects and regions

In general, material objects can be conceived as being delimited or bounded, i.e. as having boundaries in space; or as being undelimited or unbounded, i.e. as having no boundaries in space. In what follows, I focus on material objects that are understood to have boundaries in space.

I follow Kamp and Roßdeutscher (2005: 20) and distinguish between the notion of a skin and the notion of a surface. The **skin** of a two- or three-dimensional material object is that two-dimensional *part of the material object* that literally delimits the object, while the **surface** of a material object is the two-dimensional *region* that its skin occupies. Both skins and surfaces are two-dimensional. Nevertheless, we should distinguish between skins and surfaces of three-dimensional material objects, and between skins and surfaces of two-dimensional material objects.

Skins and surfaces of three-dimensional material objects have the topology of a sphere, i.e. they can be obtained from a sphere under topological transformation (homeomorphism). For any three-dimensional material object, this has the consequence that we can determine its **inside** and its **outside** on the basis of its surface. For this, I use the predicates inside and outside, respectively. Furthermore, any line (segment) that extends from the outside of a material object to its inside (or conversely), passes through the surface of the material object. That is, a line (segment) that goes through one point belonging to the inside of a material object and through one point belonging to its outside will have at least one point in common with the surface of the material object. Note also that the material object occupies its inside region and its surface region. I use the predicate ball-like for surfaces (two-dimensional) of three-dimensional material objects. In contrast, skins and surfaces of two-dimensional material objects have the topology of a disc; i.e. they can be obtained from a disc under topological transformation. In particular, two-dimensional material objects do not have an inside or an outside. They coincide with their skin, ergo they only occupy their surface. I use the predicate disc-like for surfaces (two-dimensional) of two-dimensional material objects. Skins and surfaces can be axiomatized as in (242).

(242) Axioms for **skins** (skin) and **surfaces** (surf):

a. $\forall x[\mathsf{obj}(x) \wedge [\mathsf{2D}(x) \vee \mathsf{3D}(x)] \rightarrow \exists! y[\mathsf{obj}(y) \wedge \mathsf{skin}(y,x)]]$

b. $\forall x,y[\mathsf{skin}(x,y) \rightarrow \mathsf{obj}(x) \wedge \mathsf{obj}(y) \wedge \mathsf{2D}(x)]$

c. $\forall x,y[\mathsf{skin}(x,y) \wedge \mathsf{2D}(y) \rightarrow x = y]$

d. $\forall x,y[\mathsf{surf}(x,y) \leftrightarrow \mathsf{reg}(x) \wedge \exists! z[\mathsf{skin}(z,y) \wedge \mathsf{occ}(z,x)]]$

e. $\forall x,y[\mathsf{surf}(x,y) \wedge \mathsf{3D}(y) \rightarrow \mathsf{ball\text{-}like}(x)]$

f. $\forall x,y[\mathsf{surf}(x,y) \wedge \mathsf{2D}(y) \rightarrow \mathsf{disc\text{-}like}(x)]$

g. $\forall x[\mathsf{ball\text{-}like}(x) \rightarrow$
$\exists! y,z[\mathsf{inside}(y,x) \wedge \mathsf{outside}(z,x) \wedge \neg y \otimes z \wedge \neg x \otimes y \wedge \neg x \otimes z \wedge$
$\forall u,v[\mathsf{reg}(u) \wedge \mathsf{reg}(v) \wedge y \subseteq u \wedge z \subseteq u \wedge x \subseteq u \rightarrow v \subseteq u]]]$

h. $\forall x[\text{disc-like}(x) \rightarrow \neg\exists y,z[\text{inside}(y,x) \wedge \text{outside}(z,x)]]$

(cf. Kamp and Roßdeutscher 2005: 21)

We can further state that the region occupied by a three-dimensional material object is the mereological sum of its ball-like surface region and inside region. In the case of a two-dimensional material object, the occupied region is identical to the surface.

(243) a. $\forall x[\text{ball-like}(x) \rightarrow \exists! y,z,w[\text{obj}(y) \wedge \text{reg}(z) \wedge \text{occ}(y,z) \wedge \text{surf}(x,y) \wedge \text{inside}(w,x) \wedge z = x \oplus_S w]]$

b. $\forall x[\text{disc-like}(x) \rightarrow \exists! y,z[\text{obj}(y) \wedge \text{reg}(z) \wedge \text{occ}(y,z) \wedge \text{surf}(x,y) \wedge z = x]]$

Let me close this section with a note on rims and contours. Bounded two-dimensional material objects have a disc-like surface, and they do not have an inside and outside region. Nevertheless, they have what I call an inner surface. An inner surface is the two-dimensional counterpart to a three-dimensional inside region. The one-dimensional part of a two-dimensional material object that delimits the material object is the **rim**. The one-dimensional region that the rim occupies is the **contour**. In this sense, the relation between rim and contour is similar to the relation between skin and surface. I refer to the part of a disc-like surface that is delimited by the contour as the **inner surface**. Hence, a disc-like surface (two-dimensional) is partitioned into a two-dimensional inner surface and a one-dimensional circle-like, i.e. circular, contour.

4.3.5 Spatial contact

This section addresses the notion of spatial contact, a relation holding between two regions. Two regions have spatial contact with one another iff they touch one another. Intuitively, spatial contact is tantamount to adjacency defined in terms of adjacency structures in (255) below. However, the adjacency relation typically defined in terms of adjacency structures would not straightforwardly cover cases where the regions at issue are curved in such ways that they touch one another at several points. Instead of adjacency, I thus propose a conception of spatial contact that incorporates the idea where two regions have spatial contact with one another in (at least) one point. One way of defining spatial contact is by using the notion of a line segment. In particular, two regions are in contact with one another iff the two regions do not spatially overlap, and there is at least one line segment that has one endpoint in one region and the other endpoint in the other region and all (other) points on the line segment are either in the one region or the other region. That is, no point on the line segment is outside the two regions, or put differently, is not in one of the two regions. Note that points qua zero-dimensional regions can be included in regions. The relation of spatial contact $\propto$ holding between two regions x, y is formalized in (244). Figure 11 diagrams this configuration.

(244) **Spatial contact:**
$\forall x, y[x \asymp y \leftrightarrow \mathsf{reg}(x) \wedge \mathsf{reg}(y) \wedge \neg x \otimes y \wedge$
$\exists z, v, w[\mathsf{lis}(z) \wedge \mathsf{endpoi}(v, z) \wedge \mathsf{endpoi}(w, z) \wedge \neg v \otimes w \wedge v \subseteq x \wedge w \subseteq y \wedge$
$\forall u[\mathsf{poi}(u) \wedge \mathsf{inc}(u, z) \rightarrow u \subseteq x \vee u \subseteq y]]]$
"the regions x, y are in contact with one another iff they do not overlap and there is (at least) one line segment z with the distinct endpoints v, w such that v is included in the region x, and w in the region y, and for every point u that is incident with the line segment z, then u is either included in the region x or in the region y"

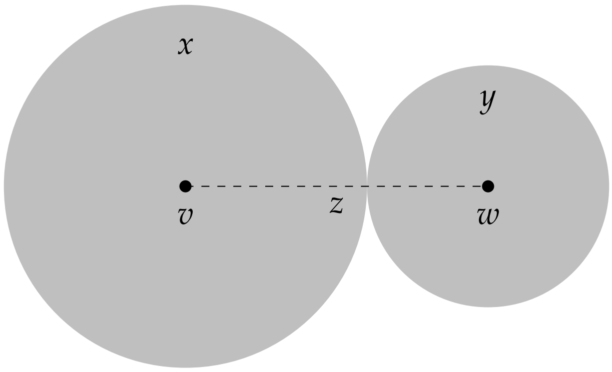


Figure 11: Spatial contact between regions

4.3.6 Conditions on line segments

This section discusses several spatial configurations of line segments that figure in semantic modeling of route prepositions (see Section 5.4.3). In general, I assume that line segments are constitutive of spatial paths (SPs). With regard to SPs denoted by route prepositions, I assume that line segments can 'directly relate' to material objects. Thus, I define several spatial relations between line segments and material objects below. Note that I further assume that SPs are line segments that are elements of an (undirected) path structure H in the sense of Krifka (1998: 203) (see Section 4.4.1). Thus, line segments can be subject to the part relation $\leq$ in the definitions below.

In general, we can identify two types of predicates over line segments. On the one hand, there are predicates according to which all subparts of the line segment must obey what I call a **boundary condition**. These predicates impose an exhaustive condition on a line segment such that one must be able to drop a perpedicular from the boundary of a material object onto every point of the line segment. As for boundary conditions, I define two predicates. The first one relates to the situation where a line segment is completely inside a material object (internal line segment), while the second one relates to the situation where a line segment is completely outside of a material object (external line segment). On the other hand, there are predicates where at least one subpart of the line segment must obey what I call a **configurational condition**. That is, these predicates impose a minimal condition on line segments such that only a subpart of the line segment must obey this condition. As for configurational conditions, I define three predicates. The first one relates to the configuration where at least one subpart of a line segment has a change of direction (L-shaped line segment); the second one relates to the configuration where at least one subpart of a line segment is in a horizontal position above a material object (plumb-square line segment); and the third one relates to the configuration where at least one subpart of a line segment pierces through a material object (spear-like line segment). In the following, I first define internal and external line segments; the type of line segment which must wholly obey the exhaustive boundary condition. Then, I define L-shaped line segments, plump-square line segments, and spear-like line segments; the type of line segment which must only partially obey a configurational condition.

Internal and external line segments

As for boundary conditions, line segments related to material objects must obey two conditions. First, the line segment has to be either completely inside or completely outside the material object. I refer to the former as **internal line segments** of material objects and to the latter as **external line segments** of material objects. Second, for both internal and external line segments of material objects, it must be possible to drop a perpendicular from the boundary of the material object onto every point of the line segment; i.e. from the skin if the material object is three-dimensional, or from the rim if the material object is two-dimensional. That is, every point on the line segment must be such that there is a point on the boundary (surface or contour) of the material object from which one can drop a perpendicular onto this point of the line segment.[72] These considerations are formalized in (245) in terms of the predicate intlis for internal line segments of material objects, and in (246) in terms of the predicate extlis for external line segments of material objects. In fact, the two definitions are identical, except for the question of whether all points z that are incident with the line segment are included in the inside or inner surface v of the material object (245c) or not (246c). An internal line segment x of a material object y is diagrammed in Figure 12, and an external line segment x of a material object y is diagrammed in Figure 13.

(245) $\forall x, y[\mathsf{intlis}(x, y) \leftrightarrow$
"x is an **internal line segment** of y iff"

a. $\mathsf{lis}(x) \wedge \mathsf{obj}(y) \wedge \forall x'[x' \leq x$
"x is a line segment and y a material object and for all $x' \leq x$ "

b. $\rightarrow \exists u, v[[\mathsf{3D}(y) \rightarrow \mathsf{surf}(u, y) \wedge \mathsf{inside}(v, y)] \wedge [\mathsf{2D}(y) \rightarrow \mathsf{cont}(u, y) \wedge \mathsf{insurf}(v, y)]$
"there are u, v such that u is the surface of y and v the inside of y if y is three-

[72] Note that this conception of 'dropping a perpendicular' onto line segments is, in some sense, close to the notion of internally and externally closest boundary vectors discussed by Zwarts (1997), Zwarts and Winter (2000). However, they use these notions for different purposes than I do.

dimensional, or such that u is the contour of y and v the inner surface of y if y is two-dimensional"

c. $\wedge\ \forall z[\mathsf{poi}(z) \wedge \mathsf{inc}(z,x') \rightarrow z \subseteq v$

"and for all points z that are incident with x', z is included in v"

d. $\wedge\ \exists w,p[\mathsf{poi}(w) \wedge \mathsf{lin}(p) \wedge w \subseteq u \wedge \mathsf{inc}(w,p) \wedge \mathsf{inc}(z,p) \wedge p \perp x']]]]]$

"and there is a point w and a line p such that w is included in u and w is incident with p and z is incident with p and p is orthogonal to x' "

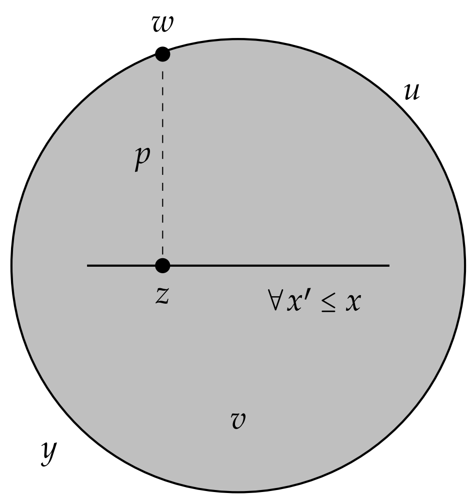


Figure 12: Internal line segment

(246) $\forall x,y[\mathsf{extlis}(x,y) \leftrightarrow$

"x is an **external line segment** of y iff"

a. $\mathsf{lis}(x) \wedge \mathsf{obj}(y) \wedge \forall x'[x' \leq x$

"x is a line segment and y a material object and for all $x' \leq x$ "

b. $\rightarrow\ \exists u,v[[\mathsf{3D}(y) \rightarrow \mathsf{surf}(u,y) \wedge \mathsf{inside}(v,y)] \wedge [\mathsf{2D}(y) \rightarrow \mathsf{cont}(u,y) \wedge \mathsf{insurf}(v,y)]$

"there are u,v such that u is the surface of y and v the inside of y, if y is three-dimensional, or such that u is the contour of y and v the inner surface of y, if y is three-dimensional"

c. $\wedge\ \forall z[\mathsf{poi}(z) \wedge \mathsf{inc}(z,x') \rightarrow \neg z \subseteq v$

"and for all points z that are incident with x', z is not included in v"

d. $\wedge\ \exists w,p[\mathsf{poi}(w) \wedge \mathsf{lin}(p) \wedge w \subseteq u \wedge \mathsf{inc}(w,p) \wedge \mathsf{inc}(z,p) \wedge p \perp x']]]]]$

"and there is a point w and a line p such that w is included in u and w is incident with p and z is incident with p and p is orthogonal to x' "

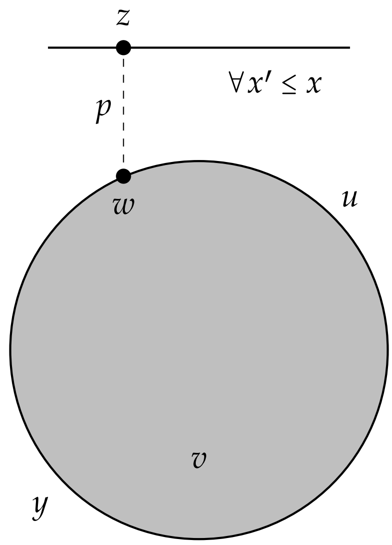


Figure 13: External line segment

L-shaped line segments

A line segment can involve one or more changes of direction. In particular, they can involve dramatic changes in which there is an angle of 90°. Such dramatic changes can be modeled by a succession of two sub-line-segments that are orthogonal to one another and that touch one another at endpoints. I call line segments consisting of two such successive sub-line-segments **L-shaped line segments**. L-shaped line segments figure in the modeling of the German route preposition *um* ('around'). The definition of the predicate L-shaped is given in (247), and a minimal model of an L-shaped line segment is depicted in Figure 14. I consider this to be a configurational condition on line segments.

(247) $\forall x[\mathsf{L\text{-}shaped}(x) \leftrightarrow \mathsf{lis}(x) \wedge \exists x'[x' \leq x$
$\wedge \exists! y, z[\mathsf{lis}(y) \wedge \mathsf{lis}(z) \wedge y \perp z$
$\wedge \exists u, v, w[\mathsf{poi}(u) \wedge \mathsf{poi}(v) \wedge \mathsf{poi}(w) \wedge u \neq v \wedge v \neq w \wedge w \neq u \wedge \mathsf{inc}(w, x') \wedge \mathsf{endpoi}(u, x')$
$\wedge \mathsf{endpoi}(u, y) \wedge \mathsf{endpoi}(v, x') \wedge \mathsf{endpoi}(v, z) \wedge \mathsf{endpoi}(w, y) \wedge \mathsf{endpoi}(w, z)]]]]$
"x is an **L-shaped** line segment iff there is a $x' \leq x$ and there are two line segments y, z that are orthogonal to one another, and y, z each share one endpoint with x' and one with one another, and the endpoint that y, z share is incident with x' "

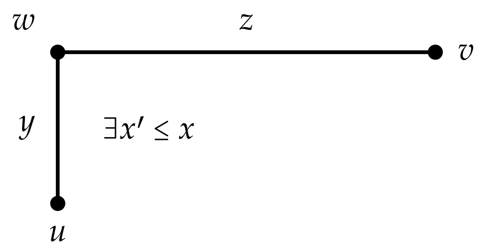


Figure 14: L-shaped line segment

Plumb-square line segments

Line segments can have at least one subpart that is in a horizontal position above a material object, which I consider to be a configurational condition on line segments. This is reminiscent of a plumb square, as depicted in Figure 15 below. We can picture such a **plumb-square line segment** as the horizontal top edge of a plumb square that has a plumb line attached to it. The plumb line is orthogonal to the top edge and has a plumb bob attached to it. The plumb bob represents the material object above which the plumb-square line segment is situated.

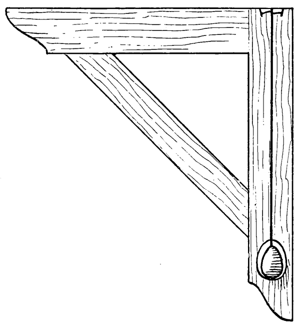


Figure 15: A plumb square from the book *Cassells' Carpentry and Joinery*

Plumb-square line segments above material objects figure in the modeling of the German route preposition *über* ('over, across'). The definition of the predicate plumb-square is given in (248), and a minimal model of a plumb-square line segment is depicted in Figure 16 below.

(248) $\forall x, y[\mathsf{plumb\text{-}square}(x,y) \leftrightarrow \mathsf{lis}(x) \wedge \mathsf{obj}(y) \wedge \exists x'[x' \leq x$
$\wedge \exists z, u, v[\mathsf{dls}(z) \wedge z \perp x' \wedge \mathsf{inipoi}(u,z) \wedge \mathsf{termpoi}(v,z) \wedge \mathsf{inc}(u,x')$
$\wedge \exists w[[\mathsf{3D}(y) \rightarrow \mathsf{surf}(w,y)] \wedge [\mathsf{2D}(y) \rightarrow \mathsf{cont}(w,y)] \wedge v \subseteq w]$
$\wedge \exists a[\mathsf{ori}(a) \wedge \mathsf{DOWN}(a) \wedge \mathsf{align}(z,a)]]]]]$

"x is an **plumb-square** line segment above material object y iff there is a $x' \leq x$, and there is a directed line segment z such that it is orthogonal to x' and that its initial point u is incident with x' and its terminal point v is included in the surface w of a three-dimensional y or with the contour w of a two-dimensional y, and the directed line segment z is aligned with the downward orientation a"

Spear-like line segments

Line segments can have at least one subpart that pierces directly through a material object. I consider this to be a configurational condition on line segments. Such a **spear-like line segment** is reminiscent of a cocktail stick with an olive (the material object) on it, as depicted in Figure 17. Typically, a spear-like line segment is orthogonal to a plane that is a cross section of the material object.

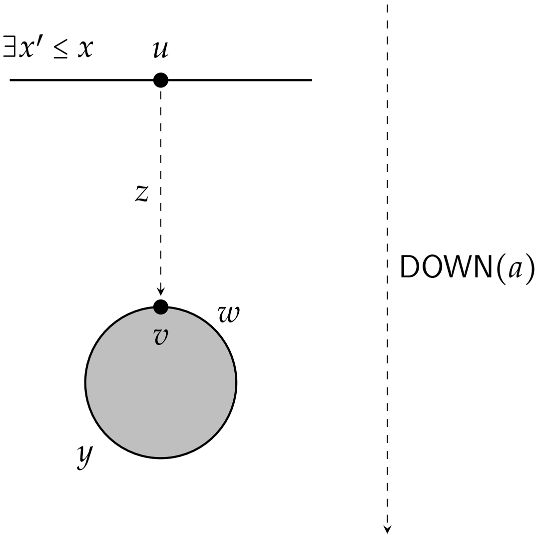


Figure 16: Plumb-square line segment

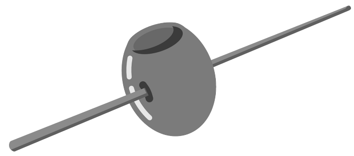


Figure 17: Cocktail stick through olive

Spear-like line segments of material objects figure in the modeling of the German route preposition *durch* ('through'). The definition of the predicate spear-like is given in (249), and a minimal model of a spear-like line segment is depicted in Figure 18 below.

(249) $\forall x, y[\textsf{spear-like}(x, y) \leftrightarrow \textsf{lis}(x) \wedge \textsf{obj}(y) \wedge \exists x'[x' \leq x$
$\wedge \exists z[[\textsf{3D}(y) \rightarrow \textsf{cross-section}(z, y)] \wedge [\textsf{2D}(y) \rightarrow \textsf{insurf}(z, y)] \wedge x' \perp z]]]$
"x is a **spear-like** line segment of material object y iff there is a $x' \leq x$, and there is a z, which is y's cross-section if y is three-dimensional and which is y's inner surface if y is two-dimensional and x' is orthogonal to z"

I assume that the cross section of a three-dimensional material object can be defined, for instance, as the intersection of the region that the material object occupies with a two-dimensional plane. This plane is typically orthogonal (or parallel) to a certain axis of the material object.[73] At this point, however, I refrain from defining cross sections of three-dimensional material objects.

[73]For a discussion of axes of material objects, e.g., in terms of Inherent Proportion Schema, I refer the reader to Lang (1990).

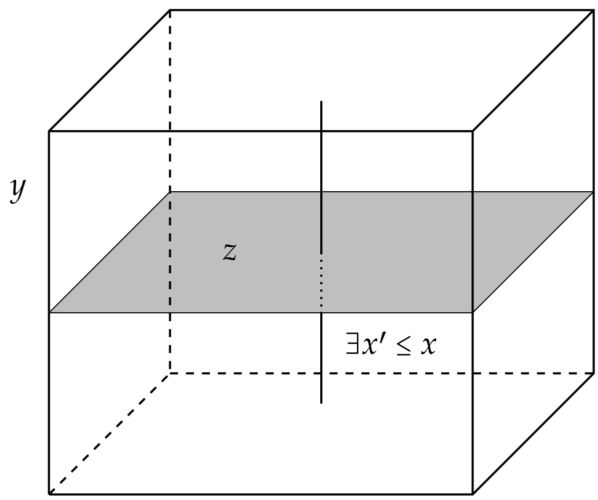


Figure 18: Spear-like line segment

4.4 Algebra

4.4.1 Mereological structures

With regard to mereological structures, I adopt Krifka's (1998) algebra, which I outline in the following. The basic algebraic structure is a **part structure** P, defined in (250).

(250) $P = \langle U_P, \oplus_P, \leq_P, <_P, \otimes_P \rangle$ is a **part structure** iff

a. U_P is a **set of entities**

b. $\oplus_P$, the **sum operation**, is a function from $U_P \times U_P$ to U_P that is idempotent, commutative, and associative, that is:
$\forall x, y, z \in U_P[[x \oplus_P x = x] \wedge [x \oplus_P y = y \oplus_P x] \wedge$
$[x \oplus_P (y \oplus_P z) = (x \oplus_P y) \oplus_P z]]$

c. $\leq_P$, the **part relation**, defined as: $\forall x, y \in U_P[x \leq_p y \leftrightarrow x \oplus_P y = y]$

d. $<_P$, the **proper part relation**, defined as:
$\forall x, y \in U_P[x <_P y \leftrightarrow x \leq_P y \wedge x \neq y]$

e. $\otimes_P$, the **overlap relation**, defined as:
$\forall x, y \in U_P[x \otimes_P y \leftrightarrow \exists z \in U_P[z \leq_P x \wedge z \leq_P y]]$

f. **Remainder principle**:
$\forall x, y \in U_P[x <_P y \rightarrow \exists! z[\neg z \otimes_P x \wedge x \oplus_P z = y]]$

(Krifka 1998: 199)

Follwing Krifka (1998, 2007), Champollion and Krifka (2016), we can define the three types of predicates in (251). A predicate Φ on a part structure P can be **cumulative** (CUM_P), **divisive** (DIV_P), or **quantized** (QUA_P). Typically, cumulativity is called an "upward-looking property" because it looks upward from the part to the sum, while divisivity is called a "downward-looking property" because it looks downward from the sum to the parts (Champollion and Krifka 2016: 525).

(251) a. $\forall\Phi \subseteq U_P[\mathsf{CUM}_P(\Phi) \leftrightarrow \forall x, y \in U_P[\Phi(x) \wedge \Phi(y) \rightarrow \Phi(x \oplus_P y)]]$
"a predicate Φ is **cumulative** if and only if whenever it holds of two things, it also holds of their sum"
(Champollion and Krifka 2016: 524)

b. $\forall\Phi \subseteq U_P[\mathsf{DIV}_P(\Phi) \leftrightarrow \forall x \in U_P[\Phi(x) \rightarrow \forall y \in U_P[y <_P x \rightarrow \Phi(y)]]]$
"a predicate Φ is **divisive** if and only if whenever it holds of something, it also holds of each of its proper parts"
(Champollion and Krifka 2016: 525)

c. $\forall\Phi \subseteq U_P[\mathsf{QUA}_P(\Phi) \leftrightarrow \forall x \in U_P[\Phi(x) \rightarrow \forall y \in U_P[y <_P x \rightarrow \neg\Phi(y)]]$
"a predicate Φ is **quantized** if and only if whenever it holds of something, it does not hold of any of its proper parts"
(Champollion and Krifka 2016: 526)

For example, a predicate like *water* is cumulative because, if both parts x and y each qualify for the predicate *water*, then also their sum $x \oplus_P y$ qualifies for the predicate *water*. In contrast, a predicate like *three liters of water* is non-cumulative because if both parts x and y each qualify for the predicate *three liters of water*, then their sum $x \oplus_P y$ qualifies for the predicate *three liters of water*.

At this point, we should draw attention to extensive measure functions. In general, measure functions relate an empirical relation like *be cooler than*, for physical bodies, to a numerical relation, like *be smaller than*, for numbers (Krifka 1998: 200–201). In addition, extensive measure functions are based on the operation of **concatenation**, which is related to arithmetical addition. I assume that the operation of concatenation is an operation in a static sense, i.e. it does not transform the elements that serve as its input. I further assume that 'concatenation' is a partial binary operation that associates to the pair (x, y) consisting of non-overlapping elements, the unique element $x \oslash y$ – if it exists. The partial binary operation of concatenation can be considered to be a ternary relation, i.e. the set of triples $(x, y, x \oslash y)$. Thus, the extension of the concatenation $\oslash$ is a subset of the extension of the mereological sum $\oplus$. Take two rods x, y. The extensive measure function for centimeter cm yield the length in centimeter for each rod, viz. $\mathsf{cm}(x)$ and $\mathsf{cm}(y)$. The concatenation of the two rods is $x \oslash y$. The measure of the concatenation should, of course, be the numerical sum of the measures of both rods, i.e. $\mathsf{cm}(x \oslash y) = \mathsf{cm}(x) + \mathsf{cm}(y)$. That is, extensive measure functions have the property of additivity, as defined in (252b). Furthermore, extensive measure functions have the property of commensurability, as defined in (252c). This means that the measure of a concatenation is commensurate with the measure of its concatenants.

(252) m is an **extensive measure function** for a set U
with respect to concatenation $\oslash$ iff:

a. m is a function from U to the set of positive real numbers.

b. $\forall x, y \in U[m(x \oslash y) = m(x) + m(y)]$ (additivity)

c. $\forall x,y \in U[m(x) > 0 \wedge \exists z \in U[x = y \owedge z] \rightarrow m(y) > 0]$ (commensurability)
(Krifka 1998: 201)

The concatenation operation over extensive measure functions is commutative ($x \owedge y = y \owedge x$) and associative ($x \owedge (y \owedge z) = (x \owedge y) \owedge z$), but it is not idempotent ($x \owedge x \neq x$). The concatenation operation over extensive measure functions is typically restricted to non-overlapping elements, as stated in (253). As a result, the concatenation operation equals the mereological sum operation for non-overlapping elements.

(253) If $P = \langle U_P, \oplus_P, \leq_P, <_P, \otimes_P \rangle$ is a part structure, and m is an extensive measure function for (subsets of) U with concatenation $\owedge$, then m is an extensive measure function for P iff the following holds:
$\forall x,y \in U_P$, $x \owedge y$ is defined only if $\neg x \otimes_P y$, and if defined, $x \owedge y = x \oplus_P y$
(Krifka 1998: 201)

Further, Krifka (1998: 201) defines a part relation $<_m$ for an extensive measure function m as given in (254). If m is an extensive measure function for a part structure P, then $x <_m y$ implies $x <_P y$.

(254) If m is an extensive measure function with concatenation $\owedge$, then $<_m$, the part relation for m, is defined as follows:
$\forall x,y \in U[x <_m y \leftrightarrow \exists z \in U[y = x \owedge z]]$
(cf. Krifka 1998: 201)

Based on a part structure P, we can define an **adjacency structure** A as given in (255). Adjacent elements do not overlap, and if two elements x and y are adjacent and y is part of a third element z, then is z either also adjacent to x or overlaps with x. The conditions for convex elements states that all convex parts that do not overlap or are adjacent are connected by a convex element.

(255) $A = \langle U_A, \oplus_A, \leq_A, <_A, \otimes_A, \infty_A, C_A \rangle$ is an **adjacency structure** iff

a. $\langle U_A, \oplus_A, \leq_A, <_A, \otimes_A \rangle$ is a part structure

b. ∞_A, **adjacency**, is a two-place relation in U_A such that
   (i) $\forall x,y \in U_A[x \infty_A y \rightarrow \neg x \otimes_A y]$
   (ii) $\forall x,y,z \in U_A[x \infty_A y \wedge y \leq_A z \rightarrow x \infty_A z \vee x \otimes_A z]$

c. $C_A \subseteq U_A$, the set of **convex elements**, is the maximal set such that
$\forall x,y,z \in C_A[y,z \leq_A x \wedge \neg y \otimes_A z \wedge \neg y \infty_A z \rightarrow$
$\exists u \in C_A[u \leq_A x \wedge u \infty_A y \wedge u \infty_A z]]$
(Krifka 1998: 203)

Building on an adjacency structure A, we can define a **path structure** H as defined in (256).[74] The elements of a path structure (the paths) are convex and linear. Condition (256b) ensures uniqueness of subpaths. It says that two disjoint, non-adjacent parts of a path are connected by exactly one subpath, excluding circular and branching paths. Condition (256c) ensures that there is a path between any two locations. It says that each two disjoint, non-adjacent elements are connected by a path.

(256) $H = \langle U_H, \oplus_H, \leq_H, <_H, \otimes_H, \infty_H, C_H, P_H \rangle$ is a **path structure** iff

a. $\langle U_H, \oplus_H, \leq_H, <_H, \otimes_H, \infty_H, C_H \rangle$ is an adjacency structure

b. **Uniqueness of subpaths**: $P_H \subseteq C_H$ is the maximal set such that
$\forall x, y, z \in P_H[y, z \leq_H x \wedge \neg y \otimes_H z \wedge \neg y \infty_H z \rightarrow$
$\exists! u \in P_H[u \leq_H x \wedge y \infty_H u \infty_H z]]$

c. $\forall x, y \in U_H[\neg x \otimes_H y \wedge \neg x \infty_H y \rightarrow \exists z[x \infty_H z \infty_H y]]$

(Krifka 1998: 203)

Following Krifka (1998: 204), I illustrate a path structure with the toy model in Figure 19. For instance, the sum $a \oplus b \oplus c$ is a path, while the sum $a \oplus b \oplus d$ is not a path, because it contains two parts, b and d, that are not connected, which violates uniqueness of subpaths. The sum $a \oplus b \oplus c \oplus j$ also violates uniqueness of subpaths because, both the subpaths b and $b \oplus j$ connect a and c. Note at this point that I model SPs as elements of path structures, as defined in (256). For this, I refer to Section 4.5.

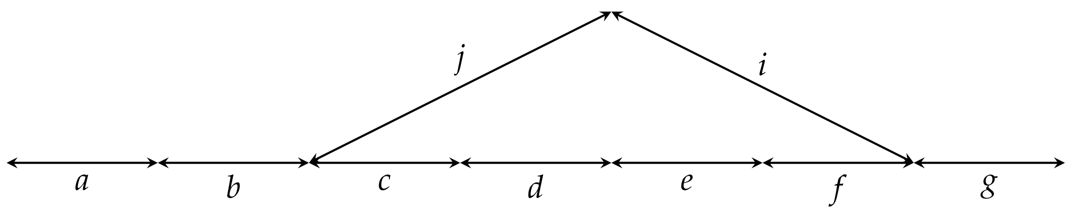


Figure 19: Toy model of (im)possible paths

For some applications of path structures, it is useful to have a concept of **tangentiality** at an endpoint. Tangentiality is defined as the union of external tangentiality (257a) and internal tangentiality (257b). In the model in Figure 19, the paths $a \oplus b$ and $c \oplus d$ are externally tangential, and the paths $a \oplus b \oplus c$ and $b \oplus c$ are internally tangential. However, the paths $b \oplus c$ and j are not tangential.

(257) a. **External tangentiality**:
$\forall x, y \in P_H[\mathsf{ETANG}_H(x, y) \leftrightarrow [[x \oplus_H y] \in P_H \wedge [x \infty_H y]]]$

b. **Internal tangentiality**:
$\forall x, y \in P_H[\mathsf{ITANG}_H(x, y) \leftrightarrow \exists z \in P_H[\neg x \otimes_H z \wedge y = x \oplus_H z]]$

[74] In order to distinguish path structures H, as defined in (256), from directed path structures D, as will be defined in (259), I sometimes refer to path structures H as **undirected** path structures.

c. **Tangentiality:**
$\mathsf{TANG}_H = \mathsf{ETANG}_H \cup \mathsf{ITANG}_H$

(Krifka 1998: 204)

Furthermore, we can identify **one-dimensional part structures** as those for which it holds that any two paths are part of a path. This is given in (258).

(258) A path structure H is called **one-dimensional** iff
$\forall x, y \in P_H \exists z \in P_H[x \leq_H z \wedge y \leq_H z]$

(Krifka 1998: 205)

Unlike a(n) (undirected or plain) path structure H, as defined in (256), a **directed path structure** D, as defined in (259), has a direction induced by the two-place ordering relation of **precedence** "<".[75]

(259) $D = \langle U_D, \oplus_D, \leq_D, <_D, \otimes_D, \infty_D, P_D, C_D, \prec_D, D_D \rangle$ is a **directed path structure** iff

a. $\langle U_D, \oplus_D, \leq_D, <_D, \otimes_D, \infty_D, P_D, C_D \rangle$ is a path structure

b. $D_D \subseteq P_D$, the set of **directed paths**, is the maximal set, and $\prec_D$, **precedence**, is a two-place relation in D_D with the following properties:

(i) $\forall x, y, z \in D_D[[\neg x \prec_D x] \wedge [x \prec_D y \rightarrow \neg y \prec_D x] \wedge$
$[x \prec_D y \wedge y \prec_D z \rightarrow x \prec_D z]]$

(ii) $\forall x, y \in D_D[x \prec_D y \rightarrow \neg x \otimes_D y]$

(iii) $\forall x, y, z \in D_D[x, y \leq_D z \wedge \neg x \otimes_D y \rightarrow x \prec_D y \vee y \prec_D x]$

(iv) $\forall x, y \in D_D[x \prec_D y \rightarrow \exists z \in D_D[x, y \leq_D z]]$

(Krifka 1998: 205)

The precedence relation is irreflexive, asymmetric, and transitive (259b-i), and it holds for non-overlapping elements (259b-ii). Whenever two subpaths of a directed path do not overlap, one must precede the other (259b-iii). And only parts of a directed path can stand in the precedence relation to one another (259b-iv). With (260), we can identify one-dimensional directed path structures as those directed path structures with a total ordering. That is, for each two convex, non-overlapping directed paths x and y, it holds that either x precedes y, or y precedes x.

(260) A directed path structure D is called **one-dimensional** iff
$\forall x, y \in D_D[\neg x \otimes_D y \rightarrow x \prec_D y \vee y \prec_D x]$

(Krifka 1998: 205)

I follow Krifka (1998) and assume a one-dimensional directed path structure D for **time**. That is, a **time structure** T is defined as given in (261). The precedence relation is interpreted as temporal precedence.

[75] Krifka (1998) uses the symbol "≪" for the precedence relation; I use the symbol "<" for it.

(261) A **time structure** T is a one-dimensional directed path structure $\langle U_T, \oplus_T, \leq_T, <_T, \otimes_T, \infty_T, P_T, C_T, \prec_T, D_T \rangle$

(Krifka 1998: 205)

Based on a time structure T, we can now define an **event structure** E as given in (262). It is a directed path structure that additionally involves a time structure. It also involves a temporal trace function τ_E, mapping event to times. We can say that it maps events to their run time, i.e. the time at which an event is happening.[76] Adjacent events are defined as events that are temporally adjacent, as in (262c-ii); and precedence of events is defined in terms of temporal precedence, as in (262c-iii). An event structure contains the set of temporally contiguous events, which shows a homomorphism with respect to the sum operations for events and times (262c-i): the run time of the sum of two events e and e' is the sum of the run time of e and the run time of e'. Temporally contiguous events are events with a contiguous run time (262c-iv), and the set of all events is the closure of the contiguous events under sum formation.

(262) $E = \langle U_E, \oplus_E, \leq_E, <_E, \otimes_E, T_E, \tau_E, \infty_E, \prec_E, C_E \rangle$ is an **event structure** iff

a. $\langle U_E, \oplus_E, \leq_E, <_E, \otimes_E \rangle$ is a part structure

b. T_E is a time structure $\langle U_T, \oplus_T, \leq_T, <_T, \otimes_T, \infty_T, P_T, D_T, \prec_T \rangle$

c. τ_E, the **temporal trace function**, is a function from U_E to U_T;
∞_E, **temporal adjacency**, is a two-place relation in U_E;
$\prec_E$, **temporal precedence**, is a two-place relation in U_E;
C_E, the set of **temporally contiguous events**, is a subset of U_E, with the following properties:

(i) $\forall e, e' \in U_E[\tau_E(e \oplus_E e') = \tau_E(e) \oplus_T \tau_E(e')]$

(ii) $\forall e, e' \in U_E[e \infty_E e' \leftrightarrow \tau_E(e) \infty_T \tau_E(e')]$

(iii) $\forall e, e' \in U_E[e \prec_E e' \leftrightarrow \tau_E(e) \prec_T \tau_E(e')]$

(iv) $\forall e \in C_E[\tau_E(e) \in P_T]$

(v) U_E is the smallest set such that $C_E \subseteq U_E$, and $\forall e, e' \in U_E[[e \oplus_E e'] \in U_E]$.

(Krifka 1998: 206)

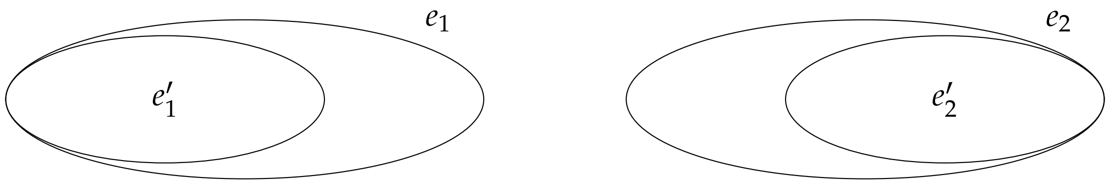
As an event structure includes a time structure, which is a one-dimensional directed path structure (i.e. temporal order), we can define the predicate INI_E for **initial parts** of events in (263a), and the predicate FIN_E for **final parts** of events in (263b). In particular, an event e' is an initial part of an event e if it is a part of e that is not preceded by any other subevent of e. Similarly, an event e' is a final part of an event e if no other subevent of e follows e'. Graphically, this can be illustrated as in Figure 20, where e'_1 is an initial part of e_1, that is $\mathsf{INI}_E(e'_1, e_1)$, and where e'_2 is a final part of e_2, that is $\mathsf{FIN}_E(e'_2, e_2)$.

[76] Note that I use, in the tradition of DRT, the short form "$e \subseteq t$" for "$\tau_E(e) \leq_T t$", meaning that event e is temporally included within time t (Kamp and Reyle 1993: 511).

(263) a. **Initial parts** of an event:
$\forall e, e' \in U_E[\mathsf{INI}_E(e', e) \leftrightarrow e' \leq_E e \land \neg\exists e'' \in U_E[e'' \leq_E e \land e'' <_E e']]$

b. **Final parts** of an event:
$\forall e, e' \in U_E[\mathsf{FIN}_E(e', e) \leftrightarrow e' \leq_E e \land \neg\exists e'' \in U_E[e'' \leq_E e \land e' <_E e'']]$

(Krifka 1998: 207)



20.a: Event e'_1 is an **initial part** of event e_1 20.b: Event e'_2 is a **final part** of event e_2

Figure 20: Initial and final parts of events

Note that the notions of initial and final parts of events figure in the definition of sources and goals of (spatial) paths. The notions of initial and final parts of an event also play a crucial role in Krifka's account of telicity, because he uses them to define telicity as a property of event predicates; see his definition of telic event predicates in (264).[77] In particular, Krifka (1998: 207) characterizes "telicity as the property of the extension of an event predicate *X* that applies to events *e* such that every part of *e* that falls under *X* is both an initial and a final part of *e*."

(264) **Telicity**:
$\forall X \subseteq U_E[\mathsf{TEL}_E(X) \leftrightarrow \forall e, e' \in U_E[X(e) \land X(e') \land e' \leq_E e \rightarrow \mathsf{INI}_E(e', e) \land \mathsf{FIN}_E(e', e)]]$

(Krifka 1998: 207)

Take a quantized predicate such as *eat two apples*. This predicate is telic because if it applies to an event *e* then it does not apply to any proper part of *e*. That is, the only e', such that $e' \leq e$, to which the predicate applies is *e* itself. And thus it is both an initial and final part of *e*. On the other hand, take a cumulative predicate such as *sleep*. This predicate is atelic because it applies to at least two events e, e' that are not contemporaneous, that is, for which there is an e'' with $e'' \leq_E e$ and $e' <_E e''$ (Krifka 1998: 208). Note that this is all that this thesis has to say about telicity in the event domain.

4.4.2 Incremental relations

A basic observation concerning verbs and their arguments is that certain arguments can **measure out** an event (Dowty 1979, 1991, Tenny 1992, Jackendoff 1996, Krifka 1998, Beavers 2012). Dowty (1991) terms arguments measuring out events **incremental themes**. Several types of arguments can serve as incremental themes. For example, in the case of consumption

[77]Note that Beavers (2012: 34–35) proposes a weaker definition of telic event predicates by omitting the INI_E condition, an issue that should not matter here.

verbs such as *eat* (cf. Levin 1993: 213–214), the entities denoted by direct objects serve as incremental themes. Furthermore, in the case of manner of motion verbs such as *run* (cf. Levin 1993: 265–267), the spatial paths (SPs) (see Section 4.5) denoted by PPs serve as incremental themes (Dowty 1991, Tenny 1995, Jackendoff 1996, Krifka 1998, Beavers 2012).

Temporal adverbials of the form *in an hour* and *for an hour* typically serve as a standard test for telicity (Vendler 1957, Verkuyl 1972, Filip 2012). While telic predicates are felicitous with temporal *in*-PP adverbials, atelic predicates are felicitous with temporal *for*-PP adverbials. Consider the examples in (265) containing the consumption verb *eat*. When used intransitively, as in (265a), the predicate is atelic. Without the temporal adverbial, we would not have any information about the boundaries of the eating event. The *for*-PP can provide the temporal boundaries. In contrast, when used transitively with the directed object *the apple*, as in (265b), the predicate is telic. Even without the temporal adverbial, we know the boundaries of the eating event. In particular, we know that the eating event described in (265b) takes place right up to the moment *the apple* is completely eaten. That is, *the apple* measures out the eating event. The *in*-PP provides a temporal measure of the bounded event.

(265) a. John ate for/??in an hour.
b. John ate **the apple** in/?for an hour.

It is crucial to note here that telicity of the event description (265b) depends on the boundedness of the incremental theme. If the incremental theme is unbounded, that is, if it does not have quantized reference, it cannot provide the boundaries for measuring out the event.[78] Bare plurals typically do not have quantized reference. Hence, a clause with a bare plural direct object as in (266) is atelic.

(266) John ate **apples** for/??in an hour.

A parallel story can be told for the manner of motion verb *run* in (267). The difference is, however, that the incremental theme is not an entity like *the apple* but a SP expressed by the two PPs *from the university* and *to the capitol*. When used without a path description as in (267a), the predicate is atelic. Without the temporal adverbial, we would not have any information about the boundaries of the running event. Again, the *for*-PP can provide the temporal boundaries. Opposed to that, when used with a bounded path description as in (267b), the predicate is telic. Even without the temporal adverbial we know the boundaries of the running event. In particular, we know that the running event described in (267b) starts at *the university* and ends at *the capitol*. That is, *from the university to the capitol* measures out the running event. Again, the *in*-PP provides a temporal measure of the bounded event.

(267) a. John ran for/??in an hour.
b. John ran **from the university to the capitol** in/?for an hour.

[78] See Krifka's (1998: 200) definition of quantized predicates in (251c) above.

The boundedness of the path description is relevant for the telicity of the event description. For instance, PPs headed by *towards* are unbounded. That is, the predicate in (268) is atelic.

(268) John ran **towards the sea** for/$^{??}$in an hour.

There are also verbs with two incremental themes. In the literature, they are referred to as cases of **multidimensional measuring-out** (Jackendoff 1996) or **double incremental themes** (Beavers 2012). Consider the examples in (269), involving the verb *flow*. Here, the subject DP describes the entity undergoing movement, i.e. the Figure (cf. Section 4.2), while the PP describes the SP. The observation is that the boundedness of both the Figure and the SP determines the telicity of the predicate. Note that boundedness is indicated by underlining in (269). The Figure can be unbounded like *oil* in (269a)–(269c) or bounded like *a gallon of oil* in (269d)–(269f). In the former case, the Figure-DP has cumulative reference, while it has quantized reference in the latter case. Likewise, the SP can be unbounded like *towards the island* in (269c) and (269e), or bounded like *to the island* in (269c) and (269f). Alternatively, the SP can also be implicit and thus be unbounded, as in (269a) and (269d). Only in the case where both the Figure and the SP are bounded, i.e. (269f), is the predicate telic. In all other cases, i.e. (269a)–(269e), are the predicates atelic.

(269)
a. **Oil** flowed for/$^{??}$in an hour.
b. **Oil** flowed **towards the island** for/$^{??}$in an hour.
c. **Oil** flowed **to the island** for/$^{??}$in an hour.
d. **A gallon of oil** flowed for/$^{??}$in an hour.
e. **A gallon of oil** flowed **towards the island** for/$^{??}$in an hour.
f. **A gallon of oil** flowed **to the island** in/$^{?}$for an hour.

In order to capture the phenomena of incrementality or measuring out discussed above, we can define isomorphic relations based on the part structures defined above. Following Krifka (1998) and Beavers (2012), I assume that these isomorphic relations establish a mapping between events and their arguments. These relations are typically termed **thematic relations** or **θ-relations** (Krifka 1998: 210). The following sections address some θ-relations: (i) Strictly Incremental Relations (SINCs) relations account for incrementality, as seen in the context of verbs such as *eat* in (265)/(266); (ii) Movement Relations (MRs) account for incrementality, as seen in the contexts of verbs such as *run* in (267)/(268); (iii) Figure/Path Relations (FPRs) (Beavers 2009, 2012) account for predicates with double incremental themes, as seen in the context of verbs such as *flow* in (269).

Strictly Incremental Relations

The prototypical case of incremental themes are objects measuring out events; cf. (265)/(266). For this, we can define, following Krifka (1998) and Beavers (2012), **Strictly Incremental Relations (SINCs)** as in (270). SINCs θ-relate events and patients. By isomorphically tying the progress of an event to the extent of an object, the definition of SINCs in (270) formalizes the idea of objects serving as incremental themes that measure out events. SINCs have the property of mapping events to unique subobjects (MUSO) in (270a), and the property of mapping objects to unique subevents (MUSE) in (270b).[79,80]

(270) **Strictly Incremental Relation (SINC):**
Event e is θ-related to patient x such that every unique part of e corresponds to a unique part of x and vice versa, i.e. θ has the MUSO and MUSE properties:

a. **Mapping-to-Unique-Subobjects (MUSO):**
$\forall x \in U_P \forall e, e' \in U_E[\theta(x,e) \wedge e' <_E e \rightarrow \exists! x'[x' <_P x \wedge \theta(x',e')]]$
"For all x θ-related to e, for all $e' < e$ there is a unique θ-related $x' < x$."

b. **Mapping-to-Unique-Subevents (MUSE):**
$\forall x, x' \in U_P \forall e \in U_E[\theta(x,e) \wedge x' <_P x \rightarrow \exists! e'[e' <_E e \wedge \theta(x',e')]]$
"For all e θ-related to x, for all $x' < x$ there is a unique θ-related $e' < e$."

(Beavers 2012: 28)

Graphically, SINCs can be represented as in Figure 21.

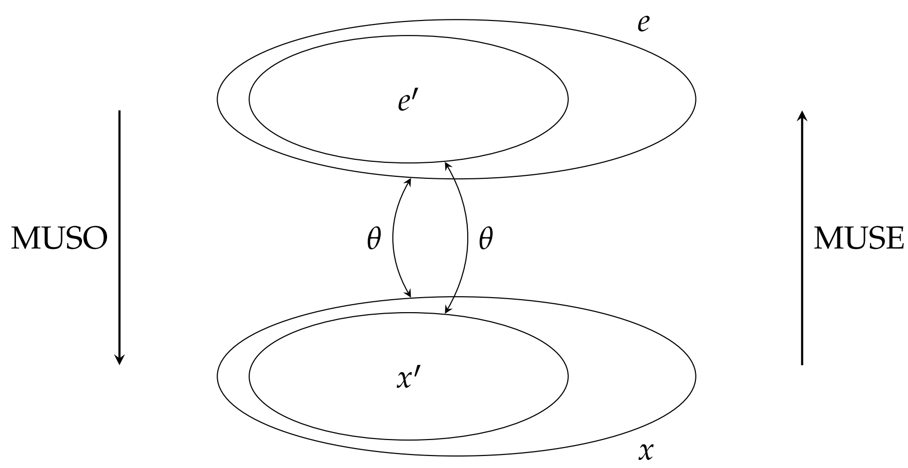


Figure 21: MUSO and MUSE properties of SINC relations

With the notion of SINCs as defined above and with telicity as defined in (264), we can predict the telicity of consumption verbs like *eat* and *drink*. Consumption verbs typically establish

[79]Note that Beavers' (2012: 28) definition of SINCs can be considered to be a condensed version of Krifka's (1998: 210–213) definition of SINCs. In particular, MUSO is a combination of Krifka's (1998: 212) Mapping-to-Subobjects (MSO) and Uniqueness-of-Objects (UO) and MUSE is a combination of Krifka's (1998: 211–212) Mapping-to-Subevents (MSE) and Uniqueness-of-Events (UE).

[80]Note that MUSE has a flaw. Objects can often be decomposed in ways that do not correspond to natural decompositions of events. Consider a pizza where one half is topped with cheese and the other half with pepperoni. Assume you cut the pizza in four pieces such that there are two pieces with cheese and two with pepperoni. The first piece you eat is a piece with cheese. Then you eat the two pieces with pepperoni and finally you eat the last piece, which is the second piece with cheese. The two pieces with cheese together can be considered a legitimate subpart of the pizza, namely the half with cheese. The unique subevent of the event of eating the pizza that corresponds to the half with cheese is a temporally discontinuous event, which is counterintuitive.

SINCs. That is, the event of V-ing is θ-related to the internal argument of V. Consider the clause in (271a) for which the classical telicity tests diagnose a telic predicate. The respective semantic representation (without tense) is given in (271b).[81]

(271) a. Caesar drank two beers in/$^{?}$for two hours.
b. $\lambda e \exists b[\mathsf{drink}(\textsc{caesar}, b, e) \wedge \mathsf{two\text{-}beers}(b)]$

(Beavers 2012: 29)

The event e and the internal argument b are θ-related. That is, for any event e of drinking two beers b, any non-initial or non-final subevent $e' < e$ is an event of drinking some $b' < b$. The predicate *two beers* has quantized reference, which means that no $b' < b$ qualifies for the predicate. This means that no e' qualifies for (271b). Basically, every $e' < e$ is only an event of drinking less than two beers. This satisfies the telicity property in (264), and thus the clause is predicted to be telic. Consider, in contrast, the clause in (272a), for which the classical telicity tests diagnose an atelic predicate. The respective semantic representation is given in (272b).

(272) a. Caesar drank beer for/$^{??}$in two hours.
b. $\lambda e \exists b[\mathsf{drink}(\textsc{caesar}, b, e) \wedge \mathsf{beer}(b)]$

(Beavers 2012: 29)

Again, the event e and the internal argument b are θ-related. That is, for any event e of drinking beer b, any non-initial or non-final subevent $e' < e$ is also an event of drinking some $b' < b$. In this case, the predicate *beer* does not have quantized reference, because any $b' < b$ still qualifies for the predicate. This means that $e' < e$ qualifies for (272b). Every $e' < e$ is also an event of drinking beer. This does not satisfy the telicity property in (264), and thus the clause is predicted to be atelic.

Movement Relations

Movement along SPs (see Section 4.5) is also an instance of incrementality (Tenny 1995, Jackendoff 1996) for which we can establish a thematic relation. Following Krifka (1998) and Beavers (2012), we can define **Strict Movement Relations (SMRs)** in (273). Like SINCs, SMRs formalize the idea of measuring out. SMRs have the adjacency property (ADJ) formalized in (273a). It states that for all θ-related e and x, temporal adjacency of all subevents $e', e'' < e$ is preserved in spatial adjacency for the respective θ-related subpaths $x', x'' < x$. Furthermore, SMRs have the property of mapping events to objects (MO) formalized in (273b). SMRs

[81] Note that the representations in (271b) and (272b) ignore the Voice Hypothesis (Kratzer 1996) according to which the external argument – *Caesar* in this case – relates to the verb via a separate predicate, typically agent. Nevertheless, for the point made here, this does not matter.

also have the property that movement happens along connected paths (MCP) formalized in (273c).[82]

(273) **Strict Movement Relation (SMR):**
Event e is θ-related to path x such that every unique part of e is θ-related to a unique part of x and vice versa and temporally adjacency in e corresponds to spatial adjacency in x and vice versa, i.e. θ has the ADJ, MO, and MCP properties:

a. **Adjacency (ADJ):**
$\forall x, x', x'' \in P_H \forall e, e', e'' \in U_E[\theta(x,e) \wedge e', e'' \leq_E e \wedge x', x'' \leq_H x \wedge \theta(x', e') \wedge \theta(x'', e'') \rightarrow [e' \infty_E e'' \leftrightarrow x' \infty_H x'']]$
"For θ-related e and x, for any $x', x'' \leq x$ θ-related to $e', e'' \leq e$ respectively, x' is spatially adjacent to x'' iff e' is temporally adjacent e''."

b. **Mapping-to-Objects (MO):**
$\forall x \in U_P \forall e, e' \in U_E[\theta(x,e) \wedge e' \leq_E e \rightarrow \exists x'[x' \leq_P x \wedge \theta(x', e')]]$
"For all θ-related e and x, for all $e' < e$ there is a θ-related $x' < x$."

c. **Movement along Connected Paths (MCP)**:
$\forall x \in U_H \forall e \in U_E[\theta(x,e) \rightarrow x \in P_H]$
"For all x θ-related to e, x is part of a connected path structure."

(Beavers 2012: 30)

Let us now look at an example of an SMR. Consider the examples (274a) and (274b), which both involve the verb *hike*. When occurring without an explicit path description, as in (274a), the predicate is atelic. In contrast, when occurring with a bounded path description as in (274a), the predicate is telic.

(274) a. Mary hiked for/*in a day.
b. Mary hiked the Vernal Falls Path in/*for a day.

(adopted from Krifka 1998: 224)

The definition of SMRs in (273) is too strict for a general account of movements. In general, movements involve a range of continuous movements dubbed **funny movements** (Krifka 1998: 225) that are excluded by (273). In order to illustrate some funny movements, consider again the toy model of paths in Figure 19, repeated here as Figure 22.
Assume that $e_m \infty_E e_n$ and $e_m \prec_E e_n$ for all $n = m + 1$, that is, we have a series of adjacent events that precede one another (here: $e_1, e_2, e_3, ...$). SMRs exclude movements with stops. In (275a), for instance, the two paths c, d are θ-related to non-adjacent e_3, e_5. This violates the ADJ property of SMRs. Likewise, SMRs exclude circular movements. In (275b), the paths j, c are adjacent, but not the θ-related event e_1, e_6. This, again, violates the ADJ property of

[82] Here, a terminological note is in order. Beavers (2012) abbreviates 'Movement along Connected Paths' with CP. By abbreviating 'Movement along Connected Paths' with MCP, I deviate from Beavers' convention. The reason is simply to avoid confusion with the syntactic abbreviation CP for complementizer phrase.

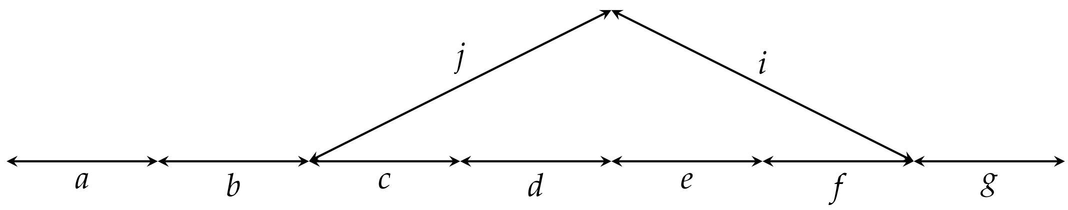


Figure 22: Toy model of (im)possible paths (repeated from Figure 19)

SMRs. Moreover, SMRs exclude movements with backups. In (275c), the events e_3, e_4 are not θ-related to two adjacent paths, but to the same path. Telekinesis is generally disallowed. In (275d), the two adjacent events e_2, e_3 θ-relate to the paths b, e that are not adjacent.

(275) a. Movements with stops (stop-n-go movements):
e.g. $\langle a, e_1\rangle, \langle b, e_2\rangle, \langle c, e_3\rangle, \langle d, e_5\rangle, \langle e, e_6\rangle, \langle f, e_7\rangle$

b. Circular movements (Alcatraz movements):
e.g. $\langle c, e_1\rangle, \langle d, e_2\rangle, \langle e, e_3\rangle, \langle f, e_4\rangle, \langle i, e_5\rangle, \langle j, e_6\rangle,$

c. Movements with backups (Echternach movements):
e.g. $\langle a, e_1\rangle, \langle b, e_2\rangle, \langle c, e_3\rangle, \langle c, e_4\rangle, \langle b, e_5\rangle$

d. *Telekinesis:
e.g. $\langle a, e_1\rangle, \langle b, e_2\rangle, \langle e, e_3\rangle, \langle f, e_4\rangle$

In order to account for funny movements of the types in (275a) to (275c) – while prohibiting telekinesis in (275d), where the moving entity would be beamed in a futurist Star-Trek manner – we can define **Movement Relations (MRs)** in (276). Essentially, an MR θ is the smallest relation that embeds an SMR, and for any two events $e <_E e'$ MR-related to tangential x, x', respectively, $e \oplus_E e'$ is MR-related to $x \oplus_H x'$. The condition in (276b) guarantees that movements are continuous. That is, any two successive movements are such that "the second movement must begin where the first movement ends" (Krifka 1998: 225).

(276) **Movement Relation (MR)**:
θ is the smallest relation that embeds an SMR and for any two events $e <_E e'$ MR-related to tangential or identical paths x, x' respectively, $e \oplus_E e'$ is MR-related to $x \oplus_H x'$, i.e.

a. There is a SMR θ', and $\theta' \subseteq \theta$

b. $\forall x, x' \in U_H \forall e, e' \in U_E[\theta(x,e) \wedge \theta(x',e') \wedge e <_E e' \wedge \forall e'', e''' \in U_E \forall x'', x''' \in U_H$
$[\mathsf{FIN}_E(e'', e) \wedge \mathsf{INI}_E(e''', e') \wedge \theta(e'', x'') \wedge \theta(e''', x''') \rightarrow \mathsf{TANG}_H(x'', x''')]$
$\rightarrow \theta(x \oplus_H x', e \oplus_E e')]$

(Beavers 2012: 32)

Figure/Path Relations

Let us now briefly turn to the cases of **double incremental themes** in (269), where both the boundedness of the Figure, which moves along a spatial path, and the boundedness of the spatial path (SP), along which the Figure moves, determine the telicity of the predicate (cf. Section 4.5 for SPs). Examples are given in (277) and (278), where boundedness is indicated by underlining. The observation is that the predicate is telic only in the case where both the Figure and the SP are bounded. Consider (277). The Figure can be bounded as in (277a) and (277c) or unbounded as in (277b) and (277d). In particular, it is bounded if the DP has quantized reference and it is unbounded if the DP has cumulative reference. In (277a) and (277b), the SP is bounded (see Section 4.6 on boundedness of SPs). In (277c) and (277d), the SP is implicit and thus unbounded.

(277) a. **The liter of wine** flowed **onto the floor** in/$^{?}$for one minute.
b. **Wine** flowed **onto the floor** for/$^{??}$in one minute.
c. **The liter of wine** flowed for/$^{??}$in one minute.
d. **Wine** flowed for/$^{??}$in one minute.

(Beavers 2012: 39, 43)

The examples in (278), where *a book*/*books* serve as Figures and *off the shelf* as the SP, are parallel to the examples in (277). The difference is that the Figure in (277) occurs as the subject of the intransitive verb *flow*, while the Figure in (278) occurs as the direct object of the transitive verb *shake*.

(278) a. The earthquake shook **a book** **off the shelf** in/$^{?}$for a few seconds.
b. The earthquake shook **books** **off the shelf** for/$^{??}$in a few seconds.
c. The earthquake shook **a book** for/$^{??}$in a few seconds.
d. The earthquake shook **books** for/$^{??}$in a few seconds.

(Beavers 2012: 25)

In order to account for this, Beavers (2012) proposes ternary θ-relations that allow for double, interdependent incremental themes. Beavers terms these ternary θ-relations **Figure/Path Relations (FPRs)**. In particular, he (2012: 37) proposes

> [...] that motion is an inherently three-place, mutually constraining relation between a Figure x, a [spatial] path p, and an event e, where the motion event can be decomposed into a series of motion subevents, each of which corresponds to some part of x moving on some part of p via a MR and ending up at the goal of p in e.

Beavers (2012) defines FPRs as given in (279).[83,84]

(279) **Figure/Path Relation (FPR):**
θ is the smallest relation where if $\theta(x, p, e)$ then for each $x_i \leq x$ $(1 \leq i \leq n)$ there is a unique pair $e_i \leq e$ and $p_i \leq p$ where:

a. e_i stands in a non-minimal MR to p_i;
b. the goal of p_i in e_i is the goal of p in e;
c. for all such e_i and p_i, $e = \sum_{i=1}^{n} e_i$ and $p = \sum_{i=1}^{n} p_i$.

(Beavers 2012: 38)

In this thesis, I follow Beavers (2012) in assuming that motion predicates are typically FPRs, i.e. three-place, mutually-constraining relations between a Figure, a SP, and an event. FPRs decompose an event e in two dimensions: (i) a dimension determined by the Figure x and (ii) a dimension determined by the SP p. This can be graphically represented as illustrated in Figure 23.

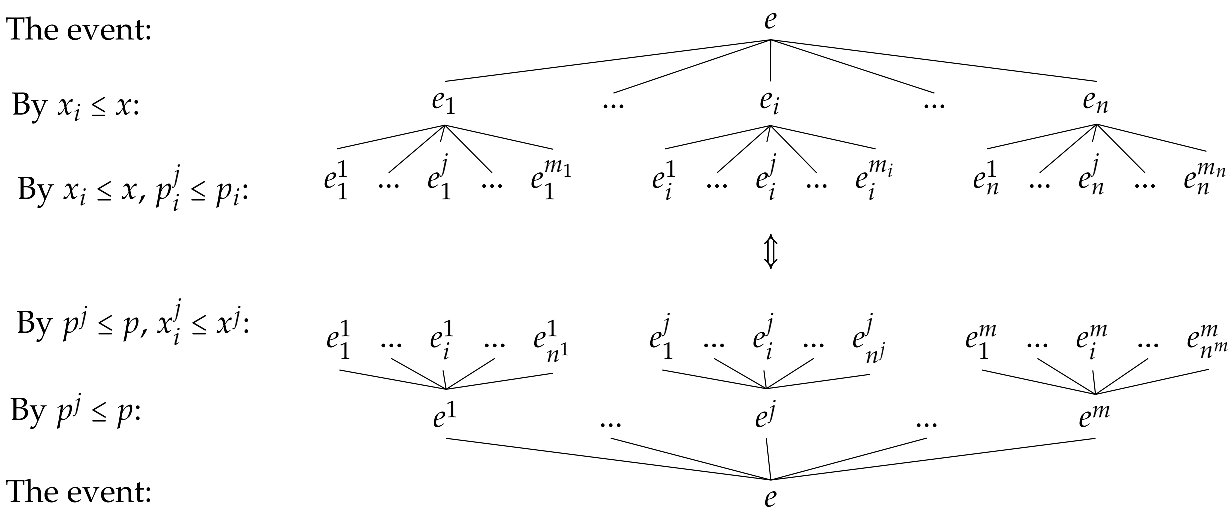


Figure 23: Figure/Path Relation (Beavers 2012: 42)

Note at this point that my analyses of prepositions denoting SPs are straightforwardly compatible with Beavers' theory of Figure/Path Relations. However, they do not hinge on it.

4.5 Spatial paths

This section addresses spatial paths (SPs). Generally, SPs are one-dimensional line segments. As described above in the context of algebraic structures and in particular in the context of Figure/Path Relation, SPs can serve as semantic arguments of motion predicates. When they are, SPs are also referred to as motion paths.

[83] Note that Beavers (2012: 33) assumes that movement with backtracking to the source is generally possible. This requires that e_i stands in a non-minimal MR to p_i. An MR θ between event e and path p is minimal iff the goal x on p in e is mapped to only one subevent of e.

[84] With regard to the notion of 'goal', I refer the reader to the respective discussion in Section 4.5.

Regarding the conceptualization of SPs, we find two basic kinds of approaches.[85] On the one hand, **axiomatic approaches** take SPs as primitives (Piñón 1993, Krifka 1998, Eschenbach et al. 2000, Beavers 2012). In axiomatic approaches in the spirit of Krifka (1998) and Beavers (2012), SPs are typically elements of an undirected path structure *H* (Krifka 1998: 204). This means that SPs do not have an inherent direction. Without an inherent direction, however, both 'ends' of a SP are tails tantamount to one another. That is, if we look at the two tails, then we cannot say which one corresponds to the starting point (source), and which one to the end point (goal) of the SP. Therefore, sources and goals are not inherently identifiable on SPs when they are assumed to be elements of an undirected path structure. Sources and goals are identifiable only when SPs are mapped to events (Krifka 1998, Beavers 2012). Unlike an undirected path structure *H*, an event structure *E* (Krifka 1998: 206) provides a direction because it involves a time structure *T* (Krifka 1998: 205), which instantiates a directed path structure *D* (Krifka 1998: 205). Spatial paths and are mapped to events in terms of a (strict) movement relation θ, as defined in (273)/(276). That is, the direction of an event structure imposes a direction on SPs by means of a θ-relation. From this direction imposed by a θ-relation, we can derive source and goal as thematic roles. In particular, we can say that those parts of SPs that relate to initial parts of events correspond to sources, and those parts of SPs that correspond to final parts of events correspond to goals. Put differently, a source is where movement begins, and a goal is where movement ends. Thus, in an axiomatic approach, source and goal are thematic roles derived by θ-related mapping of SPs to event structure.

On the other side, **constructive approaches** take SPs as constructed objects; either as nested sets or sequences of locations (Bierwisch 1988, Verkuyl and Zwarts 1992), or as functions from some ordered domain to locations (Cresswell 1978, Zwarts 2005b). In constructive approaches, SPs typically do have an inherent ordering from which sources and goals can be derived independently from event structure. For example, Zwarts (2005b: 748) defines SPs as "continuous functions from the real unit interval $[0, 1]$ (the 'indices') to positions in some model of space.[86] The relation between paths and positions is straightforward: the starting point of path p is $p(0)$, the end point is $p(1)$ and for any $i \in [0, 1]$ $p(i)$ is the corresponding point of the path." Under this view, "'source' and 'goal' are not thematic roles, but extremities of paths ($p(0)$ and $p(1)$, respectively) that only play a role PP-internally" (Zwarts 2005b: 758). Motivating a constructive approach to SPs, Zwarts (2005b: 748) claims that constructive approaches have the "advantage of making the relation between paths and places maximally explicit and of being closer to our geometric intuitions." With respect to geometry, Zwarts' constructive approach relies on his vector space model (Zwarts 1997, 2003b, 2004, Zwarts and Winter 2000) through which the respective positions in space, which the indices are mapped to, can be described. That is, SPs are sequences of points in space that can be described by vectors; or, SPs are series of vectors.

[85] I adopt the terms 'axiomatic approach' and 'constructive approach' from Zwarts (2005b: 748).

[86] Note that some parts of this discussion on spatial paths are repeated from the beginning of Section 4.3.

In this thesis, I advocate an axiomatic approach to SPs in the spirit of Krifka (1998) and Beavers (2012). I do this for two reasons, which I will briefly present in the following.

First, on a constructive approach to SPs, there is a flaw in the modeling of route prepositions (cf. Section 5.4.3) like *over* or *through*. In particular, constructive approaches do not inherently preclude kinked SPs, i.e. SPs that are not rectilinear. Applying a vector space model, Zwarts (2005b: 748) argues that constructive approaches can make spatial relations maximally explicit. However, I think that constructive approaches are too explicit, as they basically allow natural language descriptions to express SPs with shapes of any kind. Consider the examples in (280).

(280) a. John jumped over the fence.
b. John walked over the bridge.

Under an off-the-shelf constructed approach without further geometric rectilinearity constraints on SPs (e.g. Zwarts 2005b), the semantic representations of (280) do not exclude the interpretations where John does not cross the fence or the bridge, respectively. On the telic reading of these clauses,[87] it is entailed that John arrived at the other side of the fence/bridge; that is, the side where he arrived was not the one from which here started. Let us now consider Zwarts' definition of *over* as represented by the denotation of *over the fence* in (281).

(281) ⟦ over the fence ⟧ = $\{p:$ there is an interval $I \subset [0,1]$ that includes neither 0 nor 1 and that consists of all the $i \in [0,1]$ for which $p(i)$ is on/above the fence$\}$

(Zwarts 2005b: 763)

This definition correctly predicts that the source $p(0)$ and the goal $p(1)$ of paths denoted by *over the fence* are not on/above the fence, while continuous intermediate points $p(i)$ are on/above the fence. However, it does not predict that the source and the goal must be on different sides of the fence. (281) also allows situations where the SP starts on one side outside of the on/above-region of the fence, then goes into the on/above-region of the fence, and finally goes back to the very same side outside of the on/above-region of the fence where the path started. However, such kinked paths are not entailed by *over the fence*. The reason for this is that SPs qua sequences of locations are not restricted to rectilinear SPs in constructive approaches. A sequence of locations could be rectilinear, of course, but it could be also serpentine, spiral, dihedrally snapped, etc. Within an axiomatic approach, this problem need not arise, because SPs are typically represented as rectilinear line segments that function as minimal models of SPs as they are typically represented by underived motion

[87] Typically, route prepositions are ambiguous between a telic and an atelic reading. In line with Zwarts (2005b), I assume that the telic reading is basic, and the atelic reading is somehow derived. (280a) is naturally telic due to the achievement predicate *jump*. For (280b), however, both interpretations are possible. For the argument here, only the telic interpretation is relevant.

verbs combining with PPs. Such descriptions minimally commit to rectilinear line segments, or at most to orthogonally related ones.

Second, axiomatic approaches to SPs are (representationally) more economic insofar as they typically do not need extra-linguistic means in order to determine the direction of SPs. Consider, for example, the constructive approach by (Zwarts 2005b). In order to determine the direction of SPs, Zwarts incorporates the mathematical concept of the real unit interval into the theory. In particular, he (2005b: 748) defines SPs as functions from the real unit interval to positions in some model of space. That is, Zwarts' approach to SPs hinges on an additional non-linguistic concept, i.e. the real unit interval. In contrast, axiomatic approaches to SPs are more economic in this regard, because they do not need an extra-linguistic concept, such as the real unit interval, to determine the direction of SPs. Here, the direction is typically determined by θ-related mapping to event structure. Such a mapping of SPs to event structure in terms of a Movement Relation is needed independently from determining the direction of SPs, namely for the determination of lexical aspect (cf. Section 4.4.2).

After having argued for an axiomatic approach to SPs, I now define SPs. In (282), I define a SP as a one-dimensional, fundamentally rectilinear line segment that is an element of an undirected path structure H (Krifka 1998: 203); cf. also (256)

(282) **Spatial Path (SP):**
A SP is a one-dimensional, fundamentally rectilinear line segment that is element of a undirected path structure H (Krifka 1998: 203); cf. also (256)

Typically, path prepositions commit to SPs that are conceptualized as rectilinear line segments. However, the route preposition *um* ('around') apparently denotes SPs that are conceptualized as a non-rectilinear line segment.[88] In Section 5.3.2, I define SPs denoted by *um* as a minimal change of direction, to the effect that the core of an *um*-path are two rectilinear line segments that are orthogonal to one another at endpoints, i.e. that form a L-shaped right-angled SP. In that sense, SPs denoted by *um* can still be considered as fundamentally rectilinear.

Let us now look at the **concatenation of SPs**. In line with Zwarts (2005b), Habel (1989), and Nam (1995), I assume that concatenation is a natural sum operation over SPs. The motivation for assuming concatenation as the sum operation over SPs, instead of plain mereological sum formation, is that the former, but not the latter, preserves additivity and commensurability of extensive measure functions. I assume that the concatenation operation $\circledcirc$, as defined over extensive measure functions in (252) and (253), straightforwardly applies to SPs (Krifka 1998: 201). If two SPs x, y are concatenated and thereby form the complex SP z (i.e. $x \circledcirc y = z$), then x, y – the concatenants (Zwarts 2005b: 750) – are subpaths of z – the concatenation. Note that this definition of concatenation of SPs contrasts to the one by Zwarts

[88]Note at this point that the English preposition *around* involves the configurational element 'round'. Thus, it might be analyzed differently from German.

(2005b). As he pursues a constructive approach taking SPs as functions from the real unit interval to positions in space, Zwarts (2005b: 775) defines the concatenation of two SPs as head-to-tail connection where the endpoint of one concatenant equals the starting point of the other concatenant. That is, if the two SPs p, q are concatenated, then $p(1)$ equals $q(0)$.

Let us now look at **sources** and **goals** in two different axiomatic approaches to SPs. Recall from the initial part of this section that there is a fundamental difference with regard to sources and goals between axiomatic approaches to SPs, on the one hand, and constructive approaches to SPs, on the other. Constructive approaches typically conceive sources and goals as inherent extremities of SPs that are determined, for instance, by means of auxiliaries such as the real unit interval (Zwarts 2005b: 758), while axiomatic approaches typically conceive sources and goals as thematic roles that are determined by mapping to event structure (Krifka 1998, Beavers 2012). In particular, sources are those locations that are mapped to initial subevents, and goals are those locations that are mapped to final subevents. Even though both authors pursue axiomatic approaches to SPs, Krifka's and Beavers' modeling of sources and goals differ in one essential point. On the one hand, Krifka assumes that sources and goals are not part of SPs but adjacent to them, while, on the other hand, Beavers assumes that sources and goals are proper parts of SPs. Both Krifka and Beavers assume that SPs correspond to elements of a path structure H (Krifka 1998: 204). However, plain path structures H are undirected, and thus SPs do not have an inherent direction. That is, we cannot tell which end of a SP is its source and which one its goal. In contrast to an undirected path structure H, an event structure E (Krifka 1998: 206) is directed because it comprises a time structure T (Krifka 1998: 205), which itself instantiates a directed path structure D (Krifka 1998: 205). Hence, SPs obtain their direction by mapping to event structure. Krifka (1998: 227–228) defines sources as those locations that are not part of SPs, but that are adjacent to the beginning of a SP, i.e. that part of a SP that is θ-related to an initial part of an event; and goals as those locations that are not part of a SP, but that are adjacent to the end of a SP, i.e. that part of a SP that is θ-related to a final part of an event. In other words, for Krifka sources and goals are adjacent to SPs, i.e. they are **at** the boundaries of SPs. Krifka (1998: 227–228) defines the predicates SOURCE and GOAL as given in (283), where x is the source/goal at SP w in event e. These definitions are diagrammed in Figure 24.

(283) If θ is a (Strict) Movement Relation for SP w and event e, then

a. $\forall e, w, x[\mathsf{SOURCE}(x, w, e) \leftrightarrow [\neg x \leq_H w \wedge \forall e', w'[w' \leq_H w \wedge e' \leq_E e \wedge \theta(w', e') \rightarrow [[\mathsf{INI}_E(e', e) \rightarrow w' \infty_H x] \wedge [\neg \mathsf{INI}_E(e', e) \rightarrow \neg w' \infty_H x]]]]]$

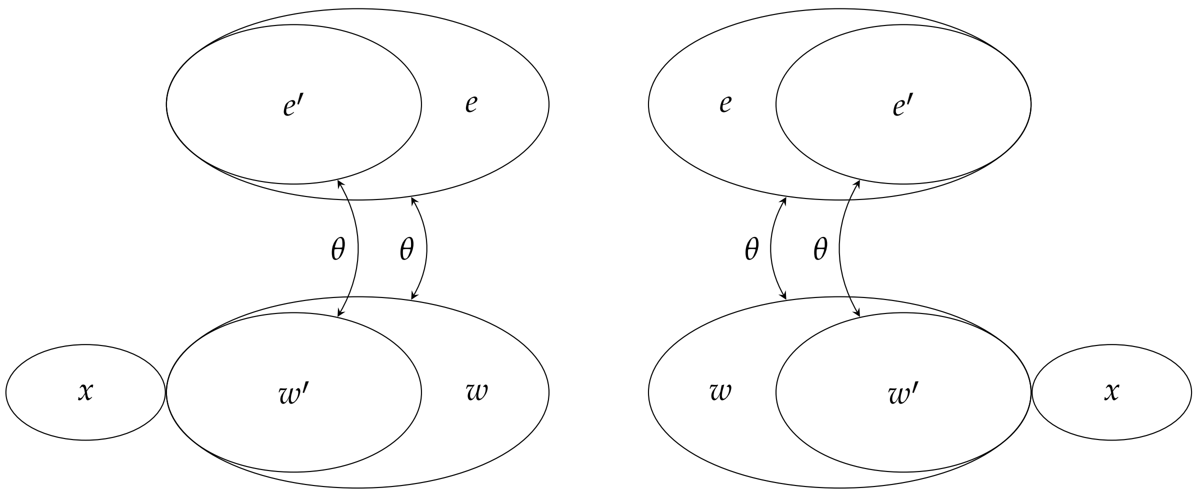
"x is the **source at** w in e iff x is not a subpath of w but adjacent to a subpath $w' \leq w$ that is θ-related to an initial subevent $e' \leq e$"

b. $\forall e, w, x[\mathsf{GOAL}(x, w, e) \leftrightarrow [\neg x \leq_H w \wedge \forall e', w'[w' \leq_H w \wedge e' \leq_E e \wedge \theta(w', e') \rightarrow [[\mathsf{FIN}_E(e', e) \rightarrow w' \infty_H x] \wedge [\neg \mathsf{FIN}_E(e', e) \rightarrow \neg w' \infty_H x]]]]]$

"x is the **goal at** w in e iff x is not a subpath of w but adjacent to a subpath $w' \leq w$

that is θ-related to a final subevent $e' \leq e$"

(cf. Krifka 1998: 227–228)



24.a: "x is the **source at** w in e" 24.b: "x is the **goal at** w in e"

Figure 24: Source and goal à la Krifka (1998: 227–228)

In contrast to Krifka (1998), Beavers (2012: 30) defines sources as those locations that correspond to the parts of SPs that are θ-related to initial parts of events, and goals as those locations that correspond to the parts of SP that are θ-related to final parts of events. In other words, for Beavers source and goal are **on** (or contained in) SPs. Beavers (2012: 30) defines the predicates SOURCE and GOAL as given in (284), where x is the source/goal on path w in event e. These definitions are diagrammed in Figure 25.

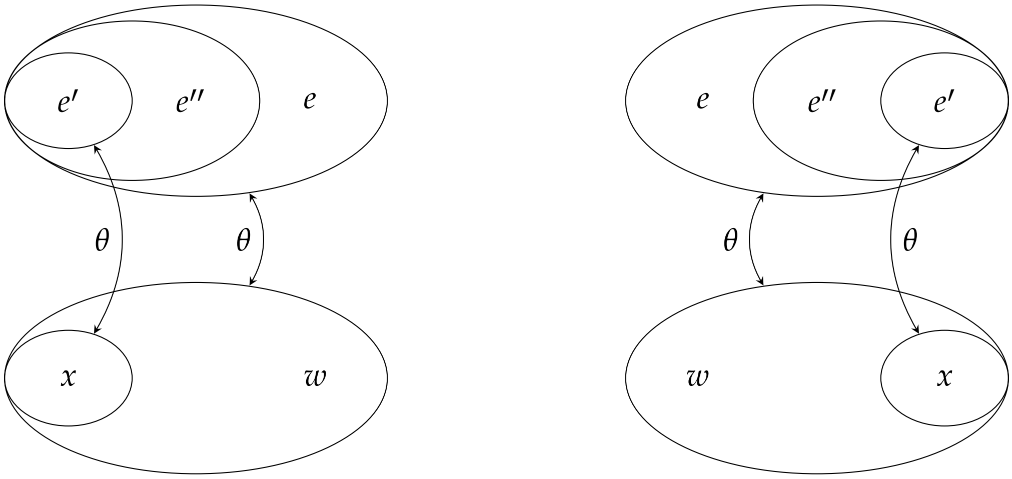
(284) If θ is an (Strict) Movement Relation for path w and event e, then

a. $\forall e, w, x[\mathsf{SOURCE}(x, w, e) \leftrightarrow [x \leq_H w \wedge \exists e' \forall e''[[\mathsf{INI}_E(e'', e) \rightarrow e' \leq_E e''] \wedge \theta(e', x)]]]$
"x is the **source on** w in e iff x is θ-related to smallest initial $e' \leq e$."

b. $\forall e, w, x[\mathsf{GOAL}(x, w, e) \leftrightarrow [x \leq_H w \wedge \exists e' \forall e''[[\mathsf{FIN}_E(e'', e) \rightarrow e' \leq_E e''] \wedge \theta(e', x)]]]$
"x is the **goal on** w in e iff x is θ-related to smallest final $e' \leq e$."

(cf. Beavers 2012: 30)

Note at this point that I will exploit – in Section 5.4.2 – the contrast between Krifka's and Beavers' coneptualization of goals and sources in order to model an aspectual contrast observed in the domain of source and goal prepositions. When combined with manner of motion verbs, the goal preposition *zu* ('to') gives rise to accomplishment predicates, while goal prepositions such as *in* ('into') or *an* ('onto') give rise to achievement predicates. In particular, I will argue that an modified version of Krifka's goal and source model underlies prepositions such as *zu* ('to') and *von* ('from') (accomplishments), and that a modified version of Beavers' goal and source model underlies prepositions such as *in* ('into') and *aus* ('out of').



25.a: "x is the **source on** w in e"   25.b: "x in the **goal on** w in e"

Figure 25: Source and goal à la Beavers (2012)

4.6 Prepositional aspect

This section discusses the notion of prepositional aspect as coined by Zwarts (2005b) and, in particular, it discusses the appropriate algebraic closure property that characterizes prepositional aspect. As observed by Jackendoff (1991), Verkuyl and Zwarts (1992), Piñón (1993), Zwarts (2005b), a.o., PPs denoting spatial paths (SPs) can – unlike PPs denoting static locations – affect the aspectual properties of clauses, in particular when they serve as arguments. Consider manner of motion verbs like *run*, *swim*, or *drive*, which are inherently atelic when used as plain unergatives without internal arguments.

(285) John ran for/$^{??}$in an hour.

Let us add a SP-denoting PP. In general, there are path prepositions, like *to* in (286a), that give rise to a telic interpretation, and there are path prepositions, like *towards* in (286b), that give rise to an atelic interpretation.

(286) a. John ran **to the station** in/$^{?}$for an hour.
b. John ran **towards the station** for/$^{??}$in an hour.

Interestingly, there are also path prepositions, like *through* in (287), that are ambiguous to the effect that they give rise to both a telic interpretation and an atelic interpretation (Piñón 1993). In fact, all morphologically-simplex route prepositions (in German) exhibit the ambiguity illustrated with *through*.

(287) John ran **through the forest** in/for an hour.

Observing this behavior of SP-denoting PPs, Zwarts (2005b: 741–742) states that "the distinction between **bounded** and **unbounded reference** familiar from the verbal and nominal domain shows itself in the prepositional domain too (Jackendoff 1991, Verkuyl and Zwarts 1992, Piñón 1993)." Zwarts (2005b: 742) terms the property that a PP has of having either bounded or unbounded reference **prepositional aspect**.[89]

What is the right closure property characterizing prepositional aspect? Section 4.4.1 introduces the three closure properties cumulativity, divisivity, and quantization, which are informally repeated here in (288).

(288) a. A predicate is **cumulative** iff whenever it holds of two things, it also holds of their sum.
b. A predicate is **divisive** iff whenever it holds of something, it also holds of each of its proper parts.
c. A predicate is **quantized** iff whenever it holds of something, it does not hold of any of its proper parts.
(Champollion and Krifka 2016: 524–526)

Krifka (1998) identifies **quantization** as the property that characterizes boundedness in other domains. Take the bounded predicate *three apples* (Krifka 1998: 200). If the element x falls under this predicate, then there is no proper part $y < x$ that also falls under this predicate. The question now is whether quantization is also the closure property that characterizes bounded predicates in the prepositional domain. Zwarts (2005b: 754) shows that quantization cannot be the right closure property characterizing bounded PPs. Take the bounded PP *to the station*. If quantization was the closure property characterizing bounded PPs, then there must not be a SP x that falls under the predicate *to the station* and that has a proper subpath $y < x$ that also falls under the predicate *to the station*. It can easily be shown that this is not the case. Consider the SP x from A to B depicted in Figure 26. It clearly falls under the predicate *to the station*. Obviously, we can find a proper subpath $y < x$ (i.e. from A' to B) that also falls under the predicate *to the station*. Thus, quantization is not the right closure property characterizing bounded PPs.

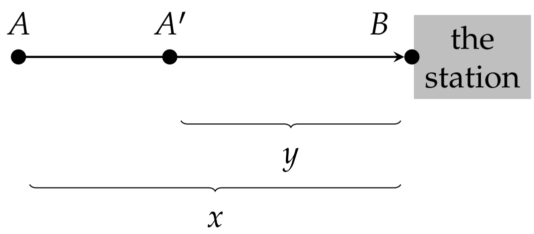


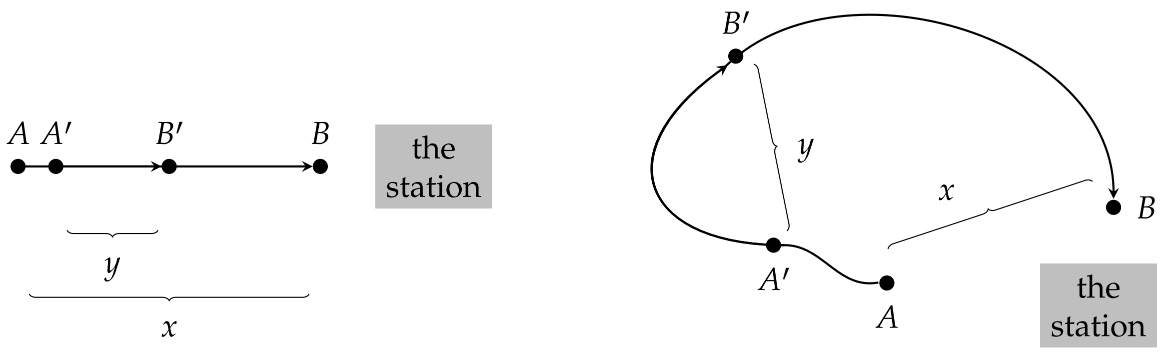
Figure 26: Non-quantization of SPs *to the station*

Let us now see whether divisivity or cumulativity characterizes unbounded PPs. The fundamental difference between these two closure properties is that divisivity is a downward-

[89]PPs that have bounded reference are referred to as bounded PPs, and those that have unbounded reference as unbounded PPs. Prepositions that head bounded PPs are referred to as bounded prepositions, and those that head unbounded PPs as unbounded prepositions.

looking closure property based on the proper part relation <, while cumulativity is an upward-looking closure property based on the sum relation ⊕.[90]

Piñón (1993) and Nam (2000) take the view that **divisivity** characterizes unboundedness in the domain of SPs. Advocating a constructive approach to SPs, Zwarts (2005b) argues that divisivity cannot be the closure property characterizing unbounded PPs. Take the unbounded predicate *towards the station* (Zwarts 2005b: 751). If divisivity was the closure property characterizing unbounded predicates in the prepositional domain, then it must be the case that if the SP x falls under the predicate *towards the station*, then each subpath $y < x$ must also fall under the predicate *towards the station*. Let us first look at axiomatic approaches to SPs, as, for instance, argued for by Piñón (1993), Krifka (1998). Here, SPs are typically assumed to be rectilinear line segments. On such approaches, one of which is depicted in Figure 27.a, divisivity correctly characterizes unbounded PPs. The SP x from A to B falls under the predicate *towards the station*, and so does each of its proper subpaths. For instance, the SP $y < x$ from A' to B' also falls under the predicate *towards the station*. Let us now look at constructive approaches to SPs, as, for instance, argued for by Zwarts (2005b). Recall from Section 4.5 that Zwarts (2005b: 748) defines SPs as functions from the real unit interval $[0, 1]$ to positions in some model of space. This definition does not contain any constraints on the shape of SPs, which is why they can have virtually any shape, as long as the locations are spatially continuous. That is, SPs can virtually have any shape. Consider the SP x from A to B in Figure 27.b, which falls under the predicate *towards the station*. Here, we can identify subpaths that do not fall under the predicate *towards the station*. Take for instance the SP $y < x$ from A' to B'. It clearly does not fall under the predicate *towards the station*.



27.a: Model with rectilinear SPs

27.b: Model with non-rectilinear SPs

Figure 27: (Non)-divisivity of SPs *towards the station*

Zwarts (2005b: 752) adduces a further argument against divisivity as the characteristic property of unbounded PPs. Consider the unbounded PP *along the river* in (289).

[90]The terms 'downward-looking' and 'upward-looking' account for the intuition that divisivity looks downward from the sum to the part, while cumulativity looks upward from the part to the sum.

(289) Alex drove **along the river** (for/*in a day).

(Zwarts 2005b: 752)

Even though Zwarts assumes a constructive approach to SPs, this argument is straightforwardly transferable to an axiomatic approach where SPs are considered to be rectilinear line segments. Depending on the shape of the river, there might be configurations where divisivity fails to characterize an unbounded PP such as *along the river*. In particular, there can be (rectilinear) SPs that fall under the predicate *along the river*, but that also have proper subpaths that do not fall under the predicate *along the river*. Imagine a meandering river as illustrated in Figure 28. The SP x form A to B clearly falls under the predicate *along the river*. There are, however, proper subpaths of x that do not fall under the predicate *along the river*. Take for example the proper subpath $y < x$ from A' to B'; this path does not fall under the predicate *along the river*.

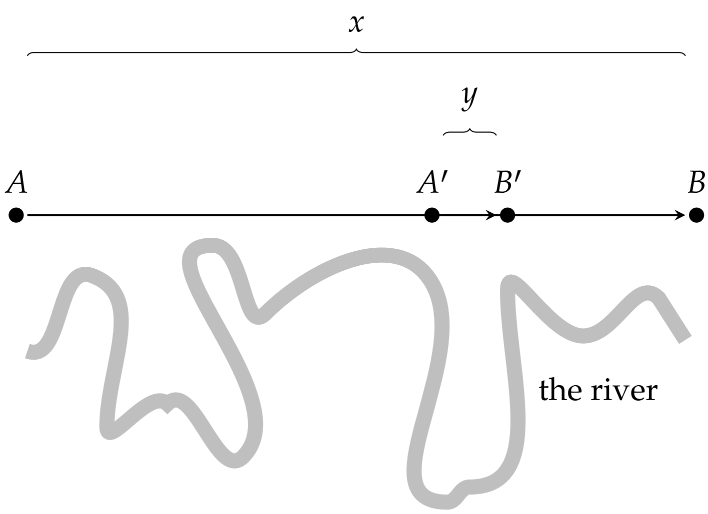


Figure 28: Non-divisivity of (rectilinear) SPs *along the river*

Considering the examples illustrated the in Figures 27.b and 28, Zwarts (2005b: 752) concludes that "divisivity is not the algebraic property that characterizes unbounded PPs." Let me add a further argument against divisivity as the characteristic closure property of unbounded PPs. The German route preposition *um* ('around') (cf. Section 5.4.3) is systematically ambiguous between a telic (bounded) and an atelic (unbounded) interpretation (Piñón 1993, Zwarts 2005b). Consider the example in (290).

(290) Hans rannte in/für zwei Stunden **um** den Bahnhof.
Hans ran in/for two hours around the.ACC station
'Hans ran around the station in/for two hours.'

Even under an axiomatic approach to SPs, the minimal model of a SP denoted by *um* is not entirely rectilinear. In Section 5.4.3, I propose that SPs denoted by *um* are minimally L-shaped line segments (cf. Section 4.3.6) embracing the reference object. For example, the path x from

A to *B* in Figure 29 falls under the predicate *um den Bahnhof* ('around the station').[91] On such a semi-rectilinear SP, we can easily identify a proper subpath that does not fall under the denotation *um den Bahnhof*. Consider the SP $y < x$ from A' to B', which does not fall under the predicate *um den Bahnhof*. Thus, I follow Zwarts (2005b: 752) in assuming that divisivity is not the right closure property that characterizes unbounded PPs.

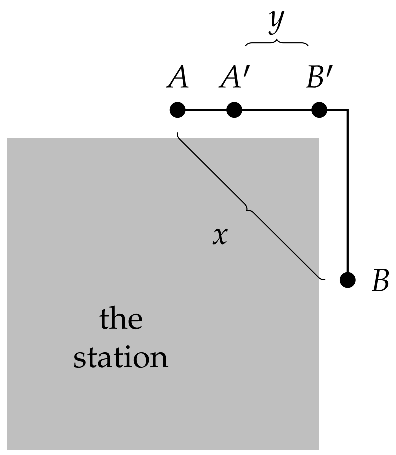


Figure 29: Non-divisivity of fundamentally rectilinear SPs *um den Bahnhof* ('around the station')

Let us now look at **cumulativity** as the closure property characterizing unbounded PPs. Unlike divisivity, which is based on the part relation, cumulativity is based on the sum operation. The idea is that a predicate has unbounded reference iff for all two entities that fall under the predicate also their mereological sum, if it exists, falls under the predicate. With regard to SPs, Zwarts (2005b: 749–750) – following Habel (1989), Nam (1995) – proposes that **concatenation** is a natural sum operation over SPs. Adopting a constructive approach, Zwarts (2005b: 748) defines SPs as continuous functions from the real unit interval $[0,1]$ to positions in some model of space. Based on this concept of SPs, he (2005b: 750) defines the concatenation of two SPs x, y such that the endpoint of one concatenant corresponds to the starting point of the other concatenant, i.e. $x(1) = y(0)$. That is, the SPs x, y connect head-to-tail. As I do not pursue a constructive approach to SPs, I cannot adopt Zwarts' definition of concatenation of SPs. Instead, I adopt Krifka's (1998: 201) definition of the concatenation operation $\oslash$ based on extensive measure functions; see (252) and (253) in Section 4.4.1. An important precondition for assuming cumulativity as the characteristic

[91] Note that the English route preposition *(a)round* might commit to another minimal model than the German route preposition *um*, even though the two prepositions are more or less direct translations of each other. English *(a)round* apparently incorporates the morpheme 'round', which obviously refers to a geometric configuration. In contrast, German *um* is frequently used as a particle in particle verb constructions describing 'change of direction scenarios', e.g. *etw. um-fahren* ('to knock sth. down, to hit sth.') or *etw. um-hauen* ('to chop/cut down sth.'). In such particle verb constructions, *um* indicates a positional change of the direct object, e.g. from an vertical to a horizontal position. This usage of *um* strongly corroborates the hypothesis that German *um* minimally commits to some fundamental 'change of direction', which I capture in terms of semi-rectilinear L-shaped line segments that contain at least one 90° bend. Note that this is still in line with an axiomatic approach to SPs. Even though L-shaped SPs have a geometrically complex modeling, they are indecomposable primes at the level of semantic representation (DRS) at LF.

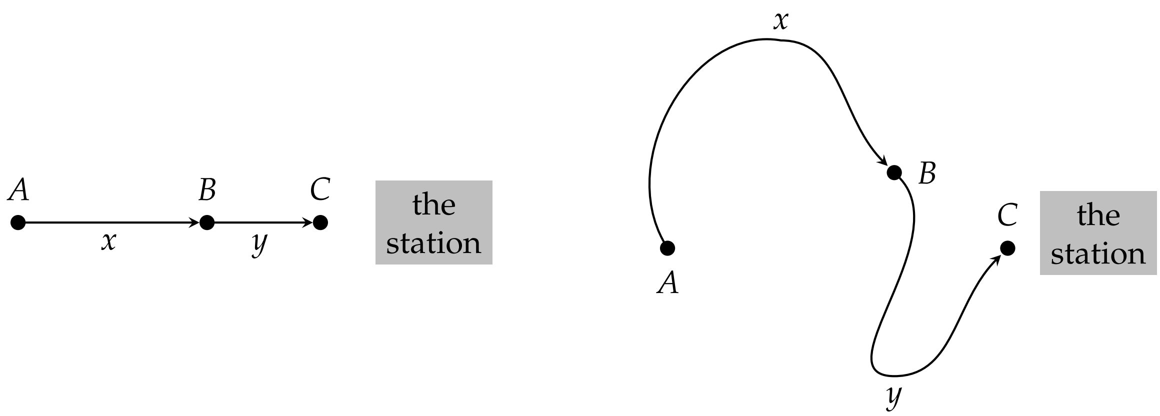
property of unbounded PPs denoting SPs relates to the fact that cumulativity is based on the mereological sum operation and the concatenation operation, respectively. We need to assume that there is at least one concatenation of two SPs in the denotation of a PP. Otherwise, PP denotations without any connecting SPs would be vacuously cumulative (Zwarts 2005b: 751). Based on these considerations on cumulativity with respect to SPs, Zwarts (2005b: 751) defines cumulative predicates over SPs as given in (291).

(291) A predicate Φ over SPs is **cumulative** iff

a. there are $x, y \in \Phi$ such that $x \oslash y$ exists and
b. for all $x, y \in \Phi$, if $x \oslash y$ exists, then $x \oslash y \in \Phi$.

(cf. Zwarts 2005b: 753)

In fact, cumulativity based on concatenation appears to be the characteristic property of unbounded PPs denoting SPs. Let us therefore revisit the cases discussed above in the context of divisivity. The PP *towards the station* has unbounded reference. Consider again a rectilinear model of SPs, as illustrated in Figure 30.a, and a non-rectilinear model of SPs, as illustrated in Figure 30.b. In both models, both the SP x from A to B and the SP y from B to C individually fall under the predicate *towards the station*, and so does their concatenation $x \oslash y$ from A to C.



30.a: Model with rectilinear SPs 30.b: Model with non-rectilinear SPs

Figure 30: Cumulativity of SPs *towards the station*

The same holds for the unbounded PP *along the river*. In Figure 31, both the SP x from A to B and the SP y from B to C fall under the predicate *along the river*. Likewise, their concatenation $x \oslash y$ from A to C falls under the predicate *along the river*.

What about German *um* ('around')? Consider again the minimal model of SPs denoted by the PP *um den Bahnhof* ('around the station') depicted in Figure 32. Both the SP x from A to B and SP y from B to C fall under the predicate *um den Bahnhof*, and so does their concatenation $x \oslash y$ from A to C.

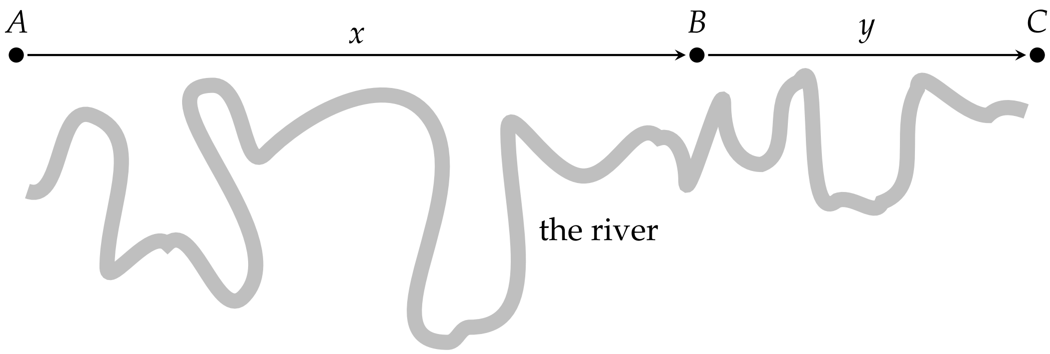


Figure 31: Cumulativity of (rectilinear) SPs *along the river*

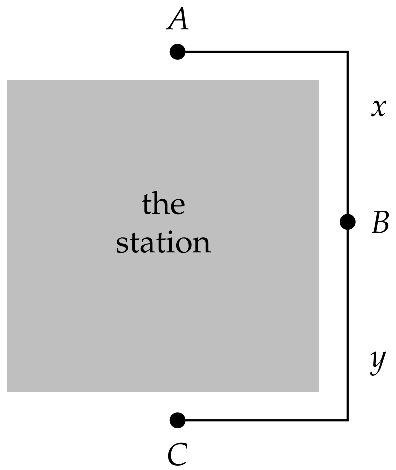


Figure 32: Cumulativity of fundamentally rectilinear SPs *um den Bahnhof* ('around the station')

I conclude, in line with Zwarts, that cumulativity is the closure property that characterizes unbounded PPs. In particular, Zwarts (2005b: 753) proposes the correlation between cumulative reference and unboundedness in (292).

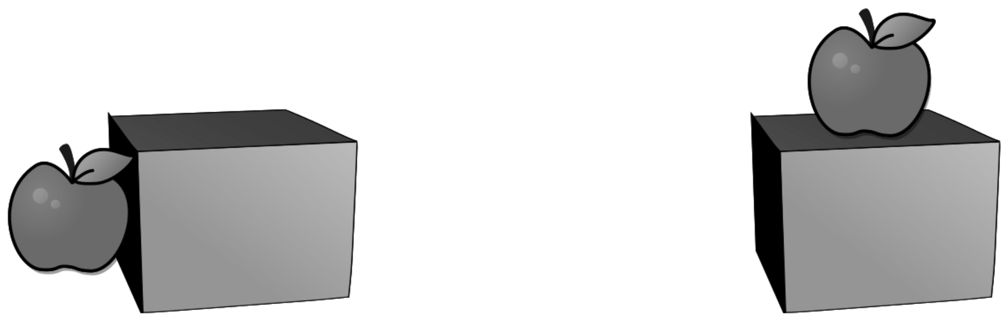
(292) a. A PP is **unbounded** iff it has cumulative reference.
b. A PP is **bounded** iff it does not have cumulative reference.
(Zwarts 2005b: 753)

I adopt (292) when modeling prepositional aspect.

4.7 Force-effective prepositions

This section addresses the concept of spatial support from below, which manifests itself as a characteristic of the topological preposition *auf* ('upon') in German. Roughly speaking, I will argue that *auf* describes situations where the Ground (the complement of the preposition) must be capable of preventing the falling down of the Figure (the external argument of the preposition); see Talmy (1975, 2000) and Section 4.2 for the notions Figure and Ground.[92]

Unlike German *an* ('on'), the topological preposition *auf* ('upon') shows the force-dynamic effect **support from below**. In their geometric usages, both topological prepositions *an* and *auf* minimally commit to spatial contact between the Figure and the Ground. The difference between the two prepositions is that *auf*, unlike *an*, commits to a configuration such that the Ground supports the Figure from below. In order to understand the force-dynamic effect of support from below, and thus the differences between *an* and *auf*, consider the two situations depicted in Figure 33 below.



33.a: Apfel **an** Kiste ('apple on box') 33.b: Apfel **auf** Kiste ('apple upon box')

Figure 33: Support from below

Let us describe these situations with the topological prepositions *an* and *auf* such that the position of the apple is described relative to the box; viz. the apple should serve as the Figure, while the box should serve as the Ground (Talmy 2000: 312). The spatial configuration in Figure 33.a can felicitously be described with *an*, as in (293a).[93] The preposition *auf* is unacceptable here. In contrast, the spatial configuration in Figure 33.b can straightforwardly be described with *auf*, as in (293b). Interestingly, *an* is not unacceptable, but marked here. Imagine a more complex situation where the apple is in a position as depicted in Figure 33.b. But where it is not the box that carries the apple but some third party, e.g., if the apple hangs on a rope but still touches the box. In such situations, the acceptability of *auf* seems to decrease, and the acceptability of *an* seems to increase.

(293) a. Der Apfel ist **an**/*auf der Kiste.
the apple is on/upon the box
'The apple is at the box.' (*as a description for Figure 33.a*)

b. Der Apfel ist **auf**/$^{?}$an der Kiste.
the apple is upon/on the box
'The apple in upon the box.' (*as a description for Figure 33.b*)

[92]Note that I use the notions *Figure* and *Ground* at the beginning of this section. These notions relate, sensu stricto, to the cognitive domain of space. In fact, I replace them later in the course of this section by the notions *Agonist* and *Antagonist*, which are the respective notions from the cognitive domain of force (Talmy 2000).

[93]Note that the projective (non-topological) preposition *neben* ('beside') would also be possible here. We can consider this as another way to express this configuration. For the sake of argument, however, we will ignore this possibility here.

That is, *auf* does not only require spatial contact between the Figure and the Ground like *an*, but also that the Ground carries the Figure to the effect that it prevents the Figure from falling down. Under normal conditions on earth, all material objects are subject to gravity and thus would fall down if not supported by something or kept going away from gravity because of a kinetic momentum. In order to prevent the Figure from falling down to earth, it can, for instance, be located at the upper side of the Ground, i.e. on that part of the surface of the Ground that steadily prevents the Figure from being accelerated by gravity. This kind of configuration where the Ground carries the Figure so that the Figure does not fall down to earth can be understood as the force-dnyamic effect **support from below**.

Advocating a unified model of space and force in terms of vector spaces, Zwarts (2010a) argues that the Dutch prepositions *op* ('upon'), *aan* ('on'), and *in* ('in') – which roughly correspond to the German prepositions *auf*, *an*, and *in*, respectively – are forceful; that is, that they are force-dynamically active. While I agree with Zwarts that some prepositions might show a force-dynamic effect, I take the view that prepositions have a rather passive status with regard to force-dynamics. I am convinced that verbs can speak of forces. Prototypical instances of such verbs are *push* and *pull* in English or *drücken* and *ziehen* in German; see also Zwarts (2010a). However, I assume that prepositions, unlike verbs, do not primarily speak of forces, but rather can be selected by certain forceful verbs. Consider the following data corroborating this assumption. If a force-dynamically relevant discourse referent, i.e. a force, was present in the representation the preposition *auf*, then it should be accessible for measurement – even in a context where the verb does not speak of forces. In such contexts, however, it is apparently impossible to measure a force with an adverb like *schwer* ('heavily'), which is a prototypical adverb for measuring forces. Consider the data in (294) involving PPs headed by *auf*. Interestingly, if the verb does not speak of a force, as in (294b) and (294c), an adverb such as *schwer* that measures forces is ungrammatical. Only if the verb is force-dynamically active, as for instance the verb *lasten* ('weigh') in (294a), is the adverb felicitous.

(294) a. Die Vase war (*schwer) **auf** dem Tisch.
the vase was heavily upon the table

b. Die Vase stand (??schwer) **auf** dem Tisch.
the vase stood heavily upon the table

c. Die Vase lastete (schwer) **auf** dem Tisch.
the vase weighed heavily upon the table

I conclude from these data that the preposition *auf* is intrinsically not force-dynamically active. However, acknowledging the fact that it can show a force-dynamic effect, I assume instead that it is **force-effective**. To understand what I mean by this, let me now present some basic concepts of force-dynamics as discussed by Talmy (1975, 2000).

To begin, let us define the two force entities **Agonist** and **Antagonist** that are elementary for force-dynamic analyses. Note that I adhere in this regard to Talmy's original terms, even though many scholars apply terms that are essentially borrowed from other domains.

(295) a. **Agonist:**
The Agonist is the force entity that is singled out for focal attention. The salient issue in the force interaction is whether the Agonist is able to manifest its force tendency or is overcome. It is the force entity for which the resultant is assessed.

b. **Antagonist:**
The Antagonist is the force entity that is in force interaction with the Agonist. The Antagonist is opposing the Agonist.

(Talmy 2000: 413,415)

Talmy schematizes the Agonist as a circle and the Antagonist as a concave figure. Force entities can have an intrinsic force tendency, either toward action or toward rest. A tendency toward action is indicated by an angle bracket (>), while a tendency toward rest is indicated by a bullet (•). A further factor is the balance between the force of the Agonist and the force of the Antagonist, i.e. the relative strength of the opposing forces. Typically, the stronger force entity is marked with a plus sign (+), while the weaker force entity is unmarked. The opposing force entities yield a resultant which is either of action or of rest. The resultant is assessed only for the Agonist, as it is the force entity whose circumstance is at issue. The resultant is schematized as a line beneath the Agonist. Talmy (1988, 2000) identifies four basic steady-state force-dynamic patterns, which are illustrated in the diagrams in Figure 34. The pattern in Figure 34.a involves an Agonist with a tendency toward rest that is opposed by a stronger Antagonist. Thus, the Agonist's tendency towards rest is overcome, which results in action. An example of this pattern is given in (296a). The pattern in Figure 34.b involves an Agonist with a tendency toward rest. It is ineffectively opposed by a weaker Antagonist, which results in rest. An example of this pattern is given in (296b). The pattern in Figure 34.c involves an Agonist with a tendency toward action. It is opposed by a weaker Antagonist, which results in action. An example of this pattern is given in (296c). The pattern in Figure 34.d involves an Agonist with a tendency towards action. It is opposed by a stronger Antagonist, which results in rest. An example of this pattern is given in (296d).

(296) a. The ball kept rolling because of the wind blowing on it.
b. The shed kept standing despite the gale wind blowing against it.
c. The ball kept rolling despite the stiff grass.
d. The log kept lying on the incline because of the ridge there.

(Talmy 2000: 416)

The gravitational attraction of the earth gives weight to material objects. Being attracted by the gravity of the earth, material objects fall down to the ground, moving along the vertical

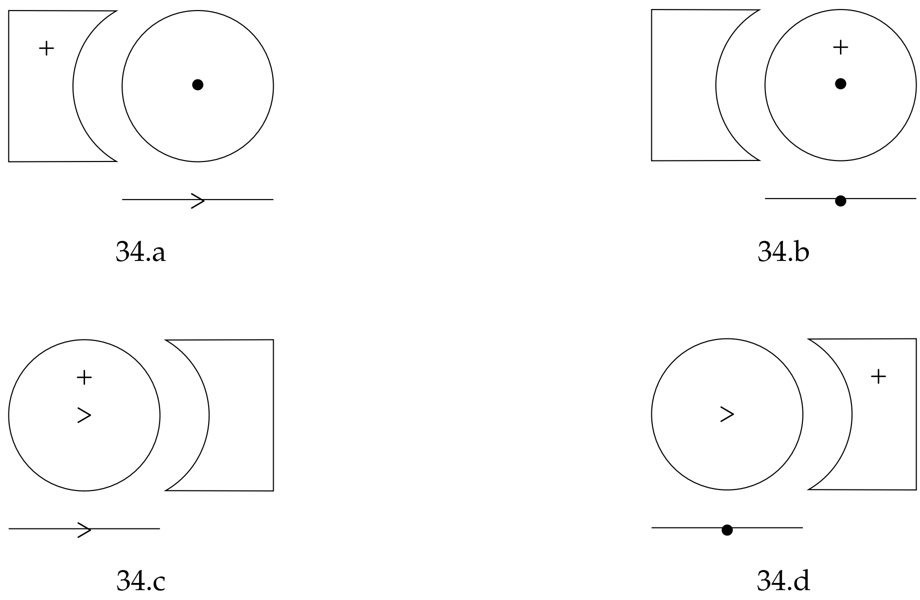


Figure 34: The basic steady-state force-dynamic patterns (Talmy 2000: 415)

axis. Let us assume that this is conceptualized to the effect that gravity endows material objects with their own intrinsic force, or, put differently, that gravity literally 'enforces' material objects. That is, material objects (on earth) are typically conceptualized as Agonists, in that they tend to fall to earth; they have an intrinsic force tendency toward action by virtue of gravity.

Let us now look again at the 'apple-upon-box' situation, i.e. the prototypical instance of the preposition *auf* ('upon') that is depicted in Figure 33.b and described by the clause in (293b). With regard to the cognitive domains of space and force, I claim that this situation is conceptualized as follows. As for space (297a), we can say that the apple serves as the Figure, while the box serves as the Ground. As for force (297b), the apple is the force entity that is singled out for focal attention. It is conceptualized as the Agonist that has a disposition to fall down. In contrast, the box is the force entity that is in force interaction with the apple; it is conceptualized as the Antagonist. The box prevents the apple from falling down so that the apple stays put. The Antagonist provides a stronger counterforce overcoming the Agonist's intrinsic force tendency toward action, which results in rest. This instantiates the steady-state force-dynamic pattern depicted in Figure 34.d.

(297)	a.	**Space**:	[$_{Figure}$	Der Apfel]	ist [$_{\text{PP}}$	**auf**	[$_{Ground}$	der Kiste]].
	b.	**Force**:	[$_{Agonist}$	Der Apfel]	ist [$_{\text{PP}}$	**auf**	[$_{Antagonist}$	der Kiste]].
				the apple	is	upon		the box

In order to account for the force-dynamic effect that manifests itself in the geometric usage of the preposition *auf* ('upon'), I do not draw on Zwarts' (2010a) integrated vector space model of space and force. Instead, I model the force-dynamic concept of **support from below** in terms of the two-place predicate sfb. It is informally sketched in (298). In particular, I leave the model-theoretic explication of sfb for future research. The predicate sfb is adopted in the definition of auf-regions in (334); cf. Section 5.3.3.

(298) The force entity x **supports** the force entity y **from below** "sfb(x, y)":

a. By virtue of gravity, the force entity y has an intrinsic force tendency toward action. The force direction is downward. The force entity y is conceptualized as an Agonist.
b. The force entity x provides a counterforce that overcomes the Agonist's tendency to fall down. The force entity x is conceptualized as an Antagonist.
c. This equilibrium of forces takes place along the vertical axis and leads to rest as resultant.
d. The canonical configuration for this is that the Agonist is on top of the Antagonist.

Note that the geometric usage of *auf* typically commits to spatial contact between the Agonist and the Antagonist. This is accounted for by the way auf-regions are defined. In particular, the definition of auf-regions in (334) involves the condition $x \propto y$, where x is the region occupied by the Agonist, y is the region occupied by the Antagonist, and $\propto$ means 'has spatial contact with' (cf. Section 4.3.5).

4.8 Summary

This chapter explored the semantic branch of the Y-model of grammar, that is Logical Form (LF). In this thesis, I adopted the tenets of Discourse Representation Theory (DRT) (Kamp and Reyle 1993, 2011, Kamp et al. 2011) to model LF. As for a model of space, I followed Kamp and Roßdeutscher (2005). As for algebraic structures, I followed Krifka (1998), Beavers (2012).

Section 4.1 presented the semantic construction algorithm. At LF, each terminal node of a syntactic structure receives a context-dependent interpretation. Compositionally, the interpretations of the terminal nodes are combined bottom-up along the syntactic structure by means of unification-based composition rules. As for the representation of LF, Discourse Representation Theory (DRT) (Kamp and Reyle 1993, 2011, Kamp et al. 2011) was chosen; cf. Section 4.1.2. One of the features of DRT is that interpretation involves a two-stage process: (i) the construction of semantic representations referred to as Discourse Representation Structures (DRSs), i.e. the LF-representation proper; and (ii) a model-theoretic interpretation of those DRSs. Section 4.1.3 illustrated the semantic construction algorithm by reproducing a textbook example, involving aspectual information.

Section 4.2 briefly discussed the general conceptualization of 'Figure' and 'Ground' in language, as introduced by Talmy (1975, 2000).

Section 4.3 focused on the model-theoretic aspects relevant for the semantic modeling of spatial prepositions. I presented two models of three-dimensional space: (i) the vector space model of space, as advocated by Zwarts (1997, 2003b, 2005b), Zwarts and Winter (2000); and (ii) the perception-driven model of space, as advocated by Kamp and Roßdeutscher (2005), who base their approach on principles formulated by Lang (1990). In this thesis, I adopted Kamp and Roßdeutscher's (2005) parsimonious, perception-driven model of space. Section 4.3.1 discussed material objects, which can be conceptualized as being one-, two-, or three-dimensional. Section 4.3.2 focused on the spatial ontology. In particular, the notions 'region', 'point', 'line', 'line segment', 'direction', 'directed line segment', and 'plane' were introduced. Then, Section 4.3.3 introduced the Primary Perceptual Space (PPS), which spans a three-dimensional space on the basis of our perceptual input (Lang 1990, Kamp and Roßdeutscher 2005). The PPS consists of three axes that are orthogonal to one another: (i) the vertical axis determined by gravity, (ii) the observer axis determined by vision, and (iii) the transversal axis derived from the other two axes as being orthogonal to both. Six orientations are identified on the three axes: up and down are orientations of the vertical axis; fore and back are orientations of the observer axis; and left and right are orientations of the transversal axis. Section 4.3.4 addressed boundaries of material objects and regions and how they can be used to determine the inside and the outside of a material object. Section 4.3.5 briefly discussed how 'spatial contact' of two regions can be modeled. Then, Section 4.3.6 discussed conditions on line segments that figure in the modeling of spatial paths denoted by route prepositions. Two types of conditions are proposed: (i) boundary conditions and (ii) configurational conditions. Boundary conditions manifest themselves to the effect that a line segment is either completely inside or completely outside the material object, i.e. an internal or external line segment of a material object. A crucial property of both boundary conditions is that one must be able to drop a perpendicular from the boundary of the material object onto every point of the line segment. Configurational conditions describe the configuration of line segments as related to material objects or the shape of line segments; three such configurational conditions of line segments are proposed: (i) an L-shaped line segment is a line segment that involves an orthogonal change of direction; (ii) a plumb-square line segment of a material object is a line segment that is horizontally aligned and above the material object (NB: the term is borrowed from a carpentry tool); and (iii) a spear-like line segment of a material object is a line segment that is orthogonal to a cross section of the material object.

Section 4.4 discussed the algebraic foundations. Section 4.4.1 presented the mereological structures that figure for the modeling of spatial paths. In particular, plain/undirected path structures *H* (Krifka 1998: 203) and directed path structures *D* (Krifka 1998: 203) were presented. Spatial paths can serve as incremental themes measuring out events (Dowty 1979, 1991, Tenny 1992, Jackendoff 1996, Krifka 1998, Beavers 2012); thus, Section 4.4.2 presented incremental relations mapping spatial paths to event. I briefly presented Beavers' (2012) Figure/Path Relations (FPRs) that account for double incremental themes.

Section 4.5 focused on spatial paths. I briefly presented two approaches to spatial paths: (i) an axiomatic approach, where spatial paths are taken as primitives in the universe of discourse (Piñón 1993, Krifka 1998, Beavers 2012); and (ii) a constructive approach, where spatial paths are defined as continuous functions from the real unit interval $[0, 1]$ to positions in some model of space (Zwarts 2005b: 748). The two approaches have different implications on the notions 'goal' and 'source'. In axiomatic approaches, 'goal' and 'source' are thematic notions that typically derive when motion events and their spatial projections map onto one another. In constructive approaches, 'goal' and 'source' are inherent extremities of spatial paths (Zwarts 2005b: 758). In this thesis, I opted for an axiomatic approach to spatial paths.

Section 4.6 explored the notion of 'prepositional aspect'. Zwarts (2005b: 742) relates prepositional aspect to the distinction between bounded and unbounded reference, which is familiar from the verbal domain, e.g., and which shows itself also in the domain of PPs denoting spatial paths (Jackendoff 1991, Verkuyl and Zwarts 1992, Piñón 1993). Following Zwarts (2005b: 753), I assume that cumulativity is the algebraic property characterizing prepositional aspect: unbounded PPs have cumulative reference, while bounded PPs nodes not have cumulative reference.

Section 4.7 discussed the force-dynamic effect of the German topological preposition *auf* ('upon'), which can be characterized as 'support from below'. In contrast to (Zwarts 2010a), who takes the view that prepositions can be forceful, I argued that prepositions are not forceful but can show force-dynamic effects. Using Talmy's (2000: 413, 415) terms 'Agonist' and 'Antagonist' for the force entities at issue, the force-dynamic effect of *auf* can be characterized to the effect that the complement of the preposition serves as an Antagonist providing a counterforce of an Agonist's tendency to fall down. The equilibrium of forces takes place along the vertical axis and leads to a resultant toward rest.

Chapter 5

Spatial prepositions at the interfaces

This chapter will spell out the syntax, semantic, morphology of spatial prepositions in German. It is the core of this thesis because it illustrates how spatial prepositions can be implemented in the Y-model of grammar. The structure of this chapter is as follows. First, Section 5.1 will classify spatial preposition according to several criteria. Section 5.1.1 will introduce the distinction between place prepositions, on the one hand, and path prepositions, on the other. Path prepositions are further subdivided into directed path prepositions (goal and source prepositions) and undirected path prepositions (route prepositions) (Jackendoff 1983, Piñón 1993, Zwarts 2006, a.o.). Section 5.1.2 will propose a geometry-based classification of spatial prepositions that is orthogonal to the place/path typology. I propose that spatial prepositions can be (i) geometric prepositions, (ii) pseudo-geometric prepositions, or (iii) non-geometric prepositions. Section 5.1.3 will classify path prepositions into bounded and unbounded path prepositions. Section 5.1.4 will map these classifications to syntactic structure. Then, Section 5.2 will briefly touch upon the cartographic decomposition of spatial prepositions (Svenonius 2006, 2010, Pantcheva 2011). Then, Section 5.3 will introduce three abstract Content features that relate to geometric concepts and that figure in the derivation of the geometric prepositions: [א] relating to interiority in Section 5.3.1; [ב] relating to contiguity in Section 5.3.2; and [ג] relating to verticality in Section 5.3.3. Then, Section 5.4 will derive the lexical structure of spatial prepositions and spell out PF-instructions for their morphophonological realization and LF-instructions for their semantic interpretation. Then, Section 5.5 will derive the functional structure of spatial prepositions and spell out PF-instructions for their morphophonological realization and LF-instructions for their semantic interpretation. Then, Section 5.6 will illustrate how a fully-fledged PP, i.e. a prepositional CP, headed by a spatial preposition can be integrated in various verbal contexts. Finally, Section 5.7 will summarize this chapter.

5.1 Classifying spatial prepositions

5.1.1 Place and path prepositions

Generally, we find two types of prepositions expressing spatial configurations. On the one hand, **place prepositions** denote static locations relative to the Ground (regions) and the Figure is located in this location. On the other hand, **path prepositions** denote dynamic locations with respect to the Ground (spatial paths) along which the Figure changes its position or moves. Path prepositions can be directed/oriented or undirected/non-oriented. Directed path preposition denote either a spatial path *from* a location relative to the Ground (**source preposition**) or a spatial path *to* a location relative to the Ground (**goal preposition**). Undirected path prepositions denote spatial paths where the location relative to the Ground serves neither as source nor as goal (**route prepositions**). This gives rise to the typology of spatial prepositions given in Figure 35, which is widely accepted in the literature (e.g. Jackendoff 1983, Piñón 1993, Zwarts 2006, Gehrke 2008, Kracht 2008, Svenonius 2010, Pantcheva 2011). The typology in Figure 35 includes examples from English.

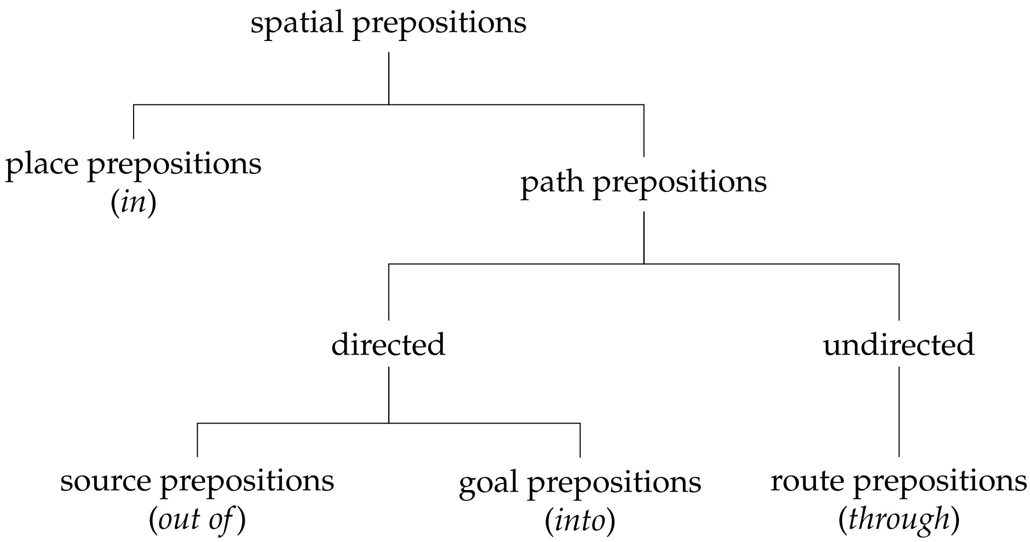


Figure 35: Typology of spatial prepositions

5.1.2 Prepositions and geometry

This section establishes three classes of spatial prepositions in German. Generally, spatial prepositions express spatial relations. Some of these spatial relations can be characterized in geometric terms, while others cannot. A crucial characteristic of the three classes that I argue for is whether the respective prepositions involve a geometric level of description or not. Essentially, this gives rise to two classes, **geometric prepositions**, i.e. those prepositions that involve a geometric level, as opposed to **non-geometric prepositions**, i.e. those prepositions that do not involve a geometric level. In addition, I argue for a third class which I refer to as **pseudo-geometric prepositions**. Superficially, they look like geometric prepositions, but, crucially, they lack a geometric level. This is shown by certain aspects of their behavior.

In this thesis, I conceive geometry in a broader sense including geometry in the narrow sense as well as topology. Thus 'geometric prepositions' is a term covering both prepositions expressing relations that are best understood in terms of topological terms (**topological prepositions**) and prepositions expressing relations that are best understood in terms of projection onto one of the three perpendicular axes of the Primary Perceptual Space (Lang 1990, Kamp and Roßdeutscher 2005), i.e. onto the vertical axis, onto the observer axis, or onto the horizontal axis (**projective prepositions**). I focus on topological prepositions. Projective prepositions behave in many – but not in all – respects like topological prepositions. For instance, projective prepositions behave like topological propositions with respect to case assignment – which is central in this thesis –, while projective prepositions behave differently from topological prepositions with respect to licensing postpositional elements – which is not central in this thesis. Thus, for the sake of clarity, I concentrate on topological prepositions. In German, these include *an* ('at, on'), *auf* ('upon'), *aus* ('out of'), and *in* ('in').[94] As for projective prepositions, which include *über* ('above'), *unter* ('under'), *vor* ('in front of'), *hinter* ('behind'), and *neben* ('next to'), I refer the reader to Herskovits (1986), Lang (1993), Zwarts (1997, 2010b), Zwarts and Winter (2000), Svenonius (2006, 2010), Hying (2009), and references therein. Note that I also omit *zwischen* ('between'), the behavior ov which is parallel to that of projective prepositions.

Note that the geometry that is crucial for geometric prepositions can be modeled in serveral ways. For example, we can model geometry in terms of a simple geometric model of space in the spirit of Kamp and Roßdeutscher (2005), a vector space model in the spirit of Zwarts (1997) and Zwarts and Winter (2000), or any other model of space; cf. Section 4.3. Topological relations can be modeled, for instance, as described by Egenhofer (1989, 1993). Note, however, that the way in which geometric relations are modeled is not crucial here.

I argue that it is crucial to distinguish between geometric prepositions and **non-geometric prepositions**. As opposed to geometric prepositions, the spatial relations conveyed by non-geometric prepositions are best understood not in geometric but in other terms. Non-geometric prepositions differ from geometric prepositions not only with respect to the spatial relation conveyed, but also in some other respects, such as (lexical) aspect or case assignment. The non-geometric prepositions include the prepositions *bei* ('at'), *zu* ('to'), *von* ('from'), *auf ... zu* ('towards'), its archaic from *gen* ('towards'), and *von ... weg* ('away from'). Note that *auf ... zu* and *von ... weg* are fixed combinations of a preposition and a postposition. Nevertheless, I avoid the term 'circumposition' because, under certain conditions, these combinations can occur in reverse order as a combination of prepositions, i.e. *zu auf* and *weg von*.

[94]Often, the spatial prepositions discussed here cannot be translated one to one into English. Thus the translations appear sometimes awkward.

In order to illustrate the non-geometricality of these prepositions, take the non-geometric preposition *zu* ('to') in (299a). Essentially, it does not provide any geometric information insofar as we do not know where exactly Hans ended up with respect to the forest. Did he enter the interior of the forest? Or did he stop at the forest boundary or at a location somewhere near the forest? (299a) does not specify this information. All we know is that he ran to a location that is somehow related to and at least near the forest. In contrast, the geometric preposition *in* ('into') in (299b) provides geometric information insofar as we know that Hans ended up in the interior of the forest.

(299) a. Hans rannte **zu** einem Wald.
Hans ran to a.DAT forest
'Hans ran to a forest.'

b. Hans rannte **in** einen Wald.
Hans ran in a.ACC forest
'Hans ran into a forest.'

Table 3 maps this geometry/non-geometry divide to the typology of spatial prepositions shown in Figure 35, that is, to place prepositions and to path prepositions (source, goal, and route). Note that route prepositions cut across the geometric/non-geometric divide.

			geometric	**non-geometric**
place			*an* ('on'), *auf* ('upon'), *in* ('in')	*bei* ('at')
path	**dir.**	**source**	*aus* ('out of'), (*von an* 'from on'), (*von auf* 'from upon'), (*von in* 'from in')	*von* ('from'), *von ... weg* ('away from')
		goal	*an* ('onto'), *auf* ('up onto'), *in* ('into')	*zu* ('to'), *auf ... zu* ('towards')
	undir.	**route**	*um* ('around'), *über* ('across, over'), *durch* ('through')	

Table 3: Geometric and non-geometric prepositions in German

The geometric prepositions are *an*, *auf*, and *in* occur, on the one hand, as place prepositions, and on the other hand, as goal prepositions. Note that they take a dative complement when serving as place prepositions and an accusative complement when serving as goal prepositions. This is the well-known place/goal alternation (or dative/accusative alternation) of German prepositions. Note also that the projective prepositions, which I omit here, are likewise subject to the place/goal alternation.

The geometric source prepositions can either have a synthetic form or an analytic form. The synthetic geometric source preposition in German is *aus*. The analytic forms are combinations of the (non-geometric) source preposition *von* plus *an*, *auf*, or *in*.[95] Note that the analytic forms are generally dispreferred, yet not ungrammatical. Note in this regard that the projective prepositions pattern with *an* and *auf*.

The geometric route prepositions have forms distinct from the other geometric prepositions. Interestingly, the topological route prepositions *um*, *über*, and *durch* are the only morphologically simplex route prepositions in German.[96] In particular, there are no morphologically-simplex projective route prepositions.

The number of non-geometric prepositions is relatively low compared to the number of geometric prepositions. There is only *bei* serving as a place preposition. For both source and goal respectively, there are two prepositions: *von* and *von ... weg* as well as *zu* and *auf ... zu*. In fact, this dichotomy mirrors the bounded/unbounded divide addressed in Section 5.1.3.

In addition to the geometric/non-geometric divide, I argue for a third class of prepositions that I refer to as **pseudo-geometric prepositions**. Pseudo-geometric prepositions can be considered as the prototypical place and path prepositions used with a certain DP providing a 'functional locative' interpretation. That is, pseudo-geometric prepositions are functional locative prepositions. Superficially, pseudo-geometric prepositions look and in some respects also behave like geometric prepositions, but, crucially, pseudo-geometric prepositions lack an explicit geometric level of description. Instead, they denote locations that have a functional character. The pesudo-geometric prepositions involve the topological prepositions *an* ('on/at, onto/to'), *auf* ('upon/at, up onto/to'), *in* ('in/at, into/to') – in both their place and path version – and additionally the path preposition *nach* ('to').

With common nouns, often both pseudo-geometric and geometric prepositions are possible, which leads to an ambiguity. Consider the examples in (300) involving the preposition *auf* and the common noun *Standesamt* ('civil registry office'). In (300a), *auf* serves as a place preposition, while it serves as a path preposition (goal) in (300b).

(300) a. Hans war **auf** dem Standesamt.
Hans was upon the.DAT civil registry office

b. Hans ging **auf** das Standesamt.
Hans went upon the.ACC civil registry office

Both the place preposition and the path preposition are at least two-way ambiguous. On the first reading, the geometric reading that is available with geometric prepositions, Hans literally was on/went onto the civil registry office, because he was a roofer, for instance. On the other reading, the general locative reading that is available with pseudo-geometric prepositions, Hans was at/went to the civil registry office, for instance, because he was a groom. I refer to this ambiguity as the **roofer/groom ambiguity**. Note that the preposition *auf* in (300) is best translated into English as 'on, onto' on the geometric usage, and as 'at, to'

[95] The source prepositional combination *von in* ('from in') is semantically tantamount to *aus* ('out of'). The combination *von in* is not ungrammatical, but highly dispreferred, which is, I think, due to the existence of *aus*.

[96] The preposition *über* is highly ambiguous. It is not only a geometric route preposition, it can also be a projective place (and goal) preposition meaning 'above' (and 'to above').

on the pseudo-geometric usage. Note also that the geometric meaning of these prepositions could also be referred to as the **literal meaning** of the prepositions.

The roofer/groom ambiguity is of course also influenced by the internal and external context of the PP. Let us look at the internal context, i.e. the complement of the preposition, e.g. *auf*. Several Ground DPs can be subject to regular polysemy, i.e. they can be conceptualized in different ways.[97] A DP like *Standesamt* ('civil registry office'), for instance, can either be conceptualized as an institution (abstract) or as a building (concrete). Here, the availability of the geometric reading of the preposition *auf* seems to correlate with the building-reading of the civil registry office. If we take a Ground DP that is not subject to regular polysemy in that way, the geometric reading of the preposition is (almost) unavailable. Consider (301) involving the noun *Party* ('party'), which cannot be conceptualized as a concrete entity. Here, *auf* typically has the meaning 'at' (place) or 'to' (goal).

(301) a. Hans war **auf** der Party.
Hans was at the.DAT party

b. Hans ging **auf** die Pary.
Hans went to the.ACC party

Nevertheless, the external context of the preposition also influences the reading of the preposition. Let us look at the choice of the verb that can take a PP headed by *auf* as an argument. In (300) the verbs have a rather unspecific or general meaning. In fact, this seems to favor the availability of the general locative reading with pseudo-geometric prepositions. If we choose a verb with a more specific manner component, e.g. *klettern* ('climb') in (302), pseudo-geometric preposition with the general locative reading is pretty unlikely.

(302) Hans kletterte **auf** das Standesamt.
Hans climbed up onto the.ACC civil registry office
'Hans climbed up onto the civil registry office.'

Due to the fact that many common nouns can be conceptualized in several distinct ways, the roofer/groom ambiguity is indeed common, but often unnoticed. Many instances can remain undisambiguated and thus blur the borderline between geometric and pseudo-geometric prepositions. However, pseudo-geometric prepositions can often be identified as such when they occur in contexts where geometric prepositions are blocked. Typical contexts of this sort are provided by toponyms, i.e. names of topological entities (countries, cities, islands, etc.), are – under normal conditions – always pseudo-geometric prepositions. I refer to pseudo-geometric prepositions that occur with toponyms as **toponymic prepositions**. Toponymic prepositions are paradigmatic instances of pseudo-geometric prepositions. This thesis discusses toponymic prepositions as a case study of pseudo-geometric prepositions.

[97] Ora Matushansky (pc) pointed out that pseudo-geometric could be licensed in the context of weak definites (Aguilar Guevara 2014). I leave this question for future work.

In German, geometric and pseudo-geometric prepositions behave differently in at least two ways. First, geometric prepositions license a so-called echo extension, i.e. a postpositional element involving the very same preposition, while pseudo-geometric prepositions do not license echo extensions. Second, geometric prepositions are subject to free choice, i.e. as long as semantic selection restrictions are obeyed, any preposition could be used depending on the spatial relation the speaker wants to express, while pseudo-geometric prepositions are not subject to free choice, i.e. they are fixed with respect to a DP.

Let us first look at the licensing ability of **echo extensions**. An echo extension is an optional postpositional element consisting of a deictic element and a recurrence of the preposition. Abraham (2010: 265) terms these optional postpositional elements echo extensions, because they contain a recurrence of the preposition. Geometric prepositions typically allow an echo extension (303).[98]

(303) a. Hans stand **an** der Wand (dr-**an**).
Hans stood on the.DAT wall there-on
'Hans stood at the wall.'

b. Hans saß **auf** dem Tisch (dr-**auf**).
Hans sat upon the.DAT table there-upon
'Hans sat upon the table.'

c. Hans lag **in** der Kiste (dr-**in**).
Hans lay in the.DAT box there-in
'Hans lay in the box.'

d. Hans kam **an** die Wand (her-**an**).
Hans came onto the.ACC wall hither-on
'Hans came to the wall.'

e. Hans sprang **auf** den Tisch (hin-**auf**).
Hans jumped up onto the.ACC table thither-upon
'Hans jumped on the table.'

f. Hans schlenderte **aus** dem Zimmer (her-**aus**)
Hans strolled out of the.DAT room hither-out
'Hans strolled out of the room.'

g. Hans rannte **in** das Zimmer (hin-**ein**)
Hans ran into the.ACC room thither-in
'Hans ran into the room.'

In contrast to geometric prepositions, pseudo-geometric prepositions do not allow echo extensions (304).

(304) a. Hans wohnte **an** der Ostsee (*dr-an).
Hans lived on the.DAT Baltic Sea there-on
'Hans lived at the Baltic Sea.'

[98] Note that not all geometric prepositions allow echo extension. Topological place and path prepositions, as well as route prepositions allow echo extension, while projective prepositions do not allow echo extensions.

b. Hans war **auf** den Kanaren (*dr-auf).
Hans was upon the.DAT Canary Islands there-upon
'Hans was in the Canary Islands.'

c. Hans war **in** der Mongolei (*dr-in)
Hans was in the.DAT Mongolia there-in
'Hans was in Mongolia.'

d. Hans wanderte **an** den Bodensee (*her-an)
Hans hiked onto the.ACC Lake Constance hither-on
'Hans hiked to Lake Constance.'

e. Hans flog **auf** die Azoren (*hin-auf)
Hans flew up onto the.ACC Azores thither-upon
'Hans flew to the Azores.'

f. Hans reiste **aus** der DDR (*her-aus).
Hans traveled out of the.DAT GDR hither-out
'Hans traveled out of the GDR.'

g. Hans fuhr **in** die Schweiz (*hin-ein).
Hans drove into the.ACC Switzerland thither-in
'Hans drove to Switzerland.'

h. Hans trampte **nach** Berlin (*hin-nach).
Hans hitchhiked to Berlin thither-to
'Hans hitchhiked to Berlin.'

With respect to echo extensions, non-geometric prepositions pattern with pseudo-geometric prepositions. Here it only makes sense to look at the non-geometric place preposition *bei* ('at') and the non-geometric path prepositions *von* ('from') and *zu* ('to'), because the non-geometric prepositions *von ... weg* ('away from') and *auf ... zu* ('towards') consist of a prepositional part and a non-echo postpositional part anyway. Non-geometric prepositions do not allow an echo extension (305).

(305) a. Hans stand **bei** der Hütte (*da-bei).
Hans stood at the.DAT hut there-at
'Hans stood at the hut.'

b. Hans fuhr **zu** der Hütte (*hin-zu).
Hans drove to the.DAT hut thither-to
'Hans drove to the hut.'

c. Hans kam **von** der Hütte (*her-von).
Hans came from the.DAT hut hither-from
'Hans came from the hut.'

Note that the constructions *bei ... dabei* and *zu ... hinzu* do in fact exist. However, both constructions do not have a spatial but rather a comitative interpretation. They thus fall outside the scope of this thesis.

(306) a. Die Rechnung war **bei** der Lieferung da-**bei**.
The bill was at the delivery there-at
'The delivery came with the bill included.'

b. Hans schüttete Wasser **zu** der Sauce hin-**zu**.
Hans pours water to the sauce thither-to
'Hans added water to the sauce.'

Let us now look at the second difference between geometric prepositions on the one hand and pseudo-geometric prepositions on the other. While geometric prepositions are subject to **free choice**, pseudo-geometric prepositions are not subject to free choice. Here, free choice refers to the choice of geometric configuration. Obviously, the choice of a genuine geometric preposition depends on the geometric configuration that is to be expressed. As long as the semantic selection restrictions are obeyed, any geometric prepositions can combine with any kind of Ground. As an example of geometric prepositions, consider the topological place prepositions in (307a) and the corresponding goal prepositions in (307b). Each preposition in (307) contributes distinct spatial information. In particular, the choice of the preposition depends on what kind of spatial relation the speaker intends to express (307).

(307) a. Hans stand **an/auf/in** der Hütte.
Hans stood on/upon/in the.DAT hut
'Hans stood at/on/in the hut.'

b. Hans sprang **an/auf/in** die Hütte.
Hans jumped onto/up onto/into the.ACC hut
'Hans jumped to/onto/into the hut.'

To a certain extent, this is similar to the free choice of the subject and the object in (308). Depending on what situation the speaker wants to describe, they might equally have chosen *shark* and *fish* as subject and object (308a), or the other way around (308b).

(308) a. The shark chased the fish.

b. The fish chased the shark.

(Harley and Noyer 2000: 7)

The picture is different with pseudo-geometric prepositions. Unlike geometric prepositions, pseudo-geometric prepositions are restricted to the effect that the Ground determines the preposition. In fact, it seems that the conceptualization of the Ground rather than the intended spatial relation determines the preposition. That is, the choice of the preposition is not free but depends on the Ground argument. In each of the examples in (309), only one preposition is possible.

(309) a. Hans war **in**/*auf/*an dem Iran.
Hans was in/upon/on the.DAT Iran
'Hans was in Iran.'

b. Hans flog **auf**/*in/*an/*nach die Balearen.
Hans flew up onto/into/onto/to the.ACC Balearic Islands
'Hans flew to the Balearic Islands.'

c. Hans fuhr **an**/*in/*auf/*nach die Nordsee.
Hans drove onto/into/up onto/to the.ACC North Sea
'Hans drove to the North Sea coast.'

d. Hans raste **nach**/*in/*auf/*an München.
Hans raced to/into/up onto/onto Munich
'Hans raced to Munich.'

By definition, non-geometric prepositions do not involve a geometric level of description and thus non-geometric prepositions do not correspond to any of the various geometric relations the way geometric prepositions do. As a consequence, the question concerning free choice does not arise for non-geometric prepositions. Nevertheless, the choice of a non-geometric preposition seems to be determined by the absence of any spatial Content feature.

Table 4 summarizes how geometric, pseudo-geometric, and non-geometric prepositions behave with respect to echo extensions and with respect to the question of free choice.

	geometric prepositions	**pseudo-geometric prepositions**	**non-geometric prepositions**
echo extensions	yes	no	no
free choice	yes	no	–

Table 4: Properties of non-geometric, geometric, and pseudo-geometric prepositions

Note that I attribute this behavior to the presence or absence of Content material in Root position within the prepositional head. That is, while geometric prepositions involve Content material in Root position, pseudo-geometric and non-geometric prepositions do not. For a detailed discussion of the lexical derivations of geometric, pseudo-geometric, and non-geometric prepositions, I refer the reader to Section 5.4. For a further discussion of echo extensions, I refer the reader to Section 5.5, which addresses the functional prepositional structure hosting echo extensions.

5.1.3 Prepositions and aspect

Following Jackendoff (1991), Verkuyl and Zwarts (1992), Piñón (1993), Zwarts (2005b), I consider prepositional aspect as being correlated to the distinction between **bounded** and **unbounded** reference familiar from the verbal and nominal domain (Bach 1986, Jackendoff 1991). Both place and path prepositions – or rather the phrases they ultimately project – can serve as heads of arguments of verbs. But while place prepositions are like state descriptions inasmuch as they are aspectually neutral, path prepositions can contribute to the aspectual properties of a clausal predicate (Zwarts 2005b: 741). Take manner of motion verbs like *walk*, *run*, or *swim*, which typically give rise to an atelic interpretation when they are used all by themselves (310a). Let us add a path preposition – goal, for instance. While the addition of the goal preposition *to* leads to a telic interpretation (310b), the addition of the goal preposition *towards* preserves the atelic interpretation of the manner of motion verb (310c).

(310) a. John swam for/$^{??}$in 30 minutes.
b. John swam **to** the island in/$^{?}$for 30 minutes.
c. John swam **towards** the island for/$^{??}$in 30 minutes.

As already mentioned, I assume that this is due to the fact that spatial paths denoted by prepositions like *to* are conceptualized as bounded, i.e. as having boundaries in space, while the spatial paths denoted by prepositions like *towards* are conceptualized as unbounded, i.e. as having no boundaries in space.

Let us look at how the notion of boundedness of paths relates to the typology of spatial prepositions in Figure 35 Of particular interest here are the three types of path prepositions: source, goal, and route prepositions. Recall that source and goal prepositions are directed, and that route prepositions are undirected. Distinguishing between bounded and unbounded paths, Jackendoff (1991) accounts for unbounded directed paths (directions) and unbounded undirected paths (routes) on the one hand, and for bounded directed paths on the other hand. That is, he assumes that only unbounded paths can be undirected. Put differently, bounded paths are always directed in his system. Consider the typology of (spatial) paths in Figure 36.

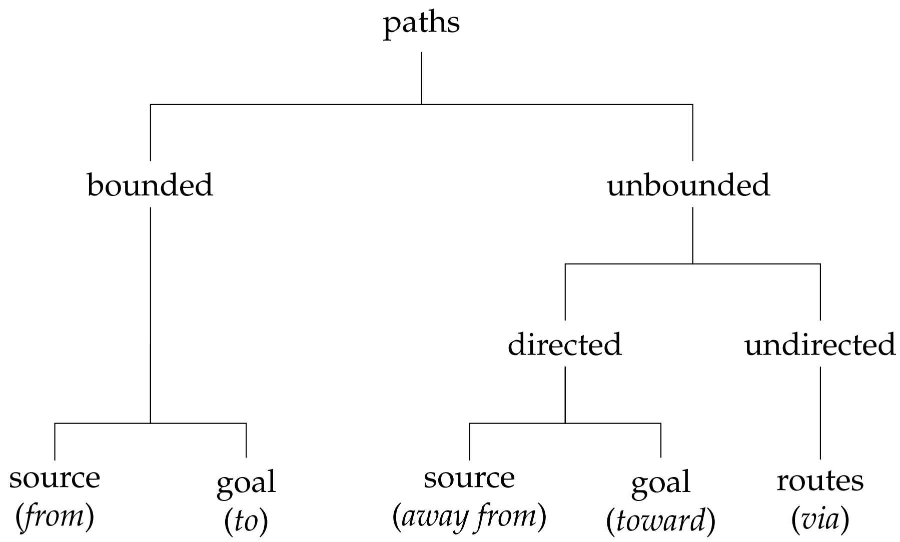


Figure 36: Typology of paths according to Jackendoff (1991)

Assuming that boundedness in the conceptualization of paths correlates to telicity in the verbal domain, Piñón (1993) takes this typology as a starting point. Applying the well-known aspectual tests involving compatibility with *in/for*-adverbials, Piñón confirms the general division into bounded and unbounded paths of goal (and source) prepositions (311a)/(311b) and that there are route prepositions that do not denote bounded paths (311c).

(311) a. Mary walked to the library {in ten minutes, #for ten minutes}.
b. John skipped towards the park {for ten minutes, #in ten minutes}.
c. The dog ran along the river {for ten minutes, #in ten minutes}.
(Piñón 1993: 298)

However, Piñón observes that some route prepositions show a variable behavior when tested for their aspectual class. In particular, the route prepositions in (312) give rise to both a telic and an atelic interpretation.

(312) a. The insect crawled through the tube {for two hours, in two hours}.
b. The procession walked by the church {for 45 minutes, in 45 minutes}.
c. Mary limped across the bridge {for ten minutes, in ten minutes}.
(Piñón 1993: 298)

Piñón (1993) concludes that paths denoted by route prepositions can be conceptualized as unbounded **and** as bounded paths. Piñón thus proposes the enriched, symmetrical typology of paths in Figure 37. In particular, both directed path prepositions (goal and source) and undirected path prepositions (route) can denote bounded and unbounded paths.

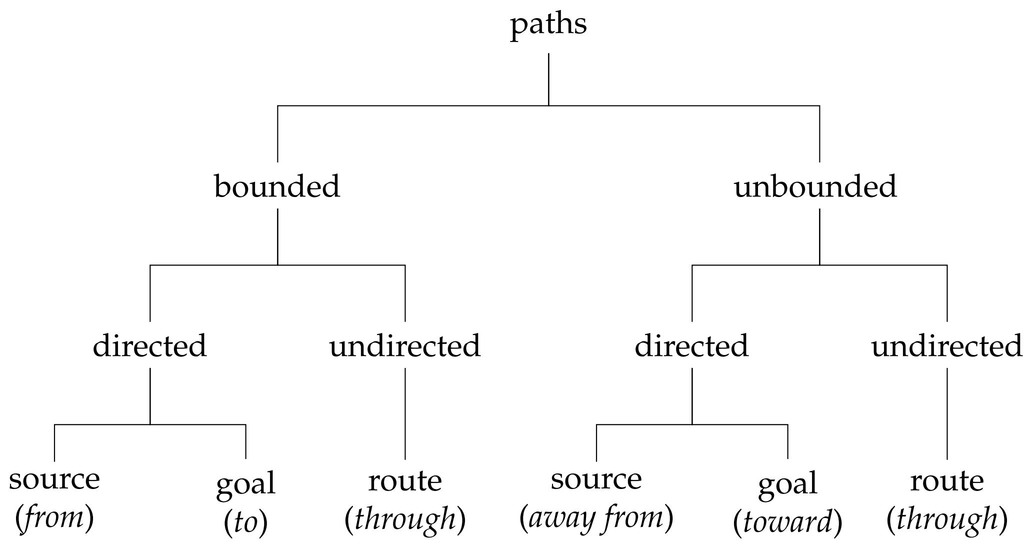


Figure 37: Symmetrical typology of paths according to Piñón (1993)

Kracht's (2002, 2008) system comprises the same six types of paths: bounded source paths are **coinitial** paths, bounded goal paths are **cofinal** paths, bounded route paths are **transitory** paths, unbounded source paths are **recessive** paths, unbounded goal paths are **approximative** paths, and unbounded route paths are **static** paths. These six classes of paths are given in Table 5, together with prototypical English examples. Note that I refer to Pantcheva (2011) for further discussion concerning classifications of paths.

	directed		**undirected (route)**
	source	**goal**	
bounded	coinitial *from*	cofinal *to*	transitory *past*
unbounded	recessive *away from*	approximative *towards*	static *along*

Table 5: Kracht's (2002, 2008) classification of paths

Let us now fill this table with German path prepositions. In German, recessive and approximative paths are typically not expressed by simplex spatial prepositions. For instance, a common way of expressing approximative paths is by using the prepositional construction *in Richtung (von)* (lit.: in direction 'towards, in the direction of') involving a nominal element. Thus, recessive and approximative path descriptions fall outside the scope of this thesis. Nevertheless, I briefly touch upon the construction *auf ... zu* ('towards') in Section 5.5.3.

	directed		**undirected**
	source	**goal**	**(route)**
bounded	coinitial *aus* ('out of'), (*von an* 'from on'), (*von auf* 'from upon'), (*von in* 'from in'), *von* ('from')	cofinal *in* ('into'), *an* ('onto'), *auf* ('up onto'), *nach* ('to'), *zu* ('to')	transitory *durch* ('through'), *über* ('across, over'), *um* ('around')
unbounded	recessive *von ... weg* ('away from')	approximative *auf ... zu* ('towards')	static *durch* ('through'), *über* ('across, over'), *um* ('around')

Table 6: Bounded and unbounded German path prepositions

Before closing this section, I should like to mention the spatial usage of the preposition *bis* ('till, until, up'). Surprisingly, *bis* does not seem to be a proper spatial preposition on par with other goal prepositions. Structurally, it seems to 'depend' on other goal prepositions. In particular, I assume that it marks **delimited** paths in the sense of Pantcheva (2011). The preposition *bis* can occur in two contexts. On the one hand, *bis* can be used optionally in combination with every German cofinal preposition resulting in a so-called terminative path description (Pantcheva 2011: 59). See (313a) for an example with the non-geometric goal preposition *zu* ('to') and (313b) for an example with the geometric goal preposition *under* ('under').

(313) a. Hans fuhr (bis) zu der alten Messestadt.
Hans drove up to the.DAT old trade fair city
'Hans drove until the old trade fair city.'

b. Hans fuhr (bis) unter das Dach.
Hans drove up under the.ACC roof
'Hans drove until he was under the roof.'

(adapted from Eisenberg et al. 1998: 393)

On the other hand, *bis* can occur with determinerless toponyms as in (314).

(314) Hans fuhr bis Frankfurt
Hans drove until Frankfurt
'Hans drove until Frankfurt.'

In this thesis, I assume that the usage of *bis* with toponyms in (314) is in fact parallel to its usages in (313). Consider the fact that *bis* can optionally co-occur with toponymic *nach* as in (315a) or with toponymic *in* as in (315b). Indicating delimited paths, *bis* in (315) behaves like in (313).

(315) a. Hans fuhr (bis) nach Frankfurt
Hans drove up to Frankfurt
'Hans drove until Frankfurt.'

b. Hans fuhr (bis) in die Schweiz.
Hans drove up in the.ACC Switzerland
'Hans drove until Switzerland.'

Nevertheless, toponymic *nach* is special when used with *bis* because it can be omitted as in (316a), giving rise to (314). Interestingly, only the toponymic preposition *nach* can be omitted. Other toponymic goal prepositions like *in* ('to, into') in (316b) cannot be omitted when used with *bis*.

(316) a. Hans fuhr bis (nach) Frankfurt.
Hans drove up to Frankfurt
'Hans drove until Frankfurt.'

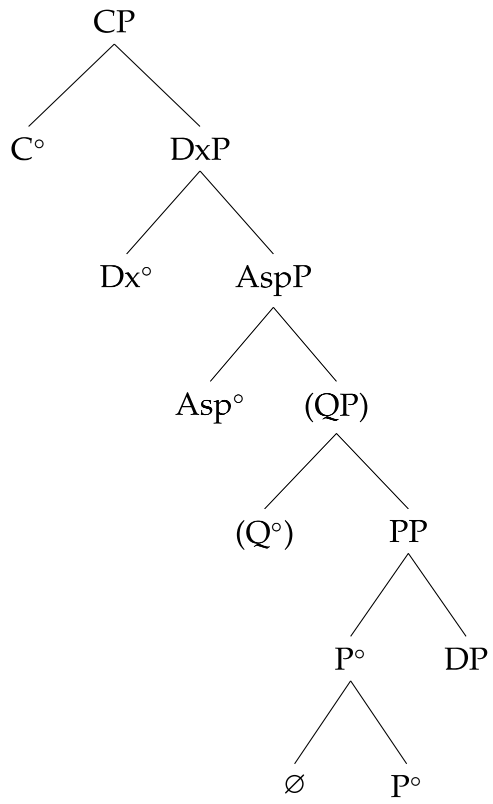
b. Hans fuhr bis *(in) die Schweiz.
Hans drove up in the.ACC Switzerland
'Hans drove until Switzerland.'

Note that this is all I have to say about *bis* in this thesis.

5.1.4 Categories and syntacticosemantic features in prepositions

This section briefly discusses how the classes of prepositions discussed in the previous sections map to prepositional structure. Let us first determine the general structure of fully-fledged prepositions. Generally, I assume that every preposition involves the lexical category P, which takes a DP-complement and which can generate a Root position; cf. Section 2.3. Furthermore, I assume that some prepositions can additionally involve the light category Q above P. In line with Den Dikken (2010), a.o., I assume that every fully-fledged PP involves the functional categories Asp (for aspect), Dx (for deixis), and C (for complementizer) above Q; or directly above P, if Q is absent. Ignoring the ultimate surface linearization (cf. Section 3.2), we can determine the general structure of fully-fledged prepositions as given in (317).

(317)



The categories of the structure in (317) can host various syntacticosemantic (synsem) features. The category P can host one of the synsem features [LOC] (for locative), [AT], or [±NINF] (for non-initial, non-final). The feature [LOC] characterizes (pseudo)-geometric prepositions, while the feature [AT] characterizes non-geometric prepositions. The feature [±NINF] (for non-initial, non-final) characterizes undirected path prepositions, i.e. route prepositions. Place prepositions involve the category P hosting either [LOC] or [AT]; place prepositions may not involve the category Q. The category Q above P derives directed path prepositions from place prepositions.[99] Q can host the synsem feature [±TO]. In both (pseudo)-geometric and non-geometric contexts, Q[+TO] derives goal prepositions and Q[−TO] derives source prepositions. Table 7 summarizes these considerations the according to the schema of Table 3.

			(pseudo)-geometric	**non-geometric**
place			P[LOC]	P[AT]
path	**dir.**	**source**	P[LOC] < Q[−TO]	P[AT] < Q[−TO]
		goal	P[LOC] < Q[+TO]	P[AT] < Q[+TO]
	undir.	**route**	P[±NINF]	

Table 7: Categories and features of (pseudo)-geometric and non-geometric prepositions

Generally, path prepositions can be bounded or unbounded (cf. Section 5.1.3). I assume that bounded and unbounded aspect of *directed* path prepositions (source and goal prepositions) relate to the synsem feature [±UNBD] (for unbounded) hosted by the functional category

[99] The idea that path-related features are structurally higher than place-related features is a common assumption in the literature (Jackendoff 1983, Koopman 2000, 2010, Folli 2008, Gehrke 2008, Mateu 2008, Svenonius 2008, 2010, Noonan 2010, Den Dikken 2010, Pantcheva 2011, a.o.).

Asp above Q; [+UNBD] leads to unbounded source and goal prepositions, and [−UNBD] leads to bounded source and goal prepositions. In contrast, bounded and unbounded aspect of *undirected* path prepositions (route prepositions, cf. Section 5.4.3) relate to the value of the synsem feature [±NINF] hosted by P; [−NINF] leads to bounded route prepositions and [+NINF] leads to unbounded route prepositions. Note that directed (pseudo)-geometric path prepositions denote transitional paths and are thus necessarily bounded; cf. Sections 5.4.2.1 and 5.4.2.2. That is, directed (pseudo)-geometric path prepositions, which are characterized by Q[±TO] above P[LOC], are uninterpretable with Asp[+UNBD]. Directed non-geometric path prepositions denote non-transitional paths and hence they can be bounded or unbounded; cf. Section 5.4.2.3. That is, directed non-geometric path prepositions, which are characterized by Q[±TO] (above P[AT]), are interpretable either with Asp[−UNBD] or with Asp[+UNBD]. Table 8 summarizes these considerations according to the schema of Table 6.

	directed		**undirected (route)**
	source	**goal**	
bounded	Q[−TO] < Asp[−UNBD]	Q[+TO] < Asp[−UNBD]	P[−NINF]
unbounded	Q[−TO] < Asp[+UNBD]	Q[+TO] < Asp[+UNBD]	P[+NINF]

Table 8: Aspectually-relevant features in path prepositions

Furthermore, I propose that the difference between geometric prepositions and pseudo-geometric prepositions relates to the filling of the prepositional Root position. I particular, I assume that geometric prepositions contain an abstract Content feature in their Root position, while pseudo-geometric prepositions (and also non-geometric prepositions) do not contain an abstract Content feature in their Root position. Section 5.3 addresses the abstract Content features that are relevant for the topological prepositions this thesis focuses on.

The functional category Dx dominates Asp and can host the synsem features [+PROX] for proximal deixis or [−PROX] for non-proximal (distal) deixis. The functional category C dominates Dx and can host the synsem features [+MOTION] for path prepositions or [−MOTION] for place prepositions.

5.2 On the cartographic decomposition of prepositions

Even though I do not pursue a cartographic analysis of German prepositions in this thesis, it is worth to briefly present some work on spatial prepositions that is embedded in the cartographic enterprise. Generally, Cartography aims at exploding syntactic structures in order to obtain articulated and fine-grained hierarchical structures of features (Cinque 1999, Cinque and Rizzi 2008, Shlonsky 2010, and the contributions in Cinque 2002, Rizzi 2004, Belletti 2004, Cinque 2006, Benincà and Munaro 2010, Cinque and Rizzi 2010). Cartographic approaches typically necessitate the assumption that multiple syntactic terminals can be realized jointly by one indecomposable morphophonological exponent. Relating to this, Nanosyntax assumes phrasal spell-out; cf. Starke (2009). A cartographic decomposition in

Distributed Morphology, however, would require spanning; cf. Svenonius (2016), Alexiadou (2016).

The domain of (spatial) prepositions is often the subject of cartographic research (see in particular the contributions in Asbury et al. 2008, Cinque and Rizzi 2010). Based on conceptual considerations by Jackendoff (1983), many scholars assume that features related to directional path semantics (PATH), if present, are in general structurally superior to features related to locative place semantics (PLACE) (e.g. Jackendoff 1983, Koopman 2000, 2010, Folli 2008, Gehrke 2008, Mateu 2008, Svenonius 2008, 2010, Noonan 2010, Den Dikken 2010, Pantcheva 2011, a.o.). Thus, the basic cartographic decomposition of spatial prepositions in (318) is often assumed.

(318) **Basic cartographic decomposition of spatial prepositions:**
PATH > PLACE

Focusing on complex spatial prepositions of the type *in front of*, as in (319), Svenonius (2006, 2010) argues for a cartographic decomposition of the PLACE component.

(319) There was a kangaroo in front of the car.

Svenonius observes that the determinerless nominal element *front* in (319) cannot be analyzed as a straightforward nominal complement of the preposition *in*, like the one in (320), involving a determiner. Consider the more or less transparent interpretations of (320). While (320a) is interpreted to the effect that a kangaroo was in one of the front seats of the car, (320b) is interpreted to the effect that a kangaroo is in contact with the surface of the front part of the car. However, (319) has a different interpretation, namely that the kangaroo is located in the space projected forward from the car.

(320) a. There was a kangaroo in the front of the car.
b. There was a kangaroo on the front of the car.

Interestingly, while the core preposition *in* can be replaced in (320a), as done in (320b), *in* cannot be replaced in (319); (321) is ungrammatical.

(321) *There was a kangaroo on front of the car.

Further, the usage of *front* with a determiner in (322a) allows pluralization, while the determinerless usage in (322b) does not.

(322) a. There were kangaroos in the fronts of the cars.
b. *There were kangaroos in fronts of the cars.

Moreover, while adjectival modification of the nominal *front* is possible in the usage with a determiner in (323a), adjectival modification is impossible in the determinerless usage in (323b).

(323) a. There was a kangaroo in the smashed-up front of the car.
 b. *There was a kangaroo in smashed-up front of the car.

Considering these data, Svenonius concludes that the preposition *in* does not simply embed a DP, but that the nominal element must realize some different syntactic position. Proposing a cartographic decomposition of prepositions, Svenonius (2006) allocates this syntactic position within the prepositional domain. In particular, Svenonius argues that the feature [AXPART] within prepositions can host nominal elements such as *front*. For PPs such as *in front of the house*, he (2010: 131) offers the analysis in (324), where the core preposition *in* realizes a feature termed [LOC], the nominal element the feature [AXPART], and *of* a further feature termed [K].

(324) [LOC=*in* [AXPART=*front* [K=*of* DP=*the house*]]]
(adapted from Svenonius 2010: 131)

Considering further features – which I do not discuss here – Svenonius (2010) ultimately proposes the cartographic decomposition of PLACE as given in (325).

(325) **Svenonius' cartographic decomposition of** PLACE:
DEG > DEIX > LOC > AXPART > K
(Svenonius 2010: 133, 144)

Recently, Svenonius (2017) has argued that a full (cartographic) spine of features, as given in (325), should not be assumed in the case of topological prepositions; simply because there is, cross-linguistically, no syntacticosemantic or morphosyntactic evidence for this. For instance, he assumes that topological prepositions, such as English *in*, *on*, and *at*, do only project [LOC] above [K] – ignoring Svenonius' (2003) little *p* at this point. I take the view that Svenonius' (2010) cartographic feature [K] roughly corresponds to the lexical category feature P in the approach outlined in this thesis. Similarly, Svenonius' cartographic feature [LOC] roughly corresponds to the synsem features [LOC] and [AT] that I assume in this thesis for (pseudo)-geometric and non-geometric prepositions. Instead of a hierarchical structuring of the category feature P and the synsem features [LOC] and [AT], I assume that the former can host one of the latter.

Pantcheva (2011) cartographically decomposes PATH. Pantcheva argues for the cartographic decomposition of PATH, as given in (326).

(326) **Pantcheva's cartographic decomposition of** PATH:
ROUTE > SOURCE > GOAL

(Pantcheva 2011: 63)

Adopting Zwarts' (2008) semantics of paths,[100] Pantcheva argues that directional prepositions are minimally goal prepositions (e.g. *into*), which contain the feature [GOAL]. This feature is interpreted as a transitional predicate to the effect that there is a path that ends at a certain location (positive phase of the path), but, crucially, does not start at this location (negative phase of the path) (327a). In the case of source prepositions (e.g. *out of*), the feature [GOAL] is dominated by the feature [SOURCE] interpreted as a reversal operator. It operates on goal paths to the effect that the path starts at a certain location but does not end at this location. That is, it turns around the positive and the negative phase of a path (327b). In the case of route prepositions (e.g. *through*), the feature [SOURCE] is dominated by the feature [ROUTE] that semantically appends a positive phase in front of a source path. That is, it yields bi-transitional paths that go into a certain location and out of that location, and thus do not start and end at that location, see (327c).

(327) a. Goal path

− − − − − + + + + +
0 1

(Zwarts 2008: 84, Pantcheva 2011: 68)

b. Source path

+ + + + + − − − − −
0 1

(Zwarts 2008: 84, Pantcheva 2011: 71)

c. Route path

− − − − + + + + − − − −
0 1

(Zwarts 2008: 84, Pantcheva 2011: 72)

In this thesis, I refrain from a cartographic analysis for path prepositions, and also for place prepositions. Assuming a compositional semantics along the syntactic structure, it follows from Pantcheva's (2011) cartographic decomposition of route prepositions that their semantics contain the semantics of goal and source prepositions. However, in Section 5.4.3, I will argue that this appears not to be the case, at least in German. Thus, I do not commit to Pantcheva's analysis that route prepositions structurally derive from goal and source prepositions.

[100] Note that in Zwarts' approach paths are functions from the real unit interval $[0, 1]$ to positions in some model of space (Zwarts 2005b: 748). Thus, paths always start at 0 and end at 1.

5.3 Abstract Content features

This thesis focuses on spatial prepositions that express **topological relations**. In order to account for the topological relations described by the geometric prepositions *in* ('in'), *aus* ('out of'), *durch* ('through'), *an* ('on'), *um* ('around'), *auf* ('upon'), and *über* ('over, across'), I assume non-generative, abstract Content features that relate to general topological concepts. The topological concepts that figure in this respect are (i) interiority, (ii) contiguity, and (iii) verticality. The corresponding abstract Content features are [א] relating to interiority, [ב] relating to contiguity, and [ג] relating to verticality.[101]

At this point, we should look at cross-linguistic differences with respect to the choice of (geometric) preposition when describing topological relations. Consider the situations (a) to (f) in Table 9 below. Almost all languages taken into account have prepositions with which these situations can be described; only Japanese does not have prepositions for describing the situations in (b)–(e). However, as for the choice of preposition, the languages given in Table 9 show great variation. Let us briefly look at English, Dutch, German, and Spanish. While the situation in (f) can be described by using the preposition *in* and similarly functioning words in most other languages, (a)–(e) can be described by using varying prepositions in different languages. For describing (a)–(e), English has only the preposition *on*. For the same situations, Dutch and German have *op*/*auf* and *aan*/*an*, respectively, although with different distributions. Spanish – in contrast to English, Dutch, and German – does not have special prepositions for the situations depicted in (a)–(e). Instead, Spanish uses the same preposition as it does for (f). I take this cross-linguistic variation as indication of a language-specific treatment of the underlying features, which are arguably [א], [ב], and [ג]. Therefore, these features should not reside in the Lexicon proper, which is fed by UG; instead, I propose that these abstract features should reside in the Content.

Generally, I assume that Content features can enter structures at Root positions. In particular, I assume that the abstract Content features [א] (relating to interiority), [ב] (relating to contiguity), and [ג] (relating to verticality) can enter the prepositional structure at the Root position of P. Moreover, I assume that an abstract Content feature is integrated into the feature bundle of P, when inserted into the Root position of P. The basic P-structure before and after insertion of an abstract Content feature (here: [א]) is illustrated in (328a) and (328b), respectively.

[101] In this thesis, I represent the abstract topological Content features by means of the first three letters of the Semitic abjads: א (aleph), ב (beth), and ג (gimel).

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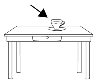
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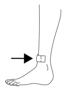
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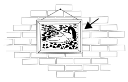
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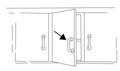
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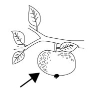
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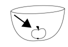
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<tr><td></td><td colspan="5">di</td></tr>
<tr><td>Spanish</td><td colspan="6">en</td></tr>
<tr><td>German</td><td>auf</td><td colspan="4">an</td><td>in</td></tr>
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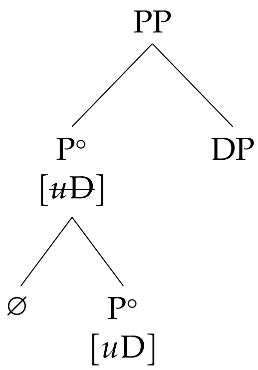
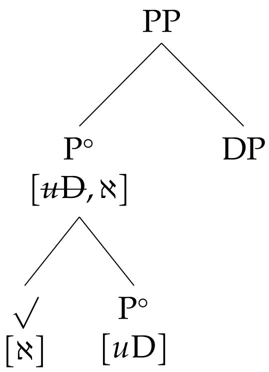
Table 9: Cross-linguistic differences in expressing topological relations (Bowerman and Choi 2001: 485)

(328) a. P-structure **before** insertion of Content feature:



b. P-structure **after** insertion of Content feature:



The PF- and LF-interface rules apply to the higher P°-node. By assumption, insertion of Content features takes place at Spell-Out. At this level, the feature [*u*D] that licenses the complement DP of the preposition is checked and thus it deletes. The Full Interpretation constraint states that "the structure to which the [...] interface rules apply contains no uninterpretable features" (Adger 2003: 85; cf. (56) on page 38). According to this constraint, the PF- and LF-interface rules may only target the structurally higher P° node, i.e. the one that potentially contains a Content feature.

Section 5.1.4 proposes three distinct P-contexts with regard to synsem features: P[LOC] is characteristic for (pseudo)-geometric prepositions (place, goal and source), P[AT] is characteristic for non-geometric prepositions (place, goal and source), and P[±NINF] is characteristic for route prepositions. I propose that the abstract Content features can, in principle, enter P-structures containing all of these three synsem features. However, in Section 5.4.1.3, I argue that the interpretation of P[AT] is incompatible with one of the abstract Content features presented above. That is, abstract Content features can enter P-structures that contain either P[LOC] or P[±NINF]. The former can additionally co-occur with the light preposition Q, which can host the synsem feature [+TO] for a goal interpretation, or [−TO] for a source interpretation. In sum, this yields four distinct contexts into which the abstract Content features [א], [ב], and [נ] can be inserted: (i) place prepositions, (ii) goal path prepositions, (iii) source path prepositions, and (iv) route prepositions.[102] I propose that the abstract Content features relate to these four structural contexts in the way shown in Table 10. Note that the respective structures yield geometric prepositions by means of insertion of Content features.[103]

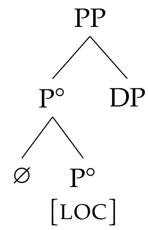
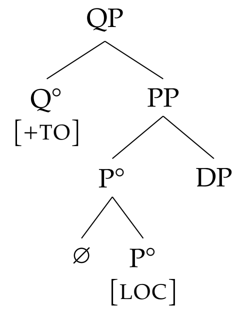
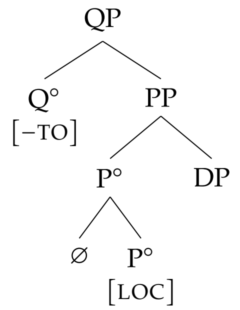
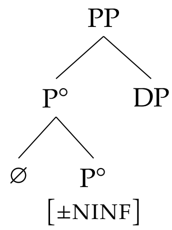
	place prepositions	**goal path prepositions**	**source path prepositions**	**route path prepositions**
				
[א]	*in* ('in')	*in* ('into')	*aus* ('out of'), (*von in* 'from in')	*durch* ('through')
[ב]	*an* ('on')	*an* ('onto')	(*von an* 'from on')	*um* ('around')
[נ]	*auf* ('upon')	*auf* ('up onto')	(*von auf* 'from upon')	*über* ('over, across')

Table 10: Abstract Content features in P-structures

Generally, there are two major prepositional contexts into which the abstract Content features can be inserted: (i) P[LOC] for place, goal and source prepositions; and (ii) P[±NINF] for route prepositions.[104] The next sections describe how the abstract Content features [א] relating to interiority, [ב] relating to contiguity, and [נ] relating to verticality manifest themselves semantically in these two prepositional contexts.

[102] Actually, there would have been five different contexts, if one would have kept P[−NINF] and P[+NINF] apart. However, the ultimate difference between these two structures (i.e. bounded vs. unbounded route prepositions) is not crucial here.

[103] With regard to Roots, one could say that the Content feature [א] is interpreted as the Root √durch when it is inserted in the Root position of P[±NINF], as the Root √aus when it is inserted in the Root position of P[LOC] dominated by Q[−TO], and as √in when it is inserted in the Root position of any other P[LOC]; cf. Section 2.3.

[104] At this point it should be mentioned that each of the predicates defined for route prepositions consists of two conditions: a boundary condition (i.e. intlis or extlis) and a configurational condition (i.e. spear-like, L-shaped, or plumb-square); cf. Section 4.3.6.

As for route prepositions, I will propose the three LF-predicates durch-bar, um-bar, and ueber-bar. The reason for labeling these predicates with the extension '-bar' is that they contribute some intermediate geometric predication. They do not function as geometric predicates of route paths, but of 'internal' parts of route paths, viz. NINF-path (non-initial, non-final paths).

5.3.1 Interiority

Both the place and goal preposition *in* ('in, into') and the route preposition *durch* ('through') conceptually relate to interiority. I assume that these two prepositions share a common feature that refers to the concept of interiority, viz. the abstract Content feature [א]. In the two prepositional contexts, the concept of interiority manifests itself in different ways. In the case of the place and goal preposition *in*, the concept of interiority manifests itself as the region that is inside the Ground, while, in the case of the route preposition *durch*, the concept of interiority manifests itself as a spatial path that lies spear-like inside the Ground. For the former configuration, I assume the two-place LF-predicate $\mathsf{in}(r, x)$ holding between a region r and a material object x, and for the latter configuration, I assume the two-place LF-predicate $\mathsf{durch\text{-}bar}(v, x)$ holding between a spatial path v and a material object x. Structurally, the place and goal preposition *in* is characterized by P[LOC] and the route preposition *durch* is characterized by P[±NINF]. Hence, I assume that [א] is interpreted as specifying an in-region of a material object when inserted into the Root position of P[LOC], while it is interpreted as specifying a durch-bar-path of a material object when inserted into the Root position of P[±NINF]. The following subsections define the model-theoretic denotations of the LF-predicates in and durch-bar, which both relate to interiority.

in-regions

I propose that the two-place predicate $\mathsf{in}(r, x)$ holding between a region r and a material object x is the core semantic interpretation of the geometric preposition *in* ('in, into'). The predicate is a prime at LF. In (329), I define that an in-region r of a material object x is included in (i) the three-dimensional inside region of x if x is conceptualized as three-dimensional, or (ii) the two-dimensional inner surface of x if x is conceptualized as two-dimensional. In order to distinguish between three- and two-dimensional material objects, we can exploit the fact that material objects that are conceptualized as three-dimensional have a ball-like surface, while material objects that are conceptualized as two-dimensional have a disc-like surface. For a discussion of the respective geometric predicates, I refer the reader to Section 4.3.4.

(329) $\forall r, x[\mathsf{in}(r, x) \leftrightarrow \mathsf{reg}(r) \wedge \mathsf{obj}(x) \wedge \exists z[\mathsf{reg}(z) \wedge r \subseteq z$
$\wedge\ \forall y[\mathsf{ball\text{-}like}(y) \wedge \mathsf{surf}(y, x) \rightarrow \mathsf{inside}(z, y)]$
$\wedge\ \forall y[\mathsf{disc\text{-}like}(y) \wedge \mathsf{surf}(y, x) \rightarrow \mathsf{insurf}(z, y)]]]$
"r is an in-region of a material object x iff r is included in a region z, and for all y if y

is a ball-like surface of x then z is the inside region of y, and for all y if y is a disc-like surface of x then z is the inner surface of y"

durch-bar-paths

I propose that the two-place predicate durch-bar(v, x) holding between a spatial path v and a material object x is the core semantic interpretation of the geometric route preposition *durch* ('through'). The predicate is a prime at LF. In (330), I define a durch-bar-path v of a material object x as an internal and spear-like line segment of the material object x. Both the respective predicates intlis (boundary condition) and spear-like (configurational condition) are defined in Section 4.3.6.

(330) durch-bar**-paths:**
$\forall v, x[\text{durch-bar}(v, x) \leftrightarrow \text{intlis}(v, x) \wedge \text{spear-like}(v, x)]$
"v is a durch-bar-path of material object x iff v is an internal and spear-like line segment of x"

5.3.2 Contiguity

Both the place and goal preposition *an* ('on, onto') and route preposition *um* ('around') conceptually relate to contiguity. I assume that these two prepositions share a common feature that refers to the concept of contiguity, viz. the abstract Content feature [⊐]. In the two prepositional contexts, the concept of contiguity manifests itself in different ways. In the case of the place and goal preposition *an*, the concept of contiguity manifests itself as the region of the Ground where a Figure has spatial contact with the Ground, while, in the case of the route preposition *um*, the concept of contiguity manifests itself as a spatial path that is external and tangential to the Ground and that changes its direction by 90° in order to keep tangentiality. For the configuration expressed by *an*, I assume the two-place LF-predicate an(r, x) holding between a region r and a material object x, and for the configuration expressed by *um*, I assume the two-place LF-predicate um-bar(v, x) holding between a spatial path v and a material object x. Structurally, the place and goal preposition *an* is characterized by P[LOC] and the route preposition *um* is characterized by P[±NINF]. Hence, I assume that [⊐] is interpreted as specifying an an-region of a material object when inserted into the Root position of P[LOC], while it is interpreted as specifying a um-bar-path of a material object when inserted into the Root position of P[±NINF]. The following subsections define the model-theoretic denotations of the LF-predicates an and um-bar, which both relate to contiguity.

an-regions

I propose that the two-place predicate an(r, x) holding between a region r and a material object x is the basic semantic interpretation of the geometric preposition *an* ('on, onto'). The predicate is a prime at LF. In (331), I define an an-region r of a material object x as a region that is in spatial contact with the region y, which is the region that x occupies. Section 4.3.5 discusses the notion of spatial contact.

(331) an**-regions:**
$\forall r, x[\mathsf{an}(r, x) \leftrightarrow \mathsf{reg}(r) \wedge \mathsf{obj}(x) \wedge \exists! y[\mathsf{reg}(y) \wedge \mathsf{occ}(x, y) \wedge r \propto y]]$
"r is an an-region of a material object x iff y is the region that x occupies, and r is in spatial contact with y"

um-bar**-paths**

I propose that the two-place predicate $\mathsf{um\text{-}bar}(v, x)$ holding between a spatial path v and a material object x is the basic semantic interpretation of the geometric preposition *um* ('around'). The predicate is a prime at LF. In (332), I define a um-bar-path v of a material object x as an external line segment of x that is L-shaped. This configuration is illustrated in Figure 38. Both the respective predicates extlis (boundary condition) and L-shaped (configurational condition) are defined in Section 4.3.6.

(332) um-bar**-paths:**
$\forall v, x[\mathsf{um\text{-}bar}(v, x) \leftrightarrow \mathsf{extlis}(v, x) \wedge \mathsf{L\text{-}shaped}(v)]$
"v is an um-bar-path of material object x iff v is an external line segment of x that is L-shaped"

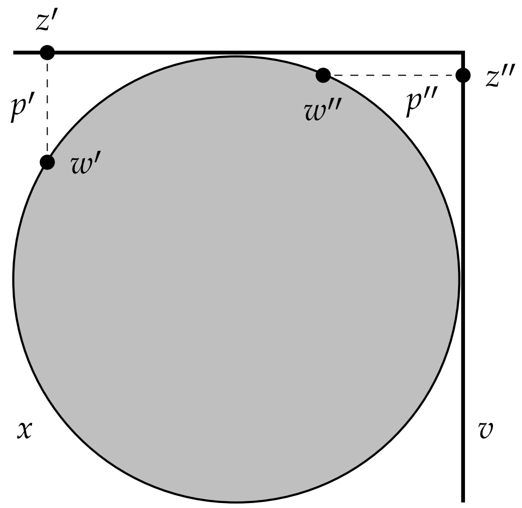


Figure 38: $\mathsf{um\text{-}bar}(v, x)$

Generally, I take the view that the German morpheme *um* fundamentally expresses some change of direction that relates to an L-shaped form.[105] This hypothesis is corroborated by various verbal constructions that *um* can enter. In addition to its usage as a route preposition,

[105]For other proposals for the German route preposition *um* ('around'), I refer the reader to Wunderlich (1993), who proposes that *um* can be semantically represented in terms of the geometric condition of enclosure.

um can also serve as a verbal prefix (inseparable verbal construction) as illustrated in (333a) or as a verbal particle (separable verbal construction) as illustrated in (333b).

(333) a. Hans **um**-fuhr den Baum.
Hans around.PREFIX-drove the.ACC tree
'Hans drove around the tree.'

b. Hans fuhr den Baum **um**.
Hans drove the.ACC tree around.PARTICLE
'Hans knocked down the tree.'

When used as a verbal prefix in combination with the verb *fahren* ('drive') as illustrated in (333a), the semantic interpretation of *um* is similar to the interpretation of *um* as a route preposition. The interpretation of the prefix verb *um-fahren* in (333a) is such that Hans takes a detour around the tree. However, when used as a verbal particle in combination with the same base verb as illustrated in (333b), the semantic interpretation of *um* is such that it expresses a fundamental positional change of the entity denoted by internal argument, i.e. the tree. In particular, the interpretation of the particle verb *um-fahren* in (333b) is such that the tree is understood as changing its position from a vertical (upright) to a horizontal (lying) position. Obviously, this positional change can also be described by means of an L-shaped configuration.

Summarizing, we can say that an L-shaped configuration generalizes over the various interpretations of *um* described above. But how does an L-shaped configuration relate to the abstract Content feature [⊐], which refers to contiguity in the first place? All usages of *um* discussed above relate in some way or another to spatial paths, which I consider to be instances of line segments. I assume that these spatial paths are to be contiguous to a contextually implicit or explicit reference point. Two things are important to note here. First, a line segment is a one-dimensional spatial entity, while a point is a zero-dimensional spatial entity. Second, a line segment is relatively contiguous to a point if one can drop a perpendicular from every point of the line segment onto that point. All in all, this means that the line segment must change its direction in order to be contiguous to the reference point in its entire length. Two line segments that are orthogonally chained together in an L-shaped way such that the two legs enfold the reference point arguably constitute such a minimal model of concentric change of direction. Such an L-shaped line segment that is concentric to a reference point is sketched in Figure 39.

In the case of the route preposition and the verbal prefix *um*, the shape of the denoted spatial paths takes the form of an L. The reference point is explicit. It is given by the Ground argument in the case of the route preposition *um* or by the internal argument of the verb in the case of the verbal prefix *um*. In contrast, in the case of the verbal particle *um*, it is the major orientation of the entity denoted by the internal argument of the verb that changes from being aligned with one leg of the L to being aligned with the other leg of the L. That is, the entity tilts by 90 degrees. Here, the reference point is implicit.

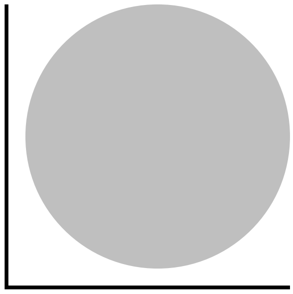


Figure 39: Generalized model of concentric change of direction

At this point, a brief note on the English route preposition *(a)round*, which is the closest translation of the German route preposition *um*, is in order. English *(a)round* might commit to another minimal model than German *um*. Unlike German *um*, English *(a)round* apparently incorporates the morpheme 'round' that obviously refers to the geometric configuration of circularity. See also footnote 91 on page 170. For an semantic representation of English *(a)round* in terms of a vector space model, I refer the reader to Zwarts (2003a, 2004).

5.3.3 Verticality

Both the place and goal preposition *auf* ('upon, up onto') and route preposition *über* ('over, across') conceptually relate to verticality. I assume that these two prepositions share a common feature that refers to the concept of verticality, viz. the abstract Content feature [ג]. In the two prepositional contexts, the concept of verticality manifests itself in different ways. In the case of the place and goal preposition *auf*, the concept of verticality manifests itself as a region adjacent to the Ground in which the Ground can support a Figure from below. The 'support' component in the meaning of *auf* entails that there also must be contact between the Ground and the Figure, or more precisely, between the region that is occupied by the Ground and the region that is occupied by the Figure. In the case of the route preposition *über*, the concept of verticality manifests itself as a spatial path that is above the Ground in a horizontal orientation. For the configuration expressed by *auf*, I assume the two-place LF-predicate $\mathsf{auf}(r, x)$ holding between a region r and a material object x, and for the configuration expressed by *über*, I assume the two-place LF-predicate $\mathsf{ueber\text{-}bar}(v, x)$ holding between a spatial path v and a material object x. Structurally, the place and goal preposition *auf* is characterized by P[LOC] and the route preposition *über* is characterized by P[±NINF]. Hence, I assume that [ג] is interpreted as specifying an auf-region of a material object when inserted into the Root position of P[LOC], while it is interpreted as specifying an ueber-bar-path of a material object when inserted into the Root position of P[±NINF]. The following two subsections define the model-theoretic denotations of the LF-predicates auf and ueber-bar, which both relate to verticality.

auf-regions

I propose that the two-place predicate $\mathsf{auf}(r, x)$ holding between a region r and a material object x is the basic semantic interpretation of the geometric preposition *auf* ('upon, up onto'). The predicate is a prime at LF. Generally, the definition of the predicate auf parallels the predicate an (cf. Section 5.3.2). In addition to the predicate an, the predicate auf expresses the force-dynamic effect that the complement of the preposition *auf* provides support from below. This is achieved by integrating the force-dynamic predicate $\mathsf{sfb}(x, z)$, i.e. "x supports y from below". The material object x, which serves as the Ground in spatial terms, serves as an Antagonist in force-dynamic terms. It is identified with the complement of the preposition. The opponent of the Antagonist, i.e. the Agonist, which serves as the Figure in spatial terms, is identified with the external argument of the PP. The Antagonist x provides support from below for the Agonist z, a material object that makes contact with x in such a way that x can support it from below. The Agonist is conceptualized as endowed with a downward force (imposed on it by gravity), which would make it fall down in the absence of the support by the Antagonist x. The Antagonist x and the Agonist z force-dynamically interact so that the respective forces level each other out, i.e. the resultant is toward rest. The force-dynamic predicate sfb is discussed in more detail in Section 4.7; see in particular (298) on page 177. Note that spatial contact is discussed in Section 4.3.5. In (334), I define an auf-region r of a material object x.

(334) auf**-regions:**
$\forall r, x[\mathsf{auf}(r, x) \leftrightarrow \mathsf{reg}(r) \wedge \mathsf{obj}(x) \wedge \exists! y[\mathsf{reg}(y) \wedge \mathsf{occ}(x, y) \wedge r \propto y$
$\wedge \exists z[\mathsf{obj}(z) \wedge \mathsf{occ}(z, r) \wedge \mathsf{sfb}(x, z)]]]$
"r is an auf-region of a material object x iff y is the region that x occupies, and r is in spatial contact with y, and r is the region that is occupied by a material object z that is supported by z from below"

ueber-bar-paths

I propose that the two-place predicate $\mathsf{ueber\text{-}bar}(v, x)$ holding between a spatial path v and a material object x is the basic semantic interpretation of the geometric route preposition *über* ('over, across'). The predicate is a prime at LF. In (335), I define an ueber-bar-path v of a material object x as an external line segment of x that is also a plumb-square line segment above x. Both the respective predicates extlis (boundary condition) and plumb-square (configurational condition) are defined in Section 4.3.6.

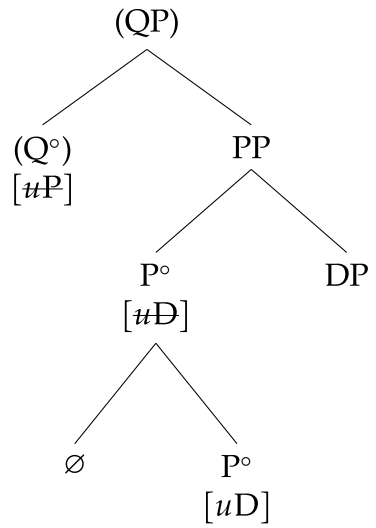
(335) ueber-bar**-path:**
$\forall v, x[\mathsf{ueber\text{-}bar}(v, x) \leftrightarrow \mathsf{extlis}(v, x) \wedge \mathsf{plumb\text{-}square}(v, x)]$
"v is an ueber-bar-path of material object x iff v is an external line segment of x and v is a plumb-square line segment above x"

The relation between the concept of verticality [ג] and the configuration expressed by the predicate ueber-bar is straightforward. Its definition involves the predicate plumb-square that directly makes reference to the downward orientation, i.e. one of the two orientations on the vertical axis; see (248) on page 144.

5.4 Lexical prepositional structure

This section discusses the lexical structure of the spatial prepositions. That is, the structure projected by the lexical category P. For convenience, I also address the optional light preposition Q in this section. Section 5.4.1 addresses place prepositions, Section 5.4.2 directed path prepositions (i.e. goal and source prepositions), and Section 5.4.3 undirected path prepositions (i.e. route prepositions). The general lexical and light structure of prepositions is depicted in (336).

(336)



5.4.1 Place prepositions

This section presents the lexical derivation of place prepositions. Section 5.4.1.1 addresses geometric place prepositions, Section 5.4.1.2 addresses pseudo-geometric place prepositions, and Section 5.4.1.3 addresses non-geometric place prepositions.

5.4.1.1 Geometric prepositions

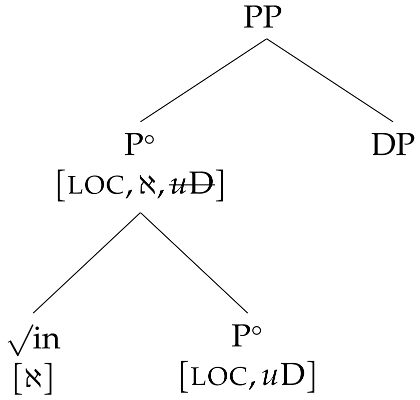
An example of a geometric place preposition is *in* ('in') as for instance given in (337).

(337) Hans war **in** einem Wald.
Hans was in a.DAT forest
'Hans was in a forest.'

The lexical structure of the PP in (337) is depicted in (338). The category P hosts the synsem feature [LOC], which is characteristic for locative prepositions, and a *u*-prefixed D-feature, i.e.

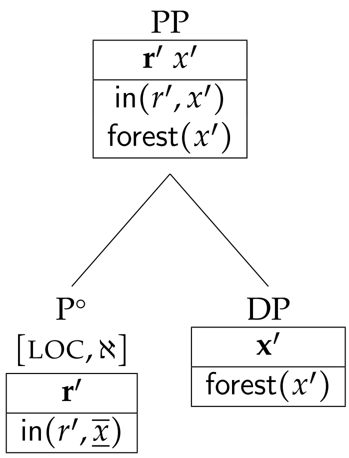
[uD], which triggers Merge with the DP-complement of the preposition. Once P has merged with its DP-complement, it projects a PP and the u-prefixed D-feature deletes. At the outset of the derivation, P[LOC, uD] undergoes Primary Merge and thereby generates a prepositional Root position; cf. Section 2.3. At Spell-Out, this prepositional Root position serves as the insertion site for abstract Content features. In the case of the geometric place preposition *in*, it is the abstract Content feature [ℵ] relating to interiority that enters the structure at the Root position of P[LOC].

(338)



Let us now look at the interpretation of this structure at the interfaces. Let us start with LF. The higher P°-node is subject to interpretation at LF. It hosts the synsem feature [LOC] together with the abstract Content feature [ℵ]. I propose that German provides an LF-instruction to the effect that P[LOC, ℵ] is interpreted as specifying an in-region r' of an anticipated material object $\underline{\overline{x}}$. The discourse referent r' serves as the referential argument of P°. In this example, the DP is interpreted as specifying a forest-entity x'. The discourse referent x' serves as the referential argument of the DP and instantiates the anticipated discourse referent $\underline{\overline{x}}$. The PP is interpreted to the effect that r' is an in-region of the forest x'. The discourse referent r' is the referential argument of the PP. The semantic interpretation of the structure at LF is depicted in (339).

(339)



The derivations of the other two geometric place prepositions *an* ('on') and *auf* ('upon') differ from the derivation of *in* ('in') in the choice of the abstract Content feature. While *in* comprises [א] relating to interiority, *an* comprises [ב] relating to contiguity, and *auf* comprises [נ] relating to verticality. As for these three geometric place prepositions, we can now formulate the LF-instructions for P in (340).[106] When P hosts the synsem feature [LOC] paired with the abstract Content feature [א], it is interpreted as providing an in-region of the material object provided by the complement DP. When [LOC] pairs with the abstract Content feature [ב], P is interpreted as providing an an-region of the material object provided by the complement DP; and when [LOC] pairs with the abstract Content feature [נ], P is interpreted as providing an auf-region of the material object provided by the complement DP.

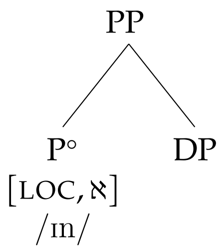
(340) **LF-instructions for P** (first version):

a. P ↔ $\begin{array}{|c|}\hline \mathbf{r'} \\ \hline \mathsf{in}(r', \underline{\overline{x}}) \\ \hline \end{array}$ / _ [LOC, א]

b. ↔ $\begin{array}{|c|}\hline \mathbf{r'} \\ \hline \mathsf{an}(r', \underline{\overline{x}}) \\ \hline \end{array}$ / _ [LOC, ב]

c. ↔ $\begin{array}{|c|}\hline \mathbf{r'} \\ \hline \mathsf{auf}(r', \underline{\overline{x}}) \\ \hline \end{array}$ / _ [LOC, נ]

Let us now turn to the morphophonological realizations of P at PF. I propose that German provides a PF-instruction to the effect that P[LOC, א] is realized as /ɪn/, which is illustrated in (341).

(341)


As for the three geometric place prepositions, we can now formulate the PF-instructions for P in (342).[107] When P hosts the synsem feature [LOC] paired with the abstract Content feature [א], it is realized as /ɪn/. When [LOC] pairs with the abstract Content feature [ב], P is realized as /an/; and when [LOC] pairs with the abstract Content feature [נ], P is realized as /a͜uf/.

(342) **PF-instructions for P** (first version):

a. P ↔ /ɪn/ / _ [LOC, א]
b. ↔ /an/ / _ [LOC, ב]
c. ↔ /a͜uf/ / _ [LOC, נ]

[106]Note that the LF-instructions for P as given (340) are incomplete; they will be extended in the next sections.
[107]Note that the PF-instructions for P as given (342) are incomplete; they will be extended in the next sections.

5.4.1.2 Pseudo-geometric prepositions

This section discusses the derivation of the pseudo-geometric place prepositions *in*, *an*, and *auf*. Recall from Section 5.1.2 that I argue that pseudo-geometric prepositions share the morphological form with geometric prepositions but that they do not have an geometrically-grounded interpretation, but that they give rise to a functional locative interpretation. For an example, consider the clause in (343) with a PP headed by *auf*. The clause is ambiguous between (i) a reading where Hans is understood as being literally *upon* (the building of) the civil registry office, e.g., because he works there as a roofer (→ **roofer reading**), and (ii) a reading where Hans is understood as being *at* (the institution of) the civil registry office, e.g., because he is a groom and about to contract a civil marriage there (→ **groom reading**). The two readings of the clause correspond to two readings of the preposition *auf*. Under the roofer reading, the preposition has a geometrically-grounded interpretation. It refers to the surface region of the building of the civil registry office that provides support from below. In contrast, under the groom reading, the preposition has a functional locative interpretation. It refers to the functionally relevant space of the institution of the civil registry office where one can carry out official things. This contrast with respect to geometry motivates the terms geometric preposition and pseudo-geometric preposition. Note that the two readings of *auf* correspond also to two different translations in English. In this example, the geometric preposition *auf* is best translated as *on top of*, while the pseudo-geometric preposition *auf* is best translated as *at*.

(343) Hans war **auf** dem Standesamt
Hans was on top of/at the.DAT civil registry office

a. ***auf* as a geometric preposition (roofer reading):**
'Hans was **on top of** (the building of) the civil registry office.'

b. ***auf* as a pseudo-geometric preposition (groom reading):**
'Hans was **at** (the institution of) the civil registry office.'

With regard to the space denoted by the preposition, the contrast between the geometric and the pseudo-geometric preposition *auf* in (343) is relatively clear. Typically, the space where one carries out official things at the civil registry office is not upon the building. However, some common nouns do not require the pseudo-geometric preposition *auf*, like *Standesamt* does, but *in*.[108] In these cases, the contrast between geometric and pseudo-geometric readings of the preposition is often not that clear. Consider the clause in (344), which is comparable to (343) in this respect. The clause is ambiguous between (i) a reading where Hans is understood to be literally *inside* (the building of) the pub, e.g. because he seeks shelter from the rain (344a), and (ii) a reading where Hans is understood to be *at* (the institution of) the pub, e.g. because he works there as a waiter (344b).

[108] Note that I assume that the choice of geometric prepositions is determined by the intention of the speaker (depending on the geometric relation that they want to express), while the choice of pseudo-geometric prepositions is determined by the conceptualization of the complement of the pseudo-geometric preposition.

(344) Hans war **in** der Kneipe.
Hans was in/at the.DAT pub

a. ***in* as a geometric preposition (cf. roofer reading):**
'Hans was **in(side)** the pub (e.g. seeking shelter from the rain).'

b. ***in* as a pseudo-geometric preposition (cf. groom reading):**
'Hans was **at** the pub (e.g. working there as a waiter).'

The difference to *auf* in (343) is that the space of a pub where one works as a waiter is typically inside the pub. That is, the distribution of the geometric and the pseudo-geometric readings of *in* is often intuitively not as clear as it is for *auf*.

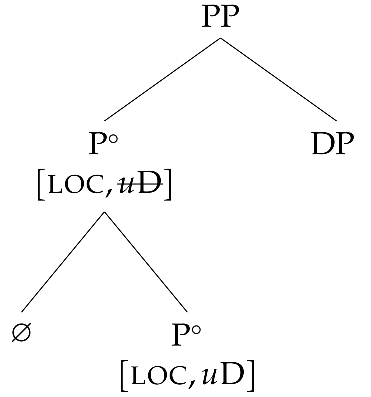
Common nouns are thus a difficult environment to exemplify pseudo-geometric prepositions. This is due to the fact that many common nouns can be conceptualized in various ways, where one conceptualization goes together with a geometric preposition, while another goes together with a pseudo-geometric preposition, like *Standesamt* ('civil registry office') in (343) or *Kneipe* ('pub') in (344). There is, however, an environment where geometric prepositions are ruled out, but pseudo-geometric prepositions are straightforwardly possible. Spatial prepositions co-occurring with toponyms, i.e. names of topological entities like countries, cities, islands, etc., are – under normal conditions – always pseudo-geometric prepositions. I refer to these pseudo-geometric prepositions as toponymic prepositions.

An example of a pseudo-geometric (toponymic) place preposition is *auf* as for instance given in (345). Note at this point that, in combination with the DP *Hispaniola* ('Hispaniola'), which refers to the island of Hispaniola, *auf* is the only locative place preposition possible; *in* is ungrammatical.

(345) Hans war **auf/*in** Hispaniola
Hans was upon/in Hispaniola
'Hans was on Hispaniola.'

The lexical structure of the PP in (345) is depicted in (346). I assume that it is generally parallel to the structure of a geometric place preposition but with the difference that the Root position is empty. That is, no abstract Content feature is inserted into the Root position of P[LOC] at Spell-Out.

(346)



Recall from the discussion in Section 5.1.2, especially from the examples in (303) and (304), that geometric prepositions allow echo extensions, while pseudo-geometric prepositions disallow them. Take (347a) as an example for a geometric place preposition, and (347b) as an example for a pseudo-geometric place preposition.

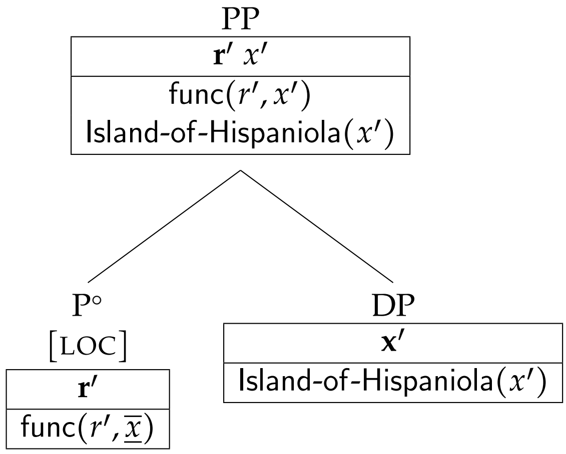
(347) a. Hans war **auf** dem Tisch (dr-**auf**).
Hans was upon the.DAT table there-upon
'Hans was upon the table.'

b. Hans war **auf** den Kanaren (*dr-auf).
Hans was upon the.DAT Canary Islands there-upon
'Hans was on the Canary Islands.'

This distribution of echo extensions can be explained if we assume that the presence of abstract Content features in the Root position of P is a necessary condition for the availability of echo extensions. Geometric prepositions have a Root position filled with abstract Content features, while pseudo-geometric prepositions have an empty Root position. For a further discussion on echo extensions, I refer the reader to Section 5.5.1.

Before we look at the PF-realization of this structure and at the question of how the surface form of the preposition is determined, let us first have a look at the interpretation of this structure at LF. Again, the higher P°-node is subject to interpretation at LF. It hosts the synsem feature [LOC]. I propose that German provides an LF-instruction to the effect that plain P[LOC] is interpreted as specifying a functional region r' of an anticipated material object $\underline{\overline{x}}$. For functional regions, I use the predicate func. I assume that a func-region is a region that is geometrically unspecific, i.e. it is not geometrically but rather functionally grounded. The discourse referent r' serves as the referential argument of P°. In this example, the DP *Hispaniola* is interpreted as specifying an entity x' that has the property of being the Caribbean island Hispaniola. For this, I use the one-place predicate Island-of-Hispaniola. The discourse referent x' serves as the referential argument of the DP and instantiates the anticipated discourse referent $\underline{\overline{x}}$. The PP is compositionally interpreted to the effect that r' is a functional region of the island Hispaniola x', i.e. some location on the island of Hispaniola. The discourse referent r' is the referential argument of the PP. The semantic interpretation of the structure at LF is depicted in (348).

(348)

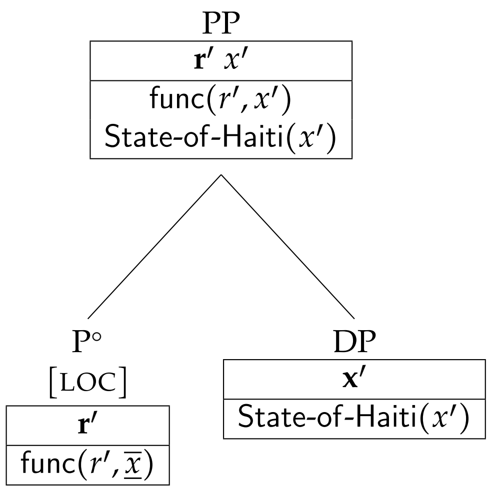


Consider now another example of a pseudo-geometric (toponymic) place preposition in (349). Here, the DP *Haiti* ('Haiti'), which refers to the state of Haiti, can only combine with the locative place preposition *in* ('in, at'); *auf* is ungrammatical.[109]

(349) Hans war **in/*auf** Haiti
Hans was in/upon Haiti
'Hans was in Haiti.'

As for the structure the PP in (349), I propose that it is parallel to the one in (346). Again, P hosts the feature [LOC] and the Root position is empty. P[LOC] is interpreted as specifying a functional region r' of an anticipated material object $\underline{x}$. In this example, the DP *Haiti* is interpreted as specifying an entity x' that has the property of being the Caribbean state Haiti. For this, I use the one-place predicate State-of-Haiti. The PP is compositionally interpreted to the effect that r' is a functional region of the state Haiti x', i.e. some location in the national territory of the Republic of Haiti. The semantic interpretation of the structure at LF is depicted in (350).

(350)



[109]Note that *Haiti* was the name of the island that has today the name *Hispaniola*. In this context, *auf Haiti* is grammatical.

In order to account for the interpretation of P[LOC] as a functional region, we can update the LF-instructions for P in (340) with the rule in (351d).

(351) **LF-instructions for P** (second version):

a. P $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{r'} \\ \hline \mathsf{in}(r', \underline{\overline{x}}) \\ \hline \end{array}$ / _ [LOC, א]

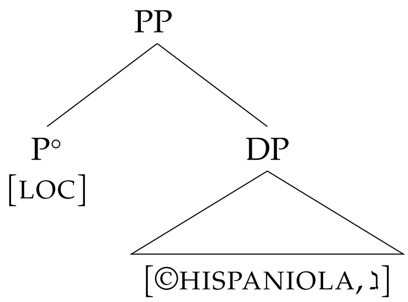
b. $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{r'} \\ \hline \mathsf{an}(r', \underline{\overline{x}}) \\ \hline \end{array}$ / _ [LOC, ב]

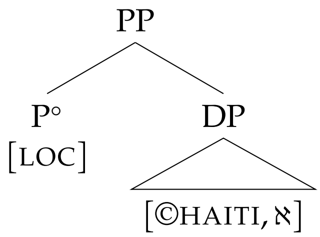
c. $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{r'} \\ \hline \mathsf{auf}(r', \underline{\overline{x}}) \\ \hline \end{array}$ / _ [LOC, נ]

d. $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{r'} \\ \hline \mathsf{func}(r', \underline{\overline{x}}) \\ \hline \end{array}$ / _ [LOC]

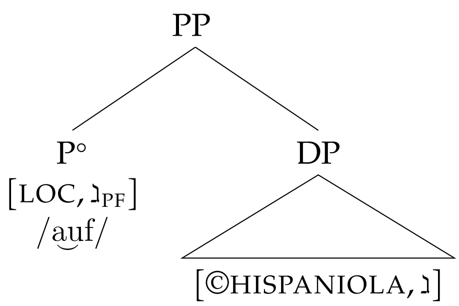
Note that the LF-instructions in (351) model some kind of geometric bleaching effect of the locative P. When the locative feature [LOC] occurs in combination with a certain abstract Content feature, i.e. (351a)–(351c), the interpretation of P is geometrically specific. In contrast, when the locative feature [LOC] occurs in isolation, i.e. (351d), the interpretation of P is geometrically unspecific.

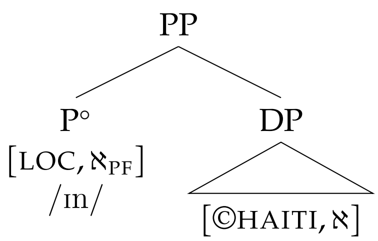
Let us now look at the conceptual differences between nouns *Hispaniola* and *Haiti*, which, I argue, explain the different realizations of the pseudo-geometric (topoynmic) P at PF. In (345) we saw that the DP *Hispaniola*, which refers to the **island** of Hispaniola, can go together only with the toponymic place preposition *auf*; and in (349) we saw that the DP *Haiti*, which refers to the **state** of Haiti, can go together only with the toponymic place preposition *in*. In order to approach this phenomenon, I first have to clarify the assumptions I make with regard to the invariant, idiosyncratic core underlying nouns like *Hispaniola* and *Haiti*. In particular, I assume that the idiosyncratic core of nouns like *Hispaniola* and *Haiti* are (idiosyncratic) Content features, say [©HISPANIOLA] and [©HAITI]. These Content features, which I mark with the copyright symbol ©, relate, in a rather abstract way, to the respective conceptual entities. Now, we have to look at the conceptual differences between *Hispaniola* (island) and *Haiti* (state). I assume that islands are conceptualized as planes or discs on the surface of the water that provide support from below, while states are conceptualized as containers with an interior. Support from below relates to the abstract Content feature [נ] for verticality; and containment relates to the abstract Content feature [א] for interiority. I propose that idiosyncratic Content features can pair with abstract Content feature and thereby reflect various aspects of possible conceptualizations. That is, the island-denoting noun *Hispaniola* contains the Content feature bundle [©HISPANIOLA, נ], while the state-denoting noun *Haiti* contains the Content feature bundle [©HAITI, א]. The respective lexical PP-structures look as depicted in (352) and (353).

(352) 

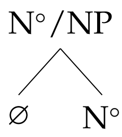
(353) 

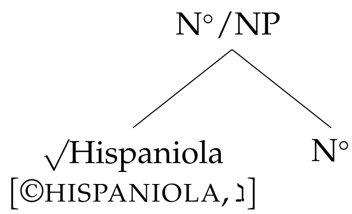
In order to achieve the different realizations of P in these two contexts, I propose that abstract Content features can be copied from within a DP to the dominating P°-node at PF. That is, abstract Content features behave like dissociated features to the effect that they can be copied at PF (Embick and Noyer 2007: 309); cf. also Section 3.3 and, in particular, (114) on page 72. In the examples at issue, P[LOC] extends to P[LOC, $נ_{PF}$] in the context of [©HISPANIOLA, נ] and P[LOC] extends to P[LOC, $א_{PF}$] in the context of [©HAITI, א]. Note that I use the subscript $_{PF}$ in the feature structure of P in order to indicate that the respective abstract Content feature is visible only at PF. This leads to the representations in (354) and (355). Now the PF-instructions for P formulated in (342) straightforwardly apply. This leads to the correct realizations of the pseudo-geometric place prepositions.

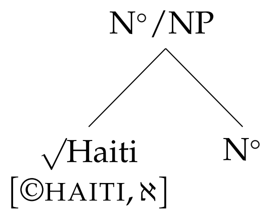
(354) 

(355) 

At this point a word on the underlying structure of the respective nominals as well as its LF-interpretation and PF-realization is in order. We could assume that N undergoes Primary Merge and thereby generates a nominal Root position as sketched in (356) (De Belder and Van Craenenbroeck 2015; cf. Section 2.3). At Spell-Out, Content feature bundles can fill in these Root positions and thereby become Roots. For instance, the Content feature bundle [©HISPANIOLA, ℷ] in a nominal Root position is interpreted as the Root $\sqrt{}$Hispaniola, which is illustrated in (357); and the Content feature bundle [©HAITI, ℵ] in a nominal Root position is interpreted as the Root $\sqrt{}$Haiti, which is illustrated in (358).

(356)


(357)


(358)


Now, the questions arise which Content feature pairings are possible and what restricts the parings. Note that the system outlined here does not preclude Content feature pairings that are not interpretable. In principle, there could be a Content feature pairing [©HISPANIOLA, ℵ] which led to the interpretation of *Hispaniola* as a state (or a city); or there could be a Content feature pairing [©HAITI, ℷ] which led to the interpretation of *Haiti* as an island. However, I assume that the respective interpretations are not available at LF because they cannot be justified in our world, i.e. there is no state named Hispaniola and there is no island named Haiti nowadays.[110] This could be formalized as sketched in (359). The LF-instructions in (359a) and (359b) are justified and thus available, while the ones in (359c) and (359d) are not. The crucial point here is that, as from a grammatical point of view, such restrictions are arbitrary.

(359) **LF-instructions for the nouns *Hispaniola* and *Haiti*:**

a. N ↔ [**x′** | Island-of-Hispaniola(x')] / _ [©HISPANIOLA, ℷ]

b. ↔ [**x′** | State-of-Haiti(x')] / _ [©HAITI, ℵ]

[110] In fact, the island of Hispaniola officially had the name Haiti between 1804 and 1844. Considering this, [©HAITI, ℷ] leading to *auf Haiti* is perfectly fine.

c. ↔ # | x' / State-of-Hispaniola(x') | / _ [©HISPANIOLA, $\aleph$]

d. ↔ # | x' / Island-of-Haiti(x') | / _ [©HAITI, $\beth$]

Figure 40: Historical map of the Greater Antilles

Consider *Kuba* ('Cuba'). Unlike *Hispaniola* and *Haiti*, *Kuba* is the name for an island and for a state.[111] Consequently, both the toponymic preposition *auf* for the island reading (360a) and the toponymic preposition *in* for the state reading (360b) are possible.

(360) a. Hans war **auf** Kuba.
Hans was upon Cuba
'Hans was on the island of Cuba.'

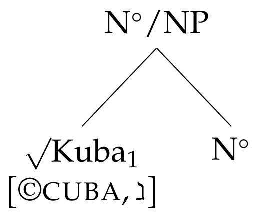
b. Hans war **in** Kuba.
Hans was in Cuba
'Hans was in the state of Cuba.'

The respective feature structures underlying the DP *Kuba* are sketched in (360); (361a) for the island reading and (361b) for the state reading. Note that, in this system, there are ultimately two distinct Roots: $\sqrt{\text{Kuba}_1}$ for the island and $\sqrt{\text{Kuba}_2}$ for the state.

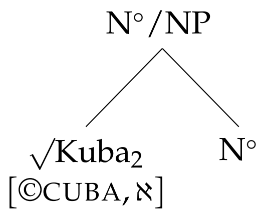
[111]Note that the island of Cuba and the state of Cuba physically overlap almost entirely. Only the area of the US Guantanamo Bay Naval Base is part of the island of Cuba, but not of the state of Cuba.

(361)

a.



b.



The LF-instructions for the noun *Kuba* could be formulated as given in (362).

(362) **LF-instructions for the noun *Kuba*:**

a. N ↔ [**x′** | State-of-Cuba(x')] / _ [©CUBA, $\aleph$]

b. ↔ [**x′** | Island-of-Cuba(x')] / _ [©CUBA, $\gimel$]

Let us now briefly look at the PF-instructions for the nouns *Hispaniola*, *Haiti*, and *Kuba*. They could be formulated as given in (363). For these nouns, the abstract Content features are immaterial at PF.

(363) **PF-instructions for the nouns *Hispaniola*, *Haiti*, and *Kuba*:**

a. N ↔ /hɪspˈani̯oːla/ / _ [©HISPANIOLA]
b. ↔ /haˈiːti/ / _ [©HAITI]
c. ↔ /ˈkuːba/ / _ [©CUBA]

Let me close this discussion with a cross-linguistic remark. I assume that the way in which Content features can pair with each other and how they are interpreted at LF or realized at PF is language-dependent. For instance, in order to account for the phenomenon discussed above, we could formulate Content rules for Standard German as follows: When occurring in a nominal Root position, (i) pairings of toponymic Content features with [$\aleph$] give rise to interpretations as states, cities, etc.; (ii) pairings of toponymic Content features with [$\gimel$] give rise to interpretations as islands, squares, etc.; and (iii) pairings of toponymic Content features with [$\beth$] give rise to interpretations as rivers, lakes, etc.

As I assume that the pairing of Content features is language-dependent, cross-linguistic variation is expected. In fact, a similar phenomenon can be observed in Norwegian Bokmål. While most cities co-occur with *i* (‘in’) as the toponymic place preposition, some cities co-occur with *på* (‘upon’). Textbooks on Norwegian Bokmål state the rule of thumb that Norwegian inland cities are used with *på* as in (364b), while Norwegian coastal cities and normally non-Norwegian cities are used with *i* as in (364a).

(364) a. Jeg bor **på** Lillehammer.
I live upon Lillehammer
'I live in Lillehammer'

b. Jeg bor **i** Oslo/Berlin.
I live in Oslo/Berlin
'I live in Oslo/Berlin' (cf. Aas 2012: 22)

A city's property of being located in the Norwegian inland should arguably not correspond to a grammatical property of Norwegian Bokmål. In particular, we cannot identify obvious syntactic, semantic, or morphological properties of the Norwegian toponyms that determine the choice of the respective toponymic place preposition. I thus propose that Norwegian Bokmål has Content rules to the effect that Content features relating to Norwegian inland cities pair with [נ] leading to the PF-realization of P as /poː/, i.e. *på*, while Content feature relating to other cities pair with [א] leading to the PF-realization of P as /iː/, i.e. *i*.[112] From a grammatical point of view, such distinctions are rather arbitrary or idiosyncratic.

5.4.1.3 Non-geometric prepositions

The region described by the non-geometric place preposition *bei* ('at') is special in various ways. It has been noted by several scholars that it denotes a general, unspecified location with respect to a Ground object (Li 1994, Nüse 1999, Levinson and Meira 2003, Zwarts 2010b). The (pseudo)-geometric place prepositions refer to regions that relate to certain spatial parts of the Ground object: (i) geometric *in* ('in') relates to the interior of the Ground, (ii) geometric *an* ('on') relates to the surface of the Ground, (iii) geometric *auf* ('upon') relates to that part of the surface of the Ground that provides support from below, and (iv) pseudo-geometric *in*, *an*, and *auf* relate to a functional region of the Ground. In contrast, the non-geometric place preposition *bei* ('at') refers to the Ground as a whole (Li 1994). Zwarts (2010b: 987) argues that what he calls the AT-location (i.e. the region denoted by German *bei* 'at') "is relevant with objects that have no interior or surface, or for which these spatial parts are not relevant." This conforms to the observations by Schröder (1986) that *bei* is preferred for general and rather unspecific location descriptions as in (365a), for animated Ground objects as in (365b) and (365d) (sphere of influence), and for workplaces (365c). Nevertheless, 'normal' Ground nouns like *Wald* ('forest') as in (365e) are also straightforwardly acceptable.

(365) a. Lützen liegt **bei** Leipzig.
Lützen lies at Leipzig
'Lützen is located near Leipzig.'

[112] For a conceptual explanation of this phenomenon, I refer the reader to Szymańska (2010: 174) who claims that *i* is conceived as relating to containment, while *på* is conceived as relating to support from below.

b. Er wohnte noch **bei** seinen Eltern.
he lived still at his.DAT parents
'He still stayed with his parents.'

c. Er arbeitet **bei** der Bahn.
he works at the.DAT railroad
'He is employed by the railroad.'

(Schröder 1986: 85, 86)

d. Hans war **bei** seiner Oma.
Hans was at his.DAT granny
'Hans was with his granny.'

e. Hans war **bei** einem Wald.
Hans was at a.DAT forest
'Hans was at a forest."

In Section 5.4.2.3, I will put forth the hypothesis that the German goal preposition *zu* ('to') relates to the non-geometric place preposition *bei* ('at') in that both refer to at-regions (cf. Zwarts' 2010b AT-location). That an at-region is special can thus also be seen with certain usages of the non-geometric goal preposition *zu*. Consider the example (366), which is a slogan used by the Green Party for the 1996 Baden-Württemberg state election; the original campaign poster is given in Figure 41.

(366) Warum fahren immer so viele **zum** Stau?
why drive always so many to.the.DAT traffic jam
'Why do so many people deliberately drive to traffic jams?'

The usage of the non-geometric goal preposition *zum* (contracted form of *zu dem* 'to the.DAT') in combination with the noun *Stau* ('traffic jam') and the motion verb *fahren* ('drive') is not straightforward because it implies that one would deliberately 'drive to a traffic jam.'This is of course not what a typical traffic participant intends to do, which is what the slogan amusingly provokes. Typically, we can derive an intentional motion description when *zu* heads the path-argument of a motion verb. In contrast, when a (pseudo)-geometric path preposition heads the path-argument of a motion verb, intentionality cannot be derived.[113] As for intentionality in the context of motion verbs, I refer the reader to Roßdeutscher (2000: 183). I take this observation as a further clue that an at-region referred to by the German non-geometric prepositions *bei* ('at') and *zu* ('to') must be functionally determined rather than geometrically (or pseudo-geometrically). In (366), the at-region must apparently be such that the subject of *fahren*, i.e. the Figure, is aware of driving there, and maybe that it has relevance for the Figure to go there.

These considerations motivate the synsem feature [AT]. In particular, I assume that the non-geometric place preposition *bei* ('at') contains the synsem feature [AT] instead of [LOC]; note that the same also holds for the non-geometric goal and source prepositions *zu* ('to')

[113]In fact, a straightforward, unmarked description of an event of getting unintentionally into a traffic jam would involve the pseudo-geometric preposition *in* ('into').

Figure 41: Campaign poster by Green Party (1996 Baden-Württemberg state election)

and *von* ('from'). As for the structure of the non-geometric place preposition *bei*, I assume that it is parallel to the structure of (pseudo)-geometric place prepositions, except for the fact that P hosts [AT] instead of [LOC]. Furthermore, I assume that the Root position of non-geometric (place) prepositions is empty, like it is for pseudo-geometric prepositions. The lexical structure of the non-geometric place preposition *bei* ('at') is illustrated in (367).

(367)

[PP [P° [AT, ~~*u*D~~] ∅ [P° [AT, *u*D]]] DP]

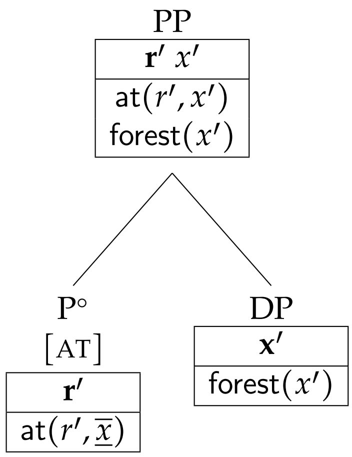
- PP
  - P° [AT, ~~*u*D~~]
    - ∅
    - P° [AT, *u*D]
  - DP

Recall from the discussion in Section 5.1.2, especially from the examples in (305), that non-geometric prepositions – like pseudo-geometric prepositions, but unlike geometric prepositions – disallow echo extensions. Take (368) as an example.

(368) Hans stand **bei** der Hütte (*da-bei).
Hans stood at the.DAT hut there-at
'Hans stood at the hut.'

The explanation I propose for why *zu*-PPs do not allow echo extensions is the same as I gave for the absence of echo extensions of in PPs with pseudo-geometric prepositions (cf. Section 5.4.1.2): echo extensions are possible only, when the Root position of P is non-empty; but since *zu* is a non-geometric preposition, its Roos position cannot contain any abstract Content features. Hence, the unavailability of echo extensions straightforwardly follows.

Let us begin by looking at the semantic interpretation of this structure at LF. The P°-node hosts the synsem feature [AT]. I assume that this is interpreted as the two-place predicate $\mathsf{at}(r',\overline{\underline{x}})$, which provides an at-region r' of an anticipated material object $\overline{\underline{x}}$. The discourse referent r' serves as the referential argument of P°. Consider (365e) as an illustrative example. Here, the DP is interpreted as specifying a forest-entity x'. The discourse referent x' serves as the referential argument of the DP and instantiates the anticipated discourse referent $\overline{\underline{x}}$. The PP is compositionally assigned the interpretation that r' is an at-region of the forest x'. The discourse referent r' is the referential argument of the PP. The semantic interpretation of the structure at LF is depicted in (369).

(369)


In order to account for the interpretation of P[AT] as an at-region, we can simply expand the LF-instructions for P by the rule in (370e).

(370) **LF-instructions for P** (third version):

a. P ↔ $\mathbf{r'}$ | $\mathsf{in}(r',\overline{\underline{x}})$ / _ [LOC, ℵ]

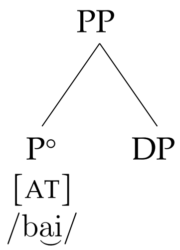
b. ↔ $\mathbf{r'}$ | $\mathsf{an}(r',\overline{\underline{x}})$ / _ [LOC, ב]

c. ↔ $\mathbf{r'}$ | $\mathsf{auf}(r',\overline{\underline{x}})$ / _ [LOC, ג]

d.	↔	$\mathbf{r'}$ / $\mathsf{func}(r', \underline{\overline{x}})$	/ _ [LOC]
e.	↔	$\mathbf{r'}$ / $\mathsf{at}(r', \underline{\overline{x}})$	/ _ [AT]

Let us now turn to the morphophonological realizations of P at PF. I propose that the structure in (367) is realized as in (371). That is, the exponent /ba͜i/ (for *bei*, 'at') is inserted in P[AT].

(371)



In order to account for the proper realization of P[AT], we can expand the PF-instructions for P by the rule in (372d).

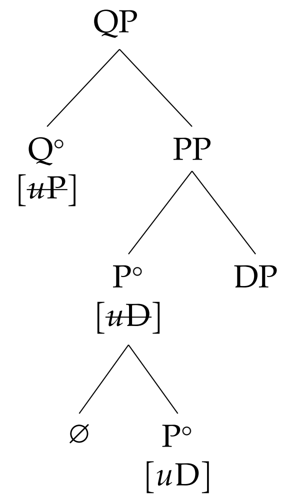
(372) **PF-instructions for P** (second version):

a.	P	↔	/ɪn/	/ _ [LOC, א]
b.		↔	/an/	/ _ [LOC, ב]
c.		↔	/a͜uf/	/ _ [LOC, ג]
d.		↔	/ba͜i/	/ _ [AT]

5.4.2 Goal and source prepositions

I take the view that goal and source prepositions, i.e. directed path prepositions, derive from place prepositions. In this section I propose that a light preposition, which I label Q, above P derives goal and source prepositions from place prepositions. That is, source and goal prepositions generally have the structure depicted in (373).

(373)



Let us first revisit the goal and source prepositions this thesis focuses on. The (pseudo)-geometric goal prepositions are *an* ('onto'), *auf* ('up onto'), and *in* ('into').[114] At this point, I should mention again that the place/goal alternation manifests itself as a case alternation. Leaving their forms unchanged, the (pseudo)-geometric place prepositions take a dative complement, while the (pseudo)-geometric goal prepositions take an accusative complement. I should also mention here the goal preposition *nach* ('to'), which can be considered as a special case. It is the pseudo-geometric goal preposition that occurs with determinerless complements. The (pseudo)-geometric source prepositions come in two versions, either as a synthetic (one-word) form or as an analytic (two-word) form. The synthetic (pseudo)-geometric source preposition is *aus* ('out of'); the analytic (pseudo)-geometric source prepositions are *von an* ('from on'), *von auf* ('from upon'), and *von in* ('from in').[115] The non-geometric goal and source prepositions are *zu* ('to') and plain *von* ('from'), respectively.

As for synsem features, I assume that the light preposition Q can host the synsem feature [+TO] leading to a goal interpretation, or the synsem feature [−TO], leading to a source interpretation. Recall that Section 5.4.1 discussed two types of place prepositions. On the one hand, P[LOC] characterizes the (pseudo)-geometric place prepositions *an* ('on'), *auf* ('upon'), and *in* ('in'), while, on the other hand, P[AT] characterizes the non-geometric place preposition *bei* ('at'). In this section, I argue that the distinction between (pseudo)-geometric and non-geometric prepositions is also valid in the domain of goal and source prepositions. One crucial difference between the two types of prepositions is that (pseudo)-geometric goal and source prepositions denote spatial paths that are conceptualized as punctual, while non-geometric goal and source prepositions denote spatial paths that are conceptualized as extended In particular, spatial paths denoted by (pseudo)-geometric goal and source prepositions can be characterized by a transitional change with regard to some spatial configuration (e.g. a spatial path denoted by the PP *into X* can roughly be described as a transition from 'not in X'

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[114]Note that the English place prepositions *in* and *on* correspond to the morphologically complex goal prepositions *in-to* and *on-to*. I consider the morpheme *-to* in these forms as cross-linguistic evidence for the light preposition Q.

[115]Note that many German speakers do not like these analytic source prepositions.

to 'in X'), while spatial paths denoted by non-geometric goal and source prepositions can be characterized by their starting point (source) or end point (goal) (e.g. a spatial path denoted *to X* can roughly be described as one that has its starting point not at X and its end point at X). In order to account for this contrast, I propose that the synsem feature [±TO] hosted by Q can give rise to different interpretations depending on the synsem features hosted by P below. In particular, I will propose that Q[±TO] above P[LOC] is interpreted as denoting transitional spatial paths that are conceptualized as punctual, while Q[±TO] above [AT] is interpreted as denoting non-transitional spatial paths that are conceptualized as extended.

The aspectual difference, as indicated above, becomes visible when the two types of goal and source PPs serve as arguments of motion verbs. For instance, when combined with manner of motion verbs, (pseudo)-geometric goal and source prepositions give rise to achievement predicates, while non-geometric goal and source prepositions give rise to accomplishment predicates. For English, Beavers (2002), Denis (2003), Denis et al. (2003), Zwarts (2005b) have observed that paths denoted by goal prepositions like *into* ((pseudo)-geometric) are conceptualized as punctual, while paths denoted by the goal preposition *to* (non-geometric) are conceptualized as extended. In particular, Denis (2003) applies several established aktionsart tests all of which show that goal PPs headed by *into* give rise to achievement predicates, when combined with manner of motion verbs, while goal PPs headed by *to* give rise to accomplishment predicates. The aktionsart test applied by Denis (2003) are: (i) the punctual adverbial test, (ii) the frame adverbial test, (iii) the perfective-to-imperfective entailment test, and (iv) the *halfway through* test.[116] In the following I reproduce these aktionsart tests for German goal prepositions.[117] In addition, I apply (v) Kratzer (2004) Kratzer (2004)'s aktionsart test involving *weiter* ('further'). Note that most of the tests involve the agentive manner motion verb *laufen* ('walk') which gives rise to an atelic predicate (activity) when it is used without a goal PP as can be seen in (374).

(374) Hans lief für/??in zwei Stunden.
Hans walked for/??in two hours.

The first aktionsart test involves **punctual adverbials** like *um 18:02 Uhr* ('at 6.02 pm') or *um Mitternacht* ('at midnight'). Such adverbials give rise to a straightforward interpretation with punctual situation types such as achievements (375a). They specify the point in time when the event happens. With accomplishments, however, punctual adverbials normally provoke an inceptive reading, i.e. a reading where the event is understood to start at the specified point in time; see (375b).

[116] Note that I omit Denis's *spend/take an hour* as it is difficult to reproduce in German.

[117] Note that I focus here on goal prepositions and leave source prepositions aside. Within this thesis, I assume that the aktionsart differences that we observe with goal prepositions are similar or even parallel for source prepositions. In fact, tentative tests suggest this. Nevertheless, I leave a detailed analysis of the aspectual behavior of source prepositions for further research.

(375) a. Hans erreichte um 18:02 Uhr den Gipfel.
Hans reached at 6.02 o'clock the summit
'Hans reached the summit at 6.02 pm.'

b. Hans baute um 18:02 Uhr eine Sandburg.
Hans built at 6.02 o'clock a sandcastle
'Hans built a sandcastle at 6.02 pm.'

In combination with (pseudo)-geometric goal prepositions as in (376a), punctual adverbials give rise to a punctual reading, as is the case with achievement predicates. The adverbial specifies the point in time when Hans enters the interior of the supermarket. In contrast, with the non-geometric goal preposition *zu* punctual adverbials give rise to an inceptive reading, as is the case with accomplishment predicates. The natural interpretation of (376b) is that Hans starts walking to the supermarket at 6.02 pm.

(376) a. Hans lief um 18:02 Uhr **in** den Supermarkt.
Hans walked at 6.02 o'clock into the.ACC supermarket
'Hans walked into the supermarket at 6.02 pm.'

b. Hans lief um 18:02 Uhr **zu** dem Supermarkt.
Hans walked at 6.02 o'clock to the.DAT supermarket
'Hans walked to the supermarket at 6.02 pm.'

The second aktionsart test involves the **temporal frame adverbial** *in an hour*. It is well known that temporal *in*-PPs are felicitous with telic predicates, that is, with accomplishments and achievements. There is, however, an interpretative difference of temporal *in*-PPs with these two situation types. With accomplishments, a temporal *in*-PP measures the duration of the event up to the culmination point where the event ends. With achievements, in contrast, a temporal *in*-PP does not measure the event itself but a preparatory phase. This preceding process is conceptually detached from the event expressed by the verb (Dowty 1979, Smith 1991). Consider an example of an achievement predicate in (377a) and an example of an accomplishment predicate in (377b)

(377) a. Hans erreichte in einer Stunde den Gipfel.
Hans reached in an hour the summit
'Hans reached the summit in an hour.'

b. Hans baute in einer Stunde eine Sandburg.
Hans built in an hour a sandcastle
'Hans built a sandcastle in an hour.'

Let us now apply the frame adverbial test to the goal prepositions under discussion. The test shows that (pseudo)-geometric goal prepositions behave like achievements, while the non-geometric goal preposition *zu* behaves like accomplishments. In (378a), the event of walking into the supermarket is expressed to happen after one hour has elapsed, while in (378a), the event of walking to the supermarket is expressed to last one hour.

(378) a. Hans lief in einer Stunde **in** den Supermarkt.
Hans walked in an hour into the.ACC supermarket
'Hans walked into the supermarket in an hour.'

b. Hans lief in einer Stunde **zu** dem Supermarkt.
Hans walked in an hour to the.DAT supermarket
'Hans walked to the supermarket in an hour.'

The third aktionsart test concerns the **perfective-to-imperfective entailment** depicted in (379). The perfective-to-imperfective entailment is typically licensed by accomplishments but not by achievements (Dowty 1979: 59, Denis 2003: 8, Rothstein 2004: 26).

(379) X VP-*ed in an hour* ⇒ X *was* VP-*ing during that hour*

Unlike English, Standard German does not have a morphologically overt progressive form. Thus, this test needs to be adapted for German. Instead of the progressive, we can use the construction *dabei sein etwas zu tun* ('to be in the act of doing sth.') in order to express imperfective aspect. That is, an achievement as in (377a) does not entail (380a), while an accomplishment as in (377b) entails (380b).

(380) a. Hans war während dieser Stunde dabei den Gipfel zu erreichen.
Hans was during that hour at the summit to reach
'Hans was reaching the summit during that hour.'

b. Hans war während dieser Stunde dabei eine Sandburg zu bauen.
Hans was during that hour at a sandcastle to build
'Hans was building a sandcastle during that hour.'

(381) a. (377a) ⇏ (380a)

b. (377b) ⇒ (380b)

When applied to the goal prepositions under discussion, the perfective-to-imperfective entailment test shows that (pseudo)-geometric goal prepositions give rise to achievement predicates, while the non-geometric goal preposition *zu* gives rise to accomplishment predicates. In particular, (378a) does not entail (382a). In contrast, (378b) entails (382b).

(382) a. Hans war während dieser Stunde dabei **in** den Supermarkt zu laufen.
Hans was during that hour at into the.ACC supermarket to walk
'Hans was walking into the supermarket during that hour.'

b. Hans war während dieser Stunde dabei **zu** dem Supermarkt zu laufen.
Hans was during that hour at to the.DAT supermarket to walk
'Hans was walking to the supermarket during that hour.'

(383) a. (378a) ⇏ (382a)

b. (378b) ⇒ (382b)

The fourth aktionsart test involves the **progressive construction** ***be halfway through doing sth.***, which is possible with accomplishments but not with achievements (Denis 2003: 9, Rothstein 2004: 44). As Standard German does not have a straightforward progressive form like English, we need to adapt this test to German. Instead of the progressive plus *halfway through*, we can use the construction *es zur Hälfte geschafft haben etw. zu tun* (lit.: it to.the half accomplished have sth. to do). In fact, achievements as in (384a) are ungrammatical, while accomplishments as in (384b) are grammatical.

(384) a. *Hans hat es zur Hälfte geschafft den Gipfel zu erreichen.
Hans has it to.the half accomplished the summit to reach
*'Hans was halfway through reaching the summit.'

b. Hans hat es zur Hälfte geschafft eine Sandburg zu bauen.
Hans has it to.the half accomplished a sandcastle to build
'Hans was halfway through building a sandcastle.'

When applied to the goal prepositions under discussion, the *halfway through* test shows that (pseudo)-geometric goal prepositions give rise to achievement predicates, while the non-geometric goal preposition *zu* gives rise to accomplishment predicates. That is, (385a) is ungrammatical, while (385b) is grammatical.

(385) a. *Hans hat es zur Hälfte geschafft **in** den Supermarkt zu laufen.
Hans has it to.the half accomplished into the.ACC supermarket to walk
*'Hans was halfway through walking into the supermarket.'

b. Hans hat es zur Hälfte geschafft **zu** dem Supermarkt zu laufen.
Hans has it to.the half accomplished to the.DAT supermarket to walk
'Hans was halfway through walking to the supermarket.'

The fifth aktionsart test involves the German **verb particle *weiter*** ('further'), which is straightforwardly interpretable with accomplishments but strange with achievements (Kratzer 2004). Compare the achievement in (386a), which is ungrammatical with *weiter*, with the accomplishment in (386b), which is grammatical with *weiter*.

(386) a. ??Hans konnte den Gipfel weiter-erreichen.
Hans could the summit further-reach
??'Hans could continue to reach the summit.'

b. Hans konnte die Sandburg weiter-bauen.
Hans could the sandcastle further-build
'Hans could continue to build the sandcastle.'

When applied to the goal prepositions under discussion, the *weiter* test shows that (pseudo)-geometric goal prepositions give rise to achievement predicates, while the non-geometric goal preposition *zu* gives rise to accomplishment predicates. (387a) is marked, while (387b) is straightforward.

(387) a. ??Hans konnte **in** den Supermarkt weiter-laufen.
Hans could into the.ACC supermarket further-walk
??'Hans could continue to walk into the supermarket.'

b. Hans konnte **zu** dem Supermarkt weiter-laufen.
Hans could to the.DAT supermarket further-walk
'Hans could continue to walk to the supermarket.'

All aktionsart tests applied above have shown that (pseudo)-geometric goal (and source) prepositions contrast with non-geometric goal (and source) prepositions such that – when combined with manner of motion verbs – the former give rise to achievement predicates, while the latter give rise to accomplishment predicates. My conclusion from this is that (pseudo)-geometric goal and source prepositions (e.g. *in* 'into' and *aus* 'out of') denote spatial paths that are conceptualized as punctual, i.e. as spatially not extended, while, on the other hand, non-geometric goal and source prepositions (i.e. *zu* 'to' and *von* 'from') denote spatial paths that are conceptualized as spatially extended. Section 4.5 discussed two different conceptualizations of goals and sources in axiomatic approaches to (spatial) paths. Krifka (1998: 227–228) defines sources and goals as being adjacent to paths, while Beavers (2012: 30) defines them as being parts of paths. I propose that this distinction can be exploited to model the aspectual difference between (pseudo)-geometric and non-geometric goal and source prepositions. In particular, I take the view that Krifka's conceptualization of goals and sources can be used to model extended spatial paths denoted by non-geometric goal and source prepositions, while Beavers' conceptualization of goals and sources can be used, in a modified way, to model transitional spatial paths denoted by (pseudo)-geometric goal and source prepositions.

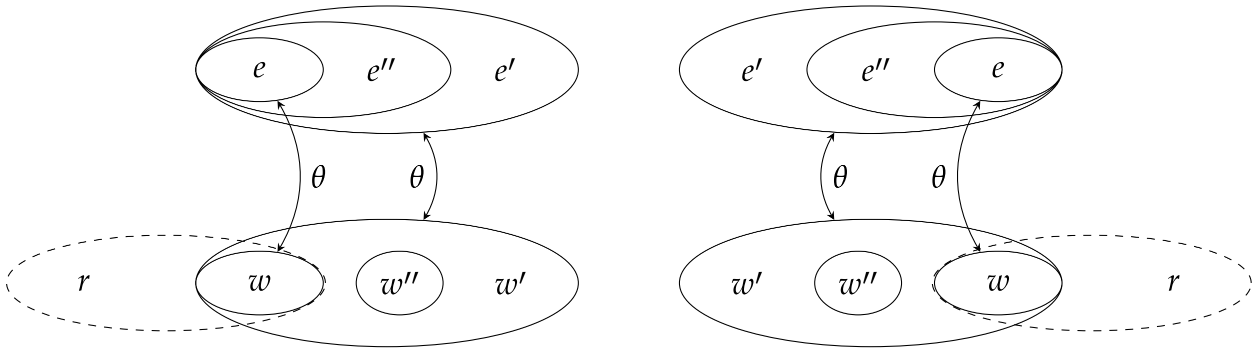
Let us first look at transitional spatial paths denoted by (pseudo)-geometric goal and source prepositions. Beavers' idea of sources and goals as being on paths combined with Krifka's (1998: 230) analysis of instantaneous movements, viz. achievements as minimal final (and initial) subevents, gives rise to the definitions of the two three-place LF-predicates $\mathsf{leave}(w,r,e)$ and $\mathsf{enter}(w,r,e)$ in (388). The model for a transitional path w leaving a region r in e is displayed in Figure 42.a; the model for a transitional path w entering a region r in e is displayed in Figure 42.b.

(388) If θ is an (Strict) Movement Relation for spatial path w and event e, then

a. $\forall e,r,w[\mathsf{leave}(w,r,e) \leftrightarrow$
$w \subseteq r \wedge \theta(w,e) \wedge \exists e',w'[e < e' \wedge \theta(w',e') \wedge \mathsf{INI}(e,e') \wedge \forall e''[\mathsf{INI}(e'',e') \rightarrow e \leq e''] \wedge$
$\forall w''[w'' \leq w' \wedge \neg w'' \otimes w \rightarrow \neg w'' \subseteq r]]]$
"path w **leaves** region r in e iff w is contained in r and w is θ-related to the minimal initial $e < e'$ such that e' is θ-related to w' and all other subpaths $w'' < w'$ that do not overlap with w are not contained in r"

b. $\forall e,r,w[\mathsf{enter}(w,r,e) \leftrightarrow$
$w \subseteq r \wedge \theta(w,e) \wedge \exists e',w'[e < e' \wedge \theta(w',e') \wedge \mathsf{FIN}(e,e') \wedge \forall e''[\mathsf{FIN}(e'',e') \rightarrow e \leq e''] \wedge$
$\forall w''[w'' \leq w' \wedge \neg w'' \otimes w \rightarrow \neg w'' \subseteq r]]]$
"path w **enters** region r in e iff w is contained in r and w is θ-related to the

minimal final $e < e'$ such that e' is θ-related to w' and all other subpaths $w'' < w'$ that do not overlap with w are not contained in r"



42.a: "path w **leaves** region r in e" 42.b: "path w **enters** region r in e"

Figure 42: Transitional goal and source paths

Let us now look at extended spatial paths denoted by non-geometric goal and source prepositions. I basically adopt Krifka' (1998: 227–228) definitions of goals and sources in order to model spatial paths denoted by non-geometric goal and source prepositions. Note that I 'relabel' Krifka's goal and source as the two three-place LF-predicates $\mathsf{to}(w,r,e)$ and $\mathsf{from}(w,r,e)$, respectively. In order to ensure that to-paths and from-paths are extended, I assume additionally that they are non-minimally complex objects (non-mco) as proposed by Beavers (2002: 19), see (389). Non-minimally complex objects are divisible into at least thee unique, non-overlapping subobjects.

(389) $\forall x[\mathsf{non\text{-}mco}(x) \leftrightarrow \exists x', x'', x'''[x = x' \oplus x'' \oplus x''' \wedge \neg x' \otimes x'' \wedge \neg x'' \otimes x''' \wedge \neg x' \otimes x''']]$

(Beavers 2002: 19)

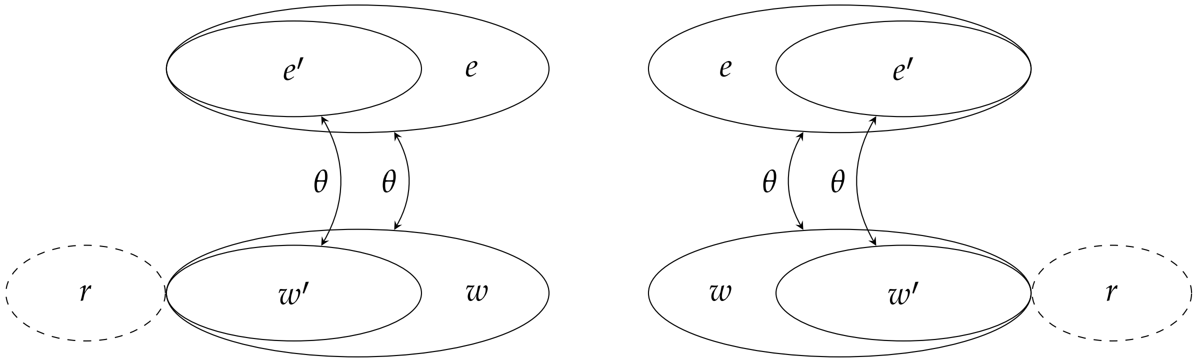
The model for a path w from a region r in e is displayed in Figure 43.a; the model for a path w to a region r in e is displayed in Figure 43.b.

(390) If θ is a (Strict) Movement Relation for spatial path w and event e, then

a. $\forall e,r,w[\mathsf{from}(w,r,e) \leftrightarrow \neg w \subseteq r \wedge \mathsf{non\text{-}mco}(w) \wedge \theta(w,e) \wedge$
$\forall e',w'[w' \leq w \wedge e' \leq e \wedge \theta(w',e') \rightarrow [[\mathsf{INI}(e',e) \rightarrow w' \infty r] \wedge [\neg \mathsf{INI}(e',e) \rightarrow \neg w' \infty r]]]]$
"w is a path **from** r in e iff w is not contained in r but all subpaths $w' \leq w$ that are θ-related to initial subevents $e' \leq e$ are adjacent to r"

b. $\forall e,r,w[\mathsf{to}(w,r,e) \leftrightarrow \neg w \subseteq r \wedge \mathsf{non\text{-}mco}(w) \wedge \theta(w,e) \wedge$
$\forall e',w'[w' \leq w \wedge e' \leq e \wedge \theta(w',e') \rightarrow [[\mathsf{FIN}(e',e) \rightarrow w' \infty r] \wedge [\neg \mathsf{FIN}(e',e) \rightarrow \neg w' \infty r]]]]$
"w is a path **to** r in e iff w is not contained in r but all subpaths $w' \leq w$ that are θ-related to final subevents $e' \leq e$ are adjacent to r"

(adapted from Krifka 1998: 227–228)



43.a: "*w* is a path **from** region *r* in *e*" 43.b: "*w* is a path **to** region *r* in *e*"

Figure 43: Extended goal and source paths

The following sections address the derivations as well as the LF-interpretations and the PF-realizations of geometric, pseudo-geometric and non-geometric goal and source prepositions.

5.4.2.1 Geometric prepositions

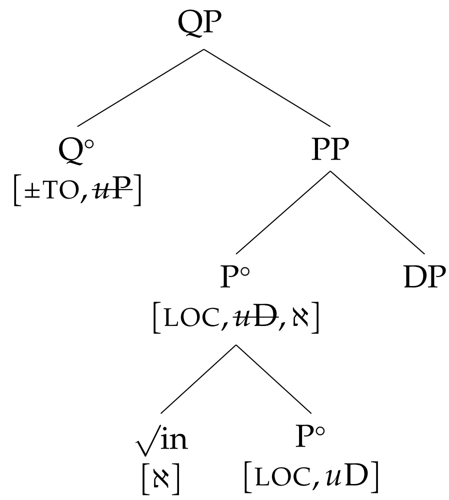
A prototypical example of the geometric goal preposition *in* ('into') is given in (391a); a prototypical example of the geometric source preposition *aus* ('out of') is given in (391b).

(391) a. Hans rannte **in** einen Wald.
Hans ran into a.ACC forest
'Hans ran into a forest.'

b. Hans rannte **aus** einem Wald.
Hans ran out of a.DAT forest
'Hans ran out of a forest.'

I assume that both geometric goal and geometric source prepositions share the lexical structure with geometric place prepositions. That is, up to the level of PP, the structure in (392) is identical to the structure in (338) on page 210. The category P hosts the synsem feature [LOC] and a *u*-prefixed D-feature that triggers Merge with the DP-complement of the preposition. Once P has merged with its DP-complement it projects a PP and the *u*-prefixed D-feature deletes. At the outset of the derivation, the category P undergoes Primary merge and thereby generates a prepositional Root position, cf. Section 2.3. At Spell-Out, this prepositional Root position serves as the insertion site for abstract Content features. In the case of the geometric goal and source prepositions *in* and *aus*, it is the abstract Content feature [א] relating to interiority that enters the structure at the Root position of P[LOC]. The light preposition Q derives goal and source prepositions from place prepositions. Q can host the synsem feature [+TO] for a goal interpretation; and [−TO] for a source interpretation. That is, the structure of the geometric goal preposition *in* ('into') in (391a) and the structure of the geometric source preposition *aus* ('out of') in (391b) looks as depicted in (392).

(392)

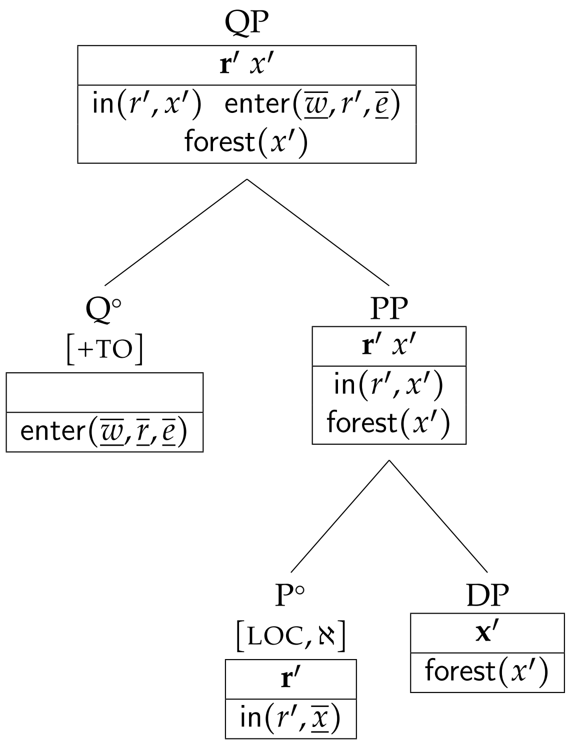


Let us now look at the interpretation of this structure at LF. Up to the level of PP, the interpretation is parallel to the interpretation of the respective geometric place preposition depicted in (369). The higher P°-node is subject to interpretation at LF. It hosts the synsem feature [LOC] together with the abstract Content feature [א]. P[LOC, א] is interpreted as specifying an in-region r' of an anticipated material object $\overline{\underline{x}}$. In this example, the DP is interpreted as specifying a forest-entity x', which instantiates $\overline{\underline{x}}$. That is, the PP is interpreted to the effect that r' is an in-region of the forest x'.

I assume that the light preposition Q above PP derives goal and source prepositions. In the case of the geometric goal preposition *in* ('into') as in (391a), Q hosts the synsem feature [+TO]. This is interpreted to the effect that it introduces the three-place predicate enter($\overline{\underline{w}}$, $\overline{\underline{r}}$, $\overline{\underline{e}}$); see the definition of the predicate in (388b). An anticipated spatial path $\overline{\underline{w}}$, which is a transitional spatial path that is conceptualized as punctual, enters an anticipated region $\overline{\underline{r}}$ in an anticipated event $\overline{\underline{e}}$. The in-region-denoting discourse referent r' is the referential argument of the PP. It instantiates the anticipated region $\overline{\underline{r}}$ of Q. That is, QP is compositionally interpreted as denoting an in-region r' of the forest x' that is entered by an anticipated spatial path $\overline{\underline{w}}$ in an anticipated event $\overline{\underline{e}}$.[118] The LF-representation of the PP in (391a) is given in (393).

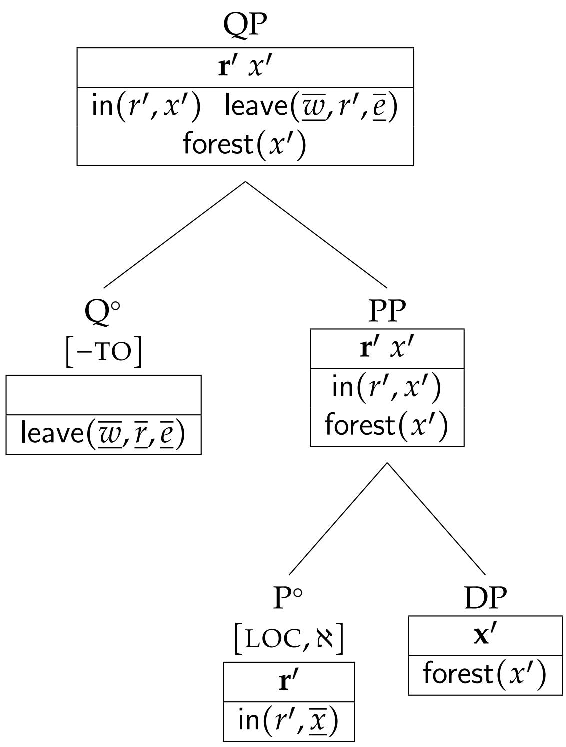
[118]The anticipated spatial path $\overline{\underline{w}}$ will be instantiated at the functional level of the derivation by the referential argument of the functional prepositional category C, while the anticipated event $\overline{\underline{e}}$ will be instantiated by the referential argument of the verb. An example of this is given in (488) and (489) in Section 5.6.2.

(393)



In the case of the geometric source preposition *aus* ('out of') as in (391b), the structure is basically identical. The only difference is that Q hosts the synsem feature [−TO]. This is interpreted to the effect that it introduces the three-place predicate leave($\underline{\overline{w}}$,$\underline{\overline{r}}$,$\underline{\overline{e}}$); see the definition of the predicate in (388a). The QP is compositionally interpreted as denoting an in-region r' of the forest x' that is left by an anticipated spatial path $\underline{\overline{w}}$ in an anticipated event $\underline{\overline{e}}$. The LF-representation of the QP in (391b) is given in (394).

(394)



In order to account for the respective interpretations, we can formulate the LF-instructions for Q as given in (395). The contexts are formulated to the effect that the interpretation rules apply only in the context of (pseudo)-geometric prepositions, which involve the synsem feature [LOC]. Note at this point that these instructions will be extended in the context of non-geometric goal and source prepositions, cf. Section 5.4.2.3. Note also that the LF-instructions for P as formulated in (340), (351), and (370) straightforwardly apply to the geometric goal and source prepositions.

(395) **LF-instructions for Q** (first version):

a. Q $\leftrightarrow$ [| enter($\overline{\underline{w}}$,$\overline{\underline{r}}$,$\overline{\underline{e}}$)] / [_ [+TO] ... P[LOC]]

b. $\leftrightarrow$ [| leave($\overline{\underline{w}}$,$\overline{\underline{r}}$,$\overline{\underline{e}}$)] / [_ [−TO] ... P[LOC]]

Let us now look at the possible PF-realizations of the structure in (392). The PF-instructions for P formulated in (342) and (372) straightforwardly apply for the geometric goal prepositions *in* ('into'), *an* ('onto'), and *auf* ('up onto'). Unlike in English, the German morphological forms of the geometric goal prepositions are identical to the morphological forms of the respective geometric place prepositions. Instead, German shows a case alternation; cf. the place/goal alternation (or dative/accusative alternation) discussed in Section 5.1.2. Geometric (and also pseudo-geometric) place prepositions have a dative complement, while the corresponding (pseudo)-geometric goal prepositions have an accusative complement. Note that I do not address this alternation at this point. Section 6.4 discusses case in the prepositional domain.

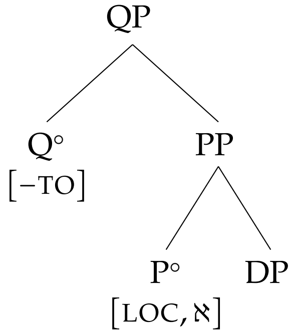
At PF, the analysis of geometric source prepositions is more complex than the analysis of geometric goal prepositions. Let us first look at the surface forms of the geometric source prepositions in German; cf. Section 5.1.2 and, in particular, Table 3 on page 184. The geometric source preposition that corresponds to the geometric goal preposition *in* ('into') has a synthetic form, namely *aus* ('out of'). In addition, German has the analytic source prepositions *von an* ('from on'), *von auf* ('from upon'), and *von in* ('from in'), which are, however, judged as marginal or even ungrammatical by many German speakers. It appears that the source preposition *von* ('from'), which is actually a non-geometric source preposition, is usually preferred.

In order to account for the synthetic source preposition *aus* ('out of'), I posit a morphological movement operation to the effect that the Q°-node morphologically lowers to and fuses with the P°-node.[119] Coming from Spell-Out, we start, at PF, with the structure depicted in (396a). Then, the Q°-node lowers to the P°-node as depicted in (396b). Technically, this step takes the form of adjunction. Finally, the Q°-node and the P°-node fuse to the node P°/Q° as

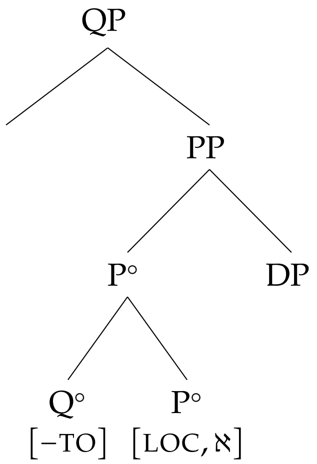
[119]See Sections 3.4 and 3.5 for a presentation of the respective morphological operations.

depicted in (396c). At the same time, the synsem-feature bundles they host individually fuse to one synsem-feature bundle, i.e. [LOC, א, −TO].

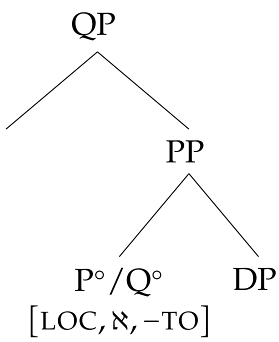
(396) a.



b.



c.



I propose the morphological rule of **Q-to-P-Lowering and subsequent P/Q-Fusion**, as formulated in (397).

(397) **Q-to-P-Lowering and subsequent P/Q-Fusion:**
Q° lowers to and fuses with P°.

Now, we can formulate the PF-instructions for P and Q in order to account for synthetic geometric source and goal prepositions. Q/P[LOC, א, −TO] is realized as /a͜us/ (or *aus*). This motivates the addition of the special rule in (398a) to the PF-instructions for P. I mentioned above that the non-geometric source preposition *von* ('from') is often used instead of analytic source prepositions. I thus add the rule in (398b). Note that this rule is independent of whether P hosts the synsem feature [LOC] for (pseudo)-geometric prepositions or [AT] for non-geometric prepositions. However, it must be ranked higher than the rules involving the synsem feature [LOC].

(398) **PF-instructions for P** (third version):

a.	P	↔	/au̯s/	/ _ [LOC, א, −TO]
b.		↔	/fɔn/	/ _ [−TO]
c.		↔	/ɪn/	/ _ [LOC, א]
d.		↔	/an/	/ _ [LOC, ב]
e.		↔	/au̯f/	/ _ [LOC, נ]
f.		↔	/bai̯/	/ _ [AT]

Let us finally look at the analytic source prepositions *von an* ('from on'), *von auf* ('from upon'), and *von in* ('from in'). I take the view that they are the result of the non-application of the morphological rule of Q-to-P-Lowering and subsequent P/Q-Fusion. In this case, the P°-node is realized straightforwardly as a geometric place preposition and the synsem feature [−TO] triggers the realization of Q as /fɔn/, i.e. *von*. The PF-instructions for Q are given in (399). Q is realized as /fɔn/ iff it hosts the synsem feature [−TO] and Q-to-P-Lowering and subsequent P/Q-Fusion has not taken place (i.e. ¬∃ P°/Q°). If [−TO] is hosted by P°/Q° as a result of Q-to-P-Lowering and subsequent P/Q-Fusion, P is realized as /fɔn/ and Q is silent.

(399) **PF-instructions for Q:**

a.	Q	↔	/fɔn/	/ _ [−TO] ∧ ¬∃ P°/Q°
b.		↔	∅	elsewhere

Note in this context that I assume that, in German, Q-to-P-Lowering and subsequent P/Q-Fusion always take place at PF by default. Only if speakers want to express a source path that can only be described by an analytic source preposition (e.g. by *von auf* 'from upon'), they can suppress Q-to-P-Lowering and subsequent P/Q-Fusion.

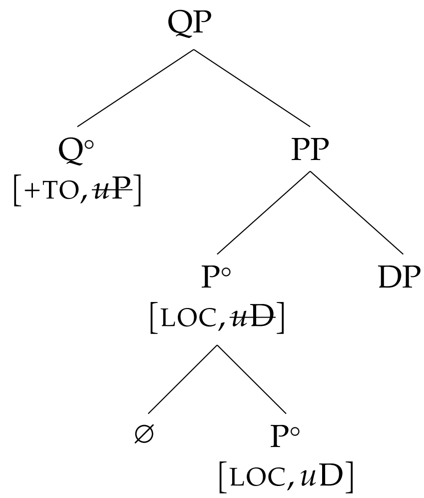
5.4.2.2 Pseudo-geometric prepositions

This section addresses the derivation of pseudo-geometric (toponymic) goal and source prepositions and their interpretation at LF as well as their realization at PF. A prototypical example of the toponymic goal preposition *in* ('to, into') is given in (400).

(400) Hans fuhr **in** die Schweiz.
Hans drove into the.ACC Switzerland
'Hans drove to Switzerland.'

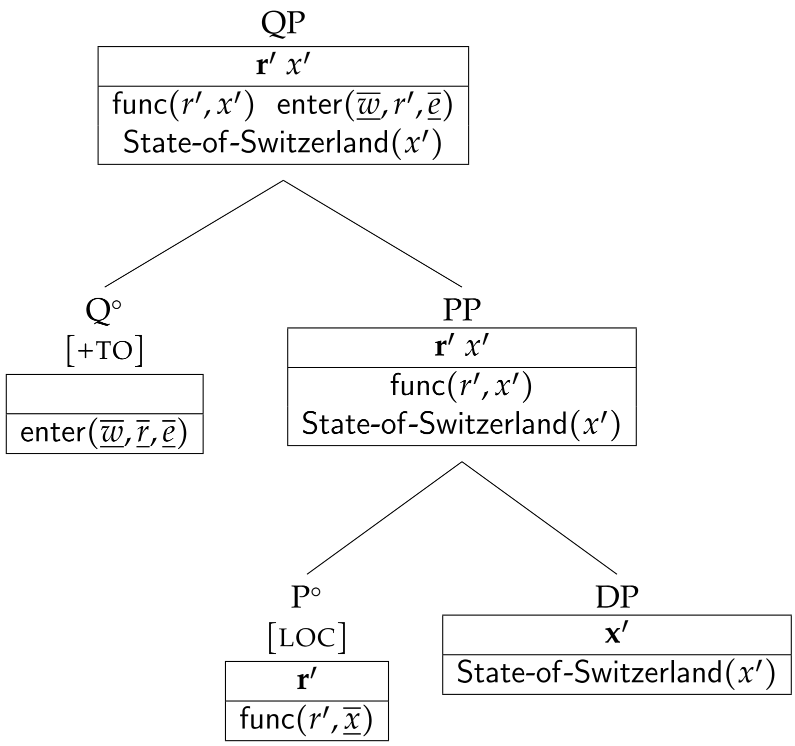
The structure of pseudo-geometric goal and source prepositions combines the derivational principle of pseudo-geometric place prepositions discussed in Section 5.4.1.2, namely that their Root position is empty, with the idea that goal and source prepositions are derived by the light preposition Q above P, which is discussed in Section 5.4.2.1. Considering the toponymic goal preposition *in* (‘to, into’) in (400) we can thus assume the structure in (401).

(401)



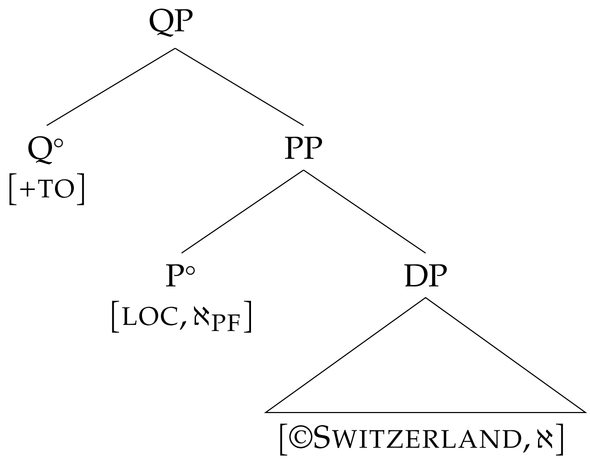
Considering the LF-instructions for P formulated in (370) and for Q formulated in (395), the structure in (401) is interpreted as depicted in (402). The QP is compositionally interpreted as denoting a func-region r' of the state of Switzerland x' that is entered via an anticipated spatial path $\overline{w}$ in an anticipated event $\underline{e}$. Note that toponymic source prepositions involving Q[−TO] derive accordingly.

(402)

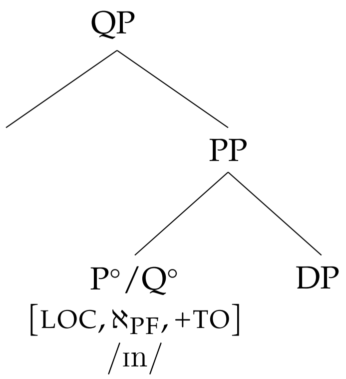


Let us now look at the PF-realization of the structure (401). As in the case of toponymic place prepositions discussed in Section 5.4.1.2, we can assume that the DP *Schweiz* (‘Switzerland’), which refers to a state, contains the abstract Content feature [א]. This feature is copied to the P°-node at PF. This yields the intermediate PF-representation in (403a). Then, the morphological operations of P-to-Q-Lowering and subsequent P/Q-Fusion take place, as proposed in (397). This yields P/Q[LOC, $\aleph_{PF}$, +TO] as given in (403b). According the PF-instructions for P as formulated in (398), this is pronounced as /ɪn/, i.e. *in*.

(403) a.



b.



So far, the system proposed here straightforwardly derives the (pseudo)-geometric goal and source prepositions *in* ('into, to'), *an* ('onto, to'), *auf* ('up onto, to'), *aus* ('out of, from'), *von an* ('from on, from'), *von auf* ('from upon, from'), *von in* ('from in, from'), and the non-geometric source preposition *von* ('from'). However, there is a special pseudo-geometric goal preposition that occurs in the context of determinerless toponyms. Consider the use of *nach* ('to') in the examples (404). In all these examples, the toponymic place preposition cannot be used as a toponymic goal preposition, in the way that was possible in the example in (400). That is, the dative/accusative alternation (or place/goal alternation) seems to fail in this case.

(404) a. Hans segelte **nach/*auf** Hispaniola.
Hans sailed to/up onto Hispaniola
'Hans sailed to Hispaniola.'

b. Hans flog **nach/*in** Haiti.
Hans flew to/into Haiti
'Hans flew to Haiti.'

c. Hans reiste **nach/*in/*auf** Kuba.
Hans traveled to/into/up onto Cuba
'Hans traveled to Cuba.'

d. Hans fuhr **nach/*in** Österreich
Hans drove to/into Austria
'Hans drove to Austria.'

Let us contrast the examples in (404) with the examples in (405). All toponyms in (405) are – unlike the ones in (404) – feminine or masculine or plural and hence they cannot occur determinerless. In these cases, *nach* ('to') is ungrammatical and 'regular' pseudo-geometric goal preposition with accusative is required.

(405) a. Hans reiste **in/*nach** die Türkei.
Hans traveled into/to the.FEM.SG.ACC Turkey
'Hans traveled to Turkey.'

b. Hans ging **in/*nach** den Iran.
Hans went into/to the.MASC.SG.ACC Iran
'Hans went to Iran.'

c. Hans fuhr **in/*nach** die Niederlande.
Hans drove into/to the.PL.ACC Netherlands
'Hans drove to the Netherlands.'

d. Hans schwamm **auf/*nach** die Pfaueninsel.
Hans swam up onto/to the.FEM.SG.ACC Pfaueninsel
'Hans swam to Pfaueninsel.'

e. Hans segelte **auf/*nach** den Darß.
Hans sailed up onto/to the.MASC.SG.ACC Darß
'Hans sailed to Darß.'

f. Hans zog **auf/*nach** die Lofoten.
Hans moved up onto/to the.PL.ACC Lofoten
'Hans moved to Lofoten.'

As illustrated in (406), toponyms that are neuter and singular are typically used determinerless,[120] while toponyms that are non-neuter (i.e. feminine as in (406b) or masculine as in (406c)) or non-singular (i.e. plural as in (406d)) are used with a determiner.[121]

(406) a. (*das) Frankreich/Argentinien/Schottland
the.NEUT.SG France/Argentina/Scotland

b. *(die) Türkei/Schweiz/Mongolei
the.FEM.SG Turkey/Switzerland/Mongolia

[120] Interestingly, many neuter and singular toponyms, especially those that name regions in Germany, Austria, Switzerland, France, and Italy are not determinerless, **(das) Sauerland* ('Sauerland'), **(das) Allgäu* ('Allgäu'), **(das) Oderbruch* ('Oderbruch'), **(das) Rhinluch* ('Rhinluch'), **(das) Marchfeld* ('Marchfeld'), **(das) Salzkammergut* ('Salzkammergut'), **(das) Tessin* ('Ticino'), **(das) Wallis* ('Valais'), **(das) Elsass* ('Alsace'), **(das) Limousin* ('Limousin'), **(das) Languedoc* ('Languedoc'), **(das) Latium* ('Lazio'), **(das) Piemont* ('Piedmont'), *?(das) Friaul* ('Friuli'), etc.

[121] Concerning the determiner, the toponym *Kosovo* is particularly interesting because it can either be masculine or neuter *der/(das) Kosovo*. It is obligatorily used with a determiner if it is masculine, while it can be used with or without a determiner if it is neuter. Only since Kosovo has been frequently mentioned in the media – due to the Yugoslav Wars and especially since its independence in 2008 – there seems to be the tendency away from the uses as masculine with a determiner towards the uses as neuter without a determiner.

c. *(der) Iran/Libanon/Jemen
the.MASC.SG Iran/Lebanon/Yemen

d. *(die) Niederlande/Lofoten/Kanaren
the.PL Netherlands/Lofoten/Canaries

If, however, neuter/singular toponyms are subject to modification, then they necessarily co-occur with a determiner, as (407).

(407) a. *(das) Frankreich des 18. Jahrhundert-s
the.NEUT.SG France the.GEN 18th century-GEN
'the France of the 18th century'

b. *(das) Argentinien, das er aus seiner Jugend kennt
the.NEUT.SG Argentina that he from his youth knows
'the Argentina that he knows from his youth'

c. *(das) regnerische Schottland
the.NEUT.SG rainy Scotland
'the rainy Scotland'

As soon as neuter/singular toponyms co-occur with a determiner, *nach* is ungrammatical and a straightforward toponymic goal preposition must be used (i.e. *in*, *auf*, or *an*). This is illustrated in (408).

(408) a. Hans segelte **auf/*nach** das tropische Hispaniola.
Hans sailed up onto/to the.NEUT.SG.ACC topical Hispaniola
'Hans sailed to the tropical Hispaniola.'

b. Hans flog **in/*nach** das von einem Erbeben betroffene
Hans flew to/into the.NEUT.SG.ACC by an earthquake affected
Haiti.
Haiti
'Hans flew to Haiti, that is affected by an earthquake.'

c. Hans reiste **in/auf/*nach** das Kuba der
Hans traveled into/up onto/to the.NEUT.SG.ACC Cuba the.GEN
Nachkriegszeit.
post-war era
'Hans traveled to post-war Cuba.'

d. Hans fuhr **in/*nach** das bergige Österreich
Hans drove into/to the.NEUT.SG.ACC mountainous Austria
'Hans drove to the mountainous Austria.'

We observe that the availability of the special toponymic goal preposition *nach* depends on the absence of a determiner. If a toponym occurs without a determiner, then *nach* is required as the goal preposition; if, however, a toponym occurs with a determiner, then *nach* is ungrammatical as the goal preposition. As for the syntacticosemantic identity of determinerless toponyms, I follow Matushansky (2015, 2016) and assume that they lack

ϕ-features, i.e. person/number/gender features. This means that determinerless toponyms can be identified by the absence of ϕ-features on their D°-head. I represent this as D[¬∃ϕ].

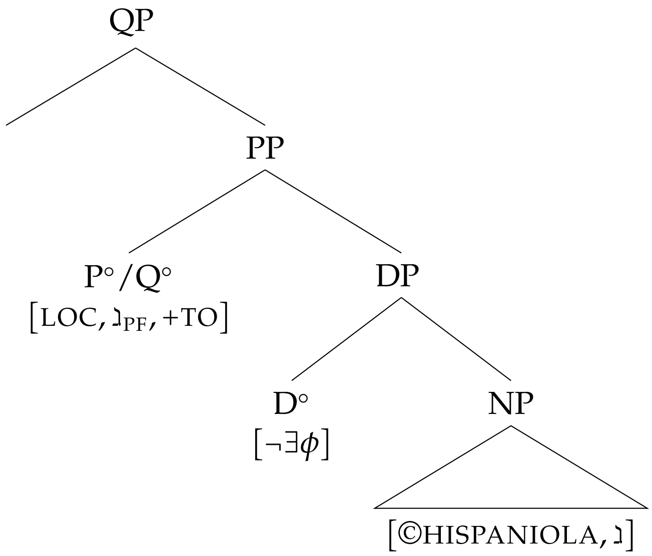
In order to illustrate the derivation, consider the example with *nach* in (409a) and the example with *auf* in (409b).

(409) a. Hans ging **nach/*auf** Hispaniola.
Hans went to/up onto Hispaniola
'Hans went to Hispaniola.'

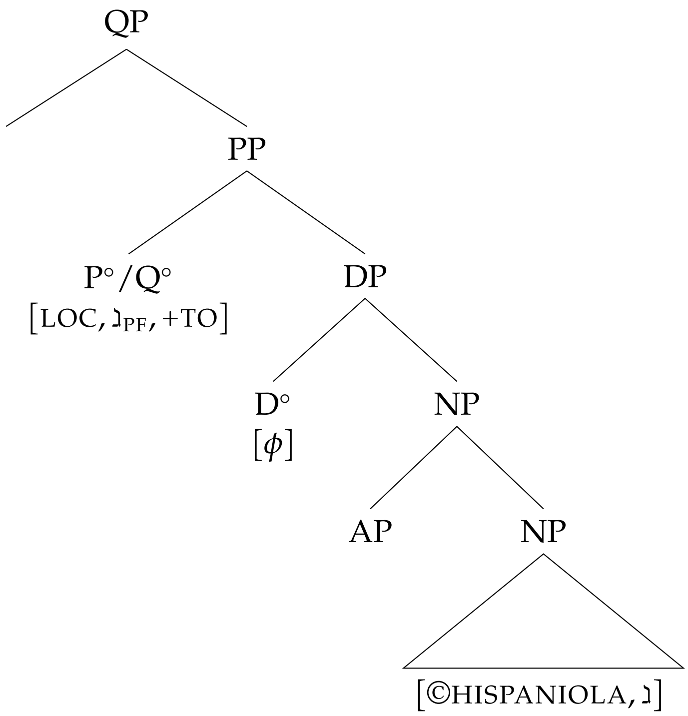
b. Hans ging **auf/*nach** das tropische Hispaniola.
Hans went up onto/to the.NEUT.SG.ACC tropical Hispaniola
'Hans went to the tropical Hispaniola.'

After PF-copying the abstract Content feature [ℷ] from within the NP to P° and after Q-to-P-Lowering and subsequent P/Q-Fusion has taken place, the QP in (409a) can be represented at PF as given in (410a) and the QP in (409b) can be represented at PF as given in (410b).

(410) a.



b.



In both cases, the P°/Q°-node has the feature specification, viz. [LOC, ℷ$_{PF}$, +TO]. The difference is on the D°-node; it hosts ϕ-features in (410b), while it does not in (410a). I propose that we can exploit this difference for the formulation of the PF-instruction for P. In order to account for the toponymic goal preposition *nach* ('to'), we can expand the PF-instructions for P by the rule in (411a). As the context in (411a) is the most specific one, this rule outranks the other rules.

(411) **PF-instructions for P** (fourth version):

a.	P	↔ /naːx/	/	[_ [LOC, +TO] ... D[¬∃ϕ]]
b.		↔ /au̯s/	/	_ [LOC, א, −TO]
c.		↔ /fɔn/	/	_ [−TO]
d.		↔ /ɪn/	/	_ [LOC, א]
e.		↔ /an/	/	_ [LOC, ב]
f.		↔ /au̯f/	/	_ [LOC, ℷ]
g.		↔ /bai̯/	/	_ [AT]

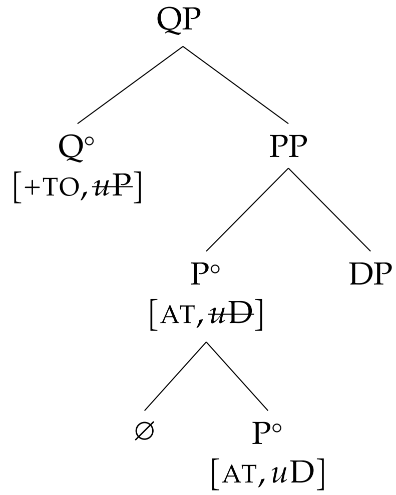
5.4.2.3 Non-geometric prepositions

This section derives the non-geometric goal and source prepositions *zu* ('to') and *von* ('from'), respectively. In line with Noonan (2010), I assume that they are the directional counterparts of the place peposition *bei* ('at'). A prototypical example of the non-geometric goal preposition *zu* is given in (412).

(412) Hans rannte **zu** einem Wald.
Hans ran to a.DAT forest
'Hans ran to a forest.'

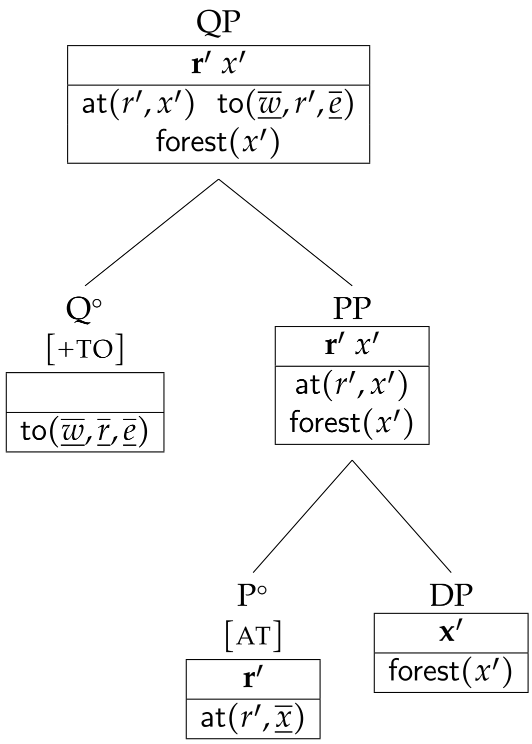
I propose that the lexical structure of the non-geometric goal preposition *zu* (‘to’) in (412) looks as in (413). The light preposition Q above P[AT] can host the synsem feature [+TO] and thereby derives the non-geometric goal preposition *zu*. Note at this point that the non-geometric source preposition *von* (‘from’) is derived analogously. In that case, Q hosts the synsem feature [−TO].

(413)



Let us now look at the interpretation of this structure at LF. Up to the level of PP, the interpretation is parallel to the interpretation of the non-geometric place preposition *bei* (‘at’) given in (369). The higher P°-node is subject to interpretation at LF. It hosts the synsem feature [AT], which is interpreted as specifying an at-region r' of an anticipated material object $\underline{\overline{x}}$. In this example, the DP is interpreted as specifying a forest-entity x', which instantiates $\underline{\overline{x}}$. That is, the PP is compositionally interpreted to the effect that r' is an at-region of the forest x'. At the next level, the light preposition Q hosts the synsem feature [+TO], whose interpretation introduces the three-place predicate to($\underline{\overline{w}}, \underline{\overline{r}}, \underline{\overline{e}}$); see the definition of the predicate to in (390b). An anticipated spatial path $\underline{\overline{w}}$, which is a non-transitional spatial path that is conceptualized as extended, leads to an anticipated region $\underline{\overline{r}}$ in an anticipated event $\underline{\overline{e}}$. The discourse referent r' is the referential argument of the PP. It instatiates the anticipated region of Q. That is, QP is compositionally interpreted as denoting an at-region r' of the forest x'; and an anticipated spatial path $\underline{\overline{w}}$ leads to r' in an anticipated event $\underline{\overline{e}}$. The LF-representation is given in (414).

(414)



In order to account for the interpretation of Q, we can expand the LF-instructions for Q by the rules in (415c) and (415d). I assume that Q[±TO] above P[AT] is the less specific case, as compared to the case when Q[±TO] occurs above P[LOC]. That is, the contexts of non-geometric goal and source prepositions are less specifc than those of (pseudo)-geometric goal and source prepositions. As a result, the rules in (415a) and (415b) rank higher than the rules in (415c) and (415d). Note furthermore that the LF-instructions for P as formulated in (370) apply straightforwardly and do not need to be extended here.

(415) **LF-instructions for Q** (second version, final):

a. Q $\leftrightarrow$ [$\mid$ $\text{enter}(\overline{\underline{w}}, \overline{\underline{r}}, \overline{\underline{e}})$] / [_ [+TO] ... P[LOC]]

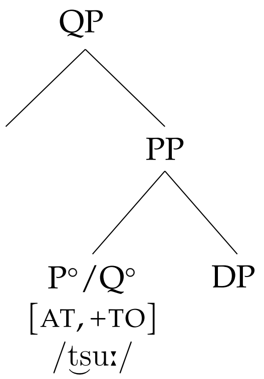
b. $\leftrightarrow$ [$\mid$ $\text{leave}(\overline{\underline{w}}, \overline{\underline{r}}, \overline{\underline{e}})$] / [_ [−TO] ... P[LOC]]

c. $\leftrightarrow$ [$\mid$ $\text{to}(\overline{\underline{w}}, \overline{\underline{r}}, \overline{\underline{e}})$] / _ [+TO]

d. $\leftrightarrow$ [$\mid$ $\text{from}(\overline{\underline{w}}, \overline{\underline{r}}, \overline{\underline{e}})$] / _ [−TO]

Let us now look at the PF-realization of the structure in (413). As usual, Q lowers to and subsequently fuses with P at PF. Thus, the non-geometric goal preposition *zu* ('to') involves the complex morpheme P/Q[AT, +TO], which is realized with the exponent /t͡suː/, i.e. *zu*; see (416).

(416)



We already have a rule in the PF-instructions for P that accounts for the non-geometric source preposition *von*, i.e. /fɔn/. The rule In (417c), which was introduced in Section 5.4.2.1, is underspecified to the effect that it covers both (pseudo)-geometric and non-geometric source prepositions. So, we need to add only the rule in (417g) in order to account for the non-geometric goal preposition *zu*. This rule must rank lower than the rules involving the synsem feature [LOC], but higher than the rule involving the synsem feature [AT].

(417) **PF-instructions for P** (fifth version):

a.	P	↔	/naːx/	/	[_ [LOC, +TO] ... D[¬∃ϕ]]
b.		↔	/a͡us/	/	_ [LOC, ℵ, −TO]
c.		↔	/fɔn/	/	_ [−TO]
d.		↔	/ɪn/	/	_ [LOC, ℵ]
e.		↔	/an/	/	_ [LOC, ℶ]
f.		↔	/a͡uf/	/	_ [LOC, ℷ]
g.		↔	/t͡suː/	/	_ [+TO]
h.		↔	/ba͡i/	/	_ [AT]

5.4.3 Route prepositions

This section discusses the German route prepositions *durch* ('through'), *um* ('around'), and *über* ('over, across'). Prototypical examples of them are given in (418).

(418) a. Hans joggte **durch** einen Wald.
Hans jogged through a.ACC forest
'Hans jogged through a forest.'

b. Hans ritt **um** einen Wald.
Hans rode around a.ACC forest
'Hans rode around a forest.'

c. Hans flog **über** einen Wald.
Hans flew over a.ACC forest
'Hans flew over a forest.'

Intuitively, the route prepositions *durch*, *um*, and *über* correspond to the place and goal prepositions *in* ('in, into'), *an* ('on, onto'), and *auf* ('upon, up onto'), respectively. In fact, I will claim that the same abstract Content features that give rise to topological geometric place and goal (and source) prepositions give also rise to route prepositions, but in another synsem feature context. In the Root position of a locative preposition, the abstract Content feature [א], which relates to interiority, gives rise to the locative prepositions *in* and *aus* ('out of'); in the Root position of a route preposition, it gives rise to the route preposition *durch* ('through'). In the Root position of a locative preposition, the abstract Content feature [ב], which relates to contiguity, gives rise to the locative preposition *an* ('on, onto'); in the Root position of a route preposition, it gives rise to the route preposition *um* ('around'). In the Root position of a locative preposition, the abstract Content feature [נ], which relates to verticality, gives rise to the locative preposition *auf* ('upon, up onto'); in the Root position of a route preposition, it gives rise to the route preposition *über* ('over, across').

After the discussion in the previous sections on (pseudo)-geometric and non-geometric prepositions, it should be clear that P[LOC] and P[AT] are characteristic of locative prepositions. But now the question arises of what is characteristic of route prepositions. In a nutshell, I propose that a third synsem feature is characteristic of route prepositions; I will label this feature [±NINF], for positive/negative non-initial, non-final paths.

In order to motivate and explicate the synsem feature [±NINF] characteristic of route prepositions, I should like to draw the reader's attention to the typology in Figure 35 established in Section 5.1.1: goal (and source) prepositions – which are derived from locative place prepositions – denote directed spatial paths, while route prepositions denote undirected spatial paths (Jackendoff 1991, Piñón 1993, Kracht 2002, 2008, Zwarts 2005b, Pantcheva 2011). That is, route prepositions are undirected path prepositions, and, therefore, I model them in terms of Krifka's (1998: 203) plain path structure H. In this respect, route prepositions contrast with goal and source prepositions, which are directed path prepositions. For the latter, a modeling in terms of Krifka's (1998: 205) directed path structure D is required; cf. (259) on page 150, as well as the LF-predicates enter and leave which are based on a directed path structure (cf. (388) on page 231). Let us look at three properties of route prepositions: (i) route prepositions are systematically ambiguous with regard to lexical aspect; (ii) route prepositions do not commit to direction; and (iii) route prepositions do not entail a result state.

First, all the route prepositions this thesis focuses on are systematically ambiguous between a bounded and an unbounded interpretation. As discussed in Section 5.1.3, most route prepositions give rise to a telic (bounded) and an atelic (unbounded) interpretation, when combined, for instance, with a motion verb; cf. Piñón's (1993: 298) English examples given in (312) on page 192; they are repeated here as (419).

(419) a. The insect crawled through the tube {for two hours, in two hours}.
b. The procession walked by the church {for 45 minutes, in 45 minutes}.
c. Mary limped across the bridge {for ten minutes, in ten minutes}.
(Piñón 1993: 298)

Consider the German data in (420), too.

(420) a. Hans lief in/für 30 Minuten **durch** den Wald.
Hans ran in/for 30 minutes through the .ACC forest
'Hans ran through the forest in/for 30 minutes.'

b. Hans rannte in/für 5 Minuten **um** den Turm.
Hans ran in/for 5 minutes around the.ACC tower
'Hans ran around the tower in/for 5 minutes.'

c. Hans flog in/für 3 Minuten **über** den Platz.
Hans flew in/for 3 minutes over the.ACC square
'Hans flew over the square in/for 3 minutes.'

Second, route prepositions do not commit to direction, something I already argued for in Section 4.3, where I also drew attention to the fact that in this respect they differ from goal (and source) prepositions, which do commit to direction. PPs headed by route prepositions serve as felicitous modifiers of underived nominals, such as *wall* or *fence* that are not conceptualized as having an inherent direction. PPs headed by goal (or source) prepositions are odd as modifiers of these nouns; see the examples (210) on page 121 and (211) on page 121. The example (210a) is repeated here as (421) and the example (211a) as (422). A further example of a route preposition is (423); further examples of goal and source prepositions are given in (424) and (425).

(421) [Die Mauer **durch** die Stadt] wurde niedergerissen.
the wall through the.ACC city was torn down
'The wall through the city has been torn down.'

(422) [Die Mauer ??**in** die Stadt] wurde niedergerissen.
the wall into the.ACC city was torn down
??'The wall into the city has been torn down.'

(423) Demonstranten zerstörten [den Zaun **um** das Gebäude].
protesters destroyed the fence around the.ACC building
'Protesters destroyed the fence around the building.'

(424) Demonstranten zerstörten [den Zaun ??**an** das Gebäude].
protesters destroyed the fence onto the.ACC building
??'Protesters destroyed the to around the building.'

(425) [Die Hecke ??**aus** dem Garten] hatte Mehltau.
the hedge out of the garden had powdery mildew
??'The hedge out of the garden had powdery mildew.'

I take these data as evidence that Krifka's (1998: 203) plain path structure *H* is sufficient for the modeling of spatial paths denoted by route prepositions.

Third, route prepositions do not entail a result state. Indicating repetition, *wieder* ('again') can generally give rise to two readings (von Stechow 1996, Beck and Johnson 2004): (i) a repetitive reading, where a event is repeated, and (ii) a restitutive reading, where a (result) state is restored. Ramchand (2012) observes that route prepositions give only rise to a repetitive reading in the scope of *wieder* ('again'), while goal and source prepositions give rise to a repetitive and restitutive reading in the scope of *wieder*. Consider the goal and source prepositions in (426), where both restitutive and repetitive readings are available; and the route prepositions in (427), where only repetitive readings are available.

(426) a. Hans rannte wieder **in** den Wald.
Hans ran again in the.ACC forest
'Hans ran into the forest again.'

b. Hans rannte wieder **aus** dem Wald.
Hans ran again out of the.DAT forest
'Hans ran out of the forest again.'

(427) a. Hans rannte wieder **durch** den Wald.
Hans ran again through the.ACC forest
'Hans ran through the forest again.'

b. Hans rannte wieder **um** das Haus.
Hans ran again around the.ACC house
'Hans ran around the house again.'

c. Hans rannte wieder **über** den Platz.
Hans ran again over the.ACC square
'Hans ran across the square again.'

I interpret this as follows. The motion verbs in (426) and (427) denote events and thus repetitive readings are always available here. Goal and source prepositions denote regions, which can be targeted by result state predications. Thus, they give rise to restitutive readings. In contrast, route prepositions do not denote regions, which can be targeted by result state predications. Thus, restitutive readings are not available.

The hypothesis that the semantics of route prepositions does not involve regions is corroborated by the observation that route prepositions do not provide regions for anaphoric binding. The goal preposition *in* ('into') in (428a) refers to an in-region of the park at the end of a spatial path; this region is then available for anaphoric binding by the locative pronoun *dort* ('there'). In contrast, the route preposition *durch* ('through') in (428b) does not refer to an in-region of the park at the end of a spatial path; and thus *dort* is infelicitous.

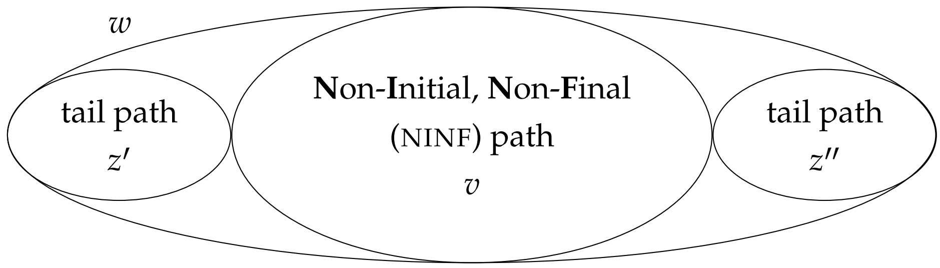
(428) a. Hans rannte **in** den Park und blieb dort für 5 Minuten.
Hans ran into the.ACC park and stayed there for 5 minutes
'Hans ran into the park and stayed there for 5 minutes.'

b. Hans rannte **durch** den Park ??und blieb dort für 5 Minuten.
Hans ran through the.ACC park and stayed there for 5 minutes
??'Hans ran through the park and stayed there for 5 minutes.'

I take the view that these semantic differences between goal and source prepositions, on the one hand, and route prepositions, on the other, serve as indication that the synsem feature [LOC] is absent in the context of route prepositions. If [LOC] was present in the context of route prepositions, this would lead to a semantics involving regions, which then could be targeted (i) by *wieder* ('again'), giving rise to restitutive readings, or (ii) by *dort* ('there') for anaphoric binding. This means that the synsem feature [LOC], which correlates to regions at LF, is absent in the structure of route prepositions. Instead, another synsem feature, which I label [±NINF] (for non-initial, non-final spatial paths), is characteristic of route prepositions. Below, I justify the feature [±NINF] semantically.

I argue that route prepositions denote route paths that have a tripartite structure. In particular, a route path w consists of a **non-initial, non-final** subpath v, the **NINF-path**, and two peripheral subpaths z', z'', the **tail paths**. The route path w is the mereological sum of the NINF-path v and the two tail paths $z'z,''$; and both tail paths are adjacent to the NINF-path, one at each side. This can be illustrated as in (429).

(429) Tripartite structure of route paths w
consisting of a NINF-path v and two peripheral tail paths z', z'':



I propose that NINF-paths and route paths figure at LF; tail paths do not. In particular, I propose that NINF-paths are subject to geometric predication at LF; and route paths are SPs denoted by route PPs. In Section 5.3, I have defined the LF-predicates durch-bar, um-bar, and ueber-bar; these predicates geometrically relate line segments to material objects. I propose that NINF-paths, qua line segments, can be predicated over by these predicates.

Let us now define NINF-paths of route paths in terms of mereological structure. As mentioned above, I take the view that a route path w has a tripartite structure to the effect that it consists of a NINF-path v and two tail paths z', z''. Recall that I assume that NINF-paths can be arguments of the LF-predicates durch-bar, um-bar, and ueber-bar. However, the tail paths z', z'' are not completely unaffected by the geometric predication. The definitions of the LF-predicates durch-bar, um-bar, and ueber-bar in Section 5.3 each consists of a boundary condition and a configurational condition. That is, when a NINF-path v serves as an argument of one of the three LF-predicates above, then v also obeys a certain boundary condition B. I claim that the two tail paths z', z'' of a NINF-path v are indistinguishable to the effect that they either both obey the boundary condition B, or else neither obeys the boundary condition B. I will discuss this in more detail below. To control for the indistinguishability of z' and z'' with regard to the boundary condition B, I use the meta-variable α, which can take either a positive or negative value.[122] Depending on whether the value of α is positive or negative

[122]That is, if α is positive then '$\alpha B(v,x)$' = '$B(v,x)$', and when α is negative then '$\alpha B(v,x)$' = '$\neg B(v,x)$'.

we can speak of a positive or negative NINF-path. In particular, if α is positive, we speak of a positive NINF-path v, and the tail paths z', z'' obey the same boundary condition B as the NINF-path v; if α is negative, we speak of a negative NINF-path v, and the tail paths z', z'' do not obey the boundary condition B. These considerations give rise to the definition of a **positive/negative NINF-path** v of a route path w relative to a material object x as given in (430).

(430) $\forall v, w, x\ [\mathsf{ninf}^{\alpha}(v, w, x) \leftrightarrow$
"v is a **positive/negative NINF-path** of route path w relative to material object x iff"

a. $v < w \wedge \mathsf{obj}(x) \wedge\ B(v, x)$
"v is a proper subpath of w, and v is an internal/external line segment of the material object x (boundary condition B)"

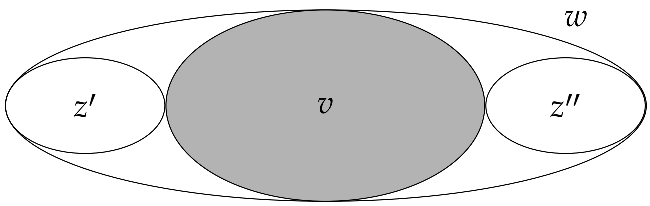
b. $\wedge\ \exists! z' \exists! z''[z' < w \wedge z'' < w$
"and there are exactly two paths z', z'' (**tail paths**) that are proper subpaths of w"

c. $\wedge\ w = z' \oplus v \oplus z'' \wedge z' \infty v \infty z''$
"and w is the mereological sum of z', v, z'', and v is adjacent to z' and to z''"

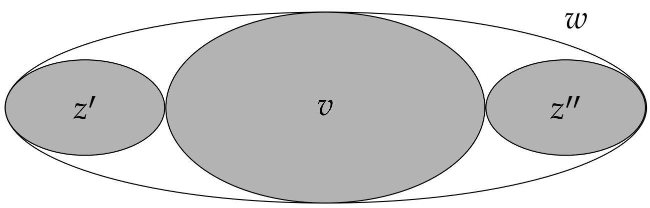
d. $\wedge\ \alpha B(z', x) \wedge \alpha B(z'', x)]]$
"and z', z'' are indistinguishable with respect to the predicate B."

We can diagram the two cases for the meta-variable α as in (431) below; the paths that obey the boundary condition B relating to x are shaded gray.

(431) a. Route path w containing a negative NINF-path v and two tail paths z', z'', i.e. $\mathsf{ninf}^{-}(v, w, x)$:



b. Route path w containing a positive NINF-path v and two tail paths z', z'', i.e. $\mathsf{ninf}^{+}(v, w, x)$:



With this, we can account for the fact that route PPs are systematically ambiguous between a bounded and an unbounded reading: (i) route PPs denoting route paths containing negative NINF-paths have bounded reference, while (ii) route PPs denoting route paths containing positive NINF-paths have unbounded reference. The proofs in Appendix B show that negative

NINF-paths give rise to bounded PPs, and that positive NINF-paths give rise to unbounded PPs.

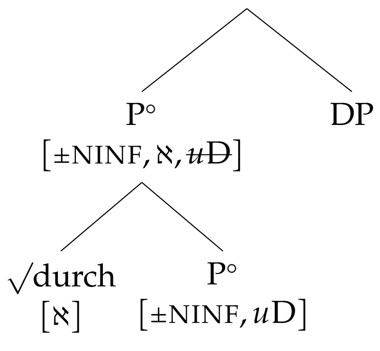
The semantic considerations concerning route paths above motivate the bivalent synsem feature [±NINF], which I consider to be characteristic of route prepositions. In fact, I take the view that route prepositions involve the category P hosting [±NINF], instead of [LOC] or [AT]. The relation between the synsem feature [±NINF] and positive/negative NINF-paths is straightforward: [+NINF] corresponds to positive NINF-paths, while [−NINF] corresponds to negative NINF-paths.

Let us now look at the derivation of route PPs. A prototypical example of the route prepositions *durch* ('through') is given in (432).

(432) Hans rannte **durch** einen Wald.
Hans ran through a.ACC forest
'Hans ran through a forest.'

The lexical structure of the PP in (432) is depicted in (433). The category P hosts the synsem feature [±NINF], which is characteristic of route prepositions, and a *u*-prefixed D-feature triggering Merge with a DP-complement; the feature [+NINF] yields positive NINF-paths and thus unbounded route PPs, and the feature [−NINF] yields negative NINF-paths and thus bounded route PPs. Once P has merged with its DP-complement, it projects a PP and the *u*-prefixed D-feature deletes. At the outset of the derivation, P[±NINF, *u*D] undergoes Primary Merge and thereby generates a prepositional Root position; cf. Section 2.3. At Spell-Out, this prepositional Root position serves as the insertion site for abstract Content features. In the case of the route preposition *durch*, it is the abstract Content feature [א] relating to interiority that enters the structure at the Root position of P[±NINF].

(433)

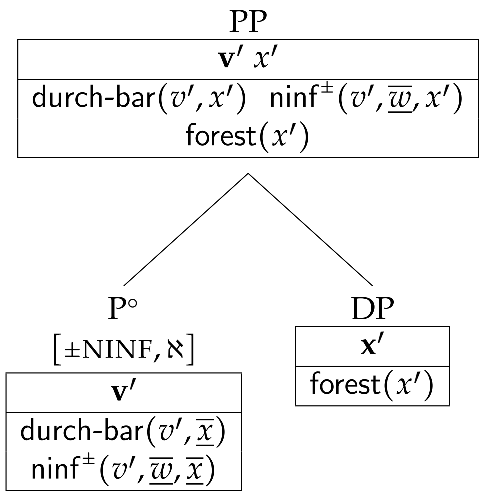


Now, a terminological note is in order. In Section 2.3, I have argued that the notion of Root is derivational in the sense that a Root is what is inserted into a Root position, i.e. sister and daughter of a minimal projection; cf. (88) on page 56 and (90) on page 56. With regard to the abstract Content features characteristic of the spatial preposition discussed in this thesis, this means that (I) the abstract Content feature [א] is interpreted (I-i) as the Root √durch in the Root position of P[±NINF] and (I-ii) as the Root √in in the Root position of P[LOC]; (II) the abstract Content feature [ב] is interpreted (II-i) as the Root √um in the Root position of

P[±NINF] and (II-ii) as the Root √an in the Root position of P[LOC]; and (III) the abstract Content feature [ℷ] is interpreted (III-i) as the Root √über in the Root position of P[±NINF] and (III-ii) as the Root √auf in the Root position of P[LOC].

Let us look at the semantic interpretation of the structure in (433) at LF. The higher P°-node is subject to interpretation at LF. It hosts the synsem feature [±NINF] for (positive/negative) non-initial, non-final SPs,[123] and the abstract Content feature [ℵ] relating to interiority. I propose that P[±NINF, ℵ] is interpreted as specifying a SP v' that is (i) a durch-bar-path of an anticipated material object $\overline{\underline{x}}$ and (ii) a ninf$^{\pm}$-path of an anticipated route path $\overline{\underline{w}}$. The discourse referent v' serves as the referential argument of P°. In this example, the DP is interpreted as specifying a forest-entity x'. The discourse referent x' serves as the referential argument of the DP and instantiates the anticipated discourse referent $\overline{\underline{x}}$. The PP is interpreted to the effect that v' is a durch-bar-path of the forest x'. The discourse referent v' is the referential argument of the PP. The semantic interpretation of the structure in (433) at LF is depicted in (434).

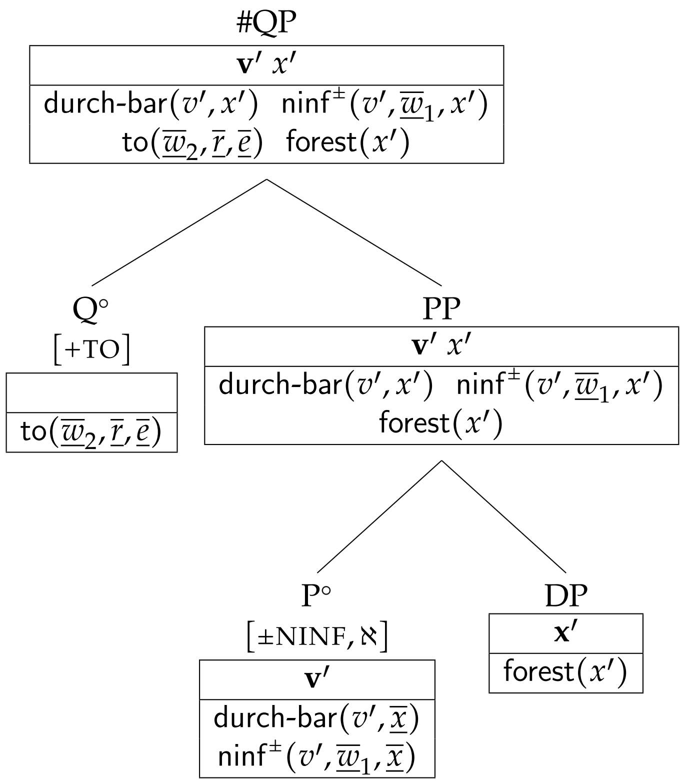
(434)



At this point, it is important to note that nothing in the syntactic module prevents the light preposition Q from merging with a PP the head of which hosts the synsem feature [±NINF] for route prepositions. However, such a derivation would crash at LF because Q[+TO], e.g., would be interpreted at LF as contributing the three-place predicate to characteristic of goal paths. Consider (435) where Q[+NINF] merges with a route PP. The interpretation of the PP involves an anticipated path w_1, and the interpretation of Q° involves an anticipated path w_2. Principally, they could unify with one another. Alternatively, the referential argument of the PP v' could unify with w_2. However – and this is the crucial point – there is and there will be no region available in the derivation of the fully-fledged PP that can unify with the anticipated region $\overline{\underline{r}}$ stemming from Q°.

[123] Note that the distinction between positive and negative NINF-paths is not crucial here. Therefore, I subsume them under '±' (positive/negative).

(435)



In Section 5.5.2, I will introduce the LF-operation Dx-Adjustment, which adjusts the deictic node Dx° such that it fits the semantic contribution of its complement. In fact, the situation is quite parallel to the situation here. The node Dx° anticipates a region which might not be filled by the referential argument of its complement. The complement of Dx°, which is AspP in that case, can sometimes only provide a path. In that case, Dx-Adjustment adjusts the interpretation of Dx° such that a path *can* serve as the semantic input (cf. (465) on page 271). A crucial difference with Dx-Adjustment is, however, that, here, no morphophonological justification for such an operation is given. While Dx-Adjustment corresponds to the overt realization of the node Dx° as *hin-* ('thither') or *her-* ('hither'), no such realizations of Q° exist.

The derivations of the two other route prepositions *um* ('around') and *über* ('over, across') differ from the derivation of *durch* ('through') in the choice of the abstract Content feature. While *durch* comprises [א] relating to interiority, *um* comprises [ב] relating to contiguity, and *über* comprises [נ] relating to verticality. In order to account for the interpretations of these three route prepositions, we can expand the LF-instructions for P by the rules in (436a), (436b), and (436c), respectively. When [±NINF] pairs with the abstract Content feature [א], P is interpreted as specifying a SP v' that is (i) a durch-bar-path of an anticipated material object $\underline{\overline{x}}$ and (ii) a ninf$^{\pm}$-path of an anticipated route path $\underline{\overline{w}}$ relative to an anticipated material object $\underline{\overline{x}}$; when [±NINF] pairs with the abstract Content feature [ב], P is interpreted as specifying a SP v' that is (i) an um-bar-path of an anticipated material object $\underline{\overline{x}}$ and (ii) a ninf$^{\pm}$-path of an anticipated route path $\underline{\overline{w}}$ relative to an anticipated material object $\underline{\overline{x}}$; when [±NINF] pairs with the abstract Content feature [נ], P is interpreted as specifying a SP v' that is (i) an ueber-bar-path of an anticipated material object $\underline{\overline{x}}$ and (ii) a ninf$^{\pm}$-path of an anticipated route path $\overline{w}$ relative to an anticipated material object $\underline{x}$. Note that the rules in (436a), (436b), and (436c) are more specific than the other rules for P, and thus they rank higher.

(436) **LF-instructions for P** (fourth version, final):

a. P $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{v'} \\ \hline \text{durch-bar}(v', \underline{x}) \\ \text{ninf}^{\pm}(v', \overline{w}, \underline{x}) \\ \hline \end{array}$ / _ [±NINF, א]

b. $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{v'} \\ \hline \text{um-bar}(v', \underline{x}) \\ \text{ninf}^{\pm}(v', \overline{w}, \underline{x}) \\ \hline \end{array}$ / _ [±NINF, ב]

c. $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{v'} \\ \hline \text{ueber-bar}(v', \underline{x}) \\ \text{ninf}^{\pm}(v', \overline{w}, \underline{x}) \\ \hline \end{array}$ / _ [±NINF, נ]

d. $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{r'} \\ \hline \text{in}(r', \underline{x}) \\ \hline \end{array}$ / _ [LOC, א]

e. $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{r'} \\ \hline \text{an}(r', \underline{x}) \\ \hline \end{array}$ / _ [LOC, ב]

f. $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{r'} \\ \hline \text{auf}(r', \underline{x}) \\ \hline \end{array}$ / _ [LOC, נ]

g. $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{r'} \\ \hline \text{func}(r', \underline{x}) \\ \hline \end{array}$ / _ [LOC]

h. $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{r'} \\ \hline \text{at}(r', \underline{x}) \\ \hline \end{array}$ / _ [AT]

At this point, we should address the question of how the DRSs assigned to P in the NINF-contexts are interpreted model-theoretically. In Section 5.3, I have defined the LF-predicates durch-bar, um-bar, and ueber-bar. These predicates geometrically relate line segments to material objects. Each of these three LF-predicates impose one boundary condition (intlis or extlis) and one configurational condition (spear-like, L-shaped, or plumb-square) on a line segment v with regard to a material object x. In the case of durch-bar, the line segment must be an internal and spear-like line segment of the material object; cf. (330) on page 204. In the case of um-bar, the line segment must be an external line segment of the material object, and an L-shaped line segment; cf. (332) on page 205. In the case of ueber-bar, the line segment must be an external and plumb-square line segment of the material object; cf. (335) on page 208. This is summarized in Table 11.

	durch-bar(v, x)	um-bar(v, x)	ueber-bar(v, x)
boundary condition	intlis(v, x)	extlis(v, x)	extlis(v, x)
configurational condition	spear-like(v, x)	L-shaped(x)	plumb-square(v, x)

Table 11: Model-theoretic decomposition of durch-bar, um-bar, and ueber-bar

Earlier in this section, I have defined the LF-predicate $\mathsf{ninf}^{\pm}$ for positive and negative NINF-paths. Positive NINF-paths underlie unbounded route paths, while negative NINF-paths underlie bounded route paths. According to the definition of $\mathsf{ninf}^{\pm}$-paths, route paths w have a tripartite structure, consisting of a NINF-path v and two peripheral tail paths z' and z''. At LF, the NINF-path v is argument to one of the predicates durch-bar, um-bar, and ueber-bar. The tail paths z', z'' are not visible at LF; however, the definition of the predicate $\mathsf{ninf}^{\pm}$ imposes the boundary condition relative to the material object x also on the tail paths. In the case of ninf^{+}, the tail paths z', z'' must obey the boundary condition; in the case of ninf^{-}, the tail paths z', z'' must not obey the boundary condition. Let us map the LF-predicates $\mathsf{ninf}^{-}(v, w, x)$ and $\mathsf{ninf}^{+}(v, w, x)$ to the LF-predicates durch-bar(v, x), um-bar(v, x), and ueber-bar(v, x); where v is the NINF-path; w is the route path, z', z'' are the tail paths, and x is a material object. This yields the model-theoretic spell out of the route predicates as depicted in Table 12.

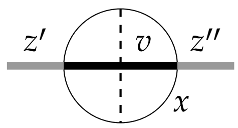
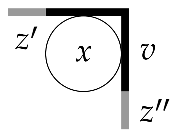
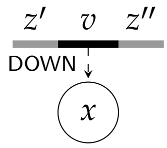
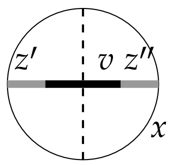
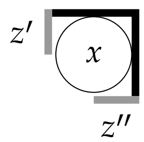
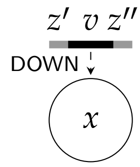
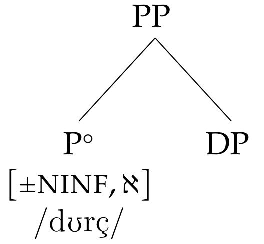
	durch-bar(v, x)	um-bar(v, x)	ueber-bar(v, x)
$\mathsf{ninf}^{-}(v, w, x)$	 NINF-path v: intlis$(v, x) \wedge$ spear-like(v, x) tail paths z', z'': $\neg$ intlis$(z', x) \wedge \neg$ intlis(z'', x)	 NINF-path v: extlis$(v, x) \wedge$ L-shaped(v) tail paths z', z'': $\neg$ extlis$(z', x) \wedge \neg$ extlis(z'', x)	 NINF-path v: extlis$(v, x) \wedge$ plumb-square(v, x) tail paths z', z'': $\neg$ extlis$(z', x) \wedge \neg$ extlis(z'', x)
$\mathsf{ninf}^{+}(v, w, x)$	 NINF-path v: intlis$(v, x) \wedge$ spear-like(v, x) tail paths z', z'': intlis$(z', x) \wedge$ intlis(z'', x)	 NINF-path v: extlis$(v, x) \wedge$ L-shaped(v) tail paths z', z'': extlis$(z', x) \wedge$ extlis(z'', x)	 NINF-path v: extlis$(v, x) \wedge$ plumb-square(v, x) tail paths z', z'': extlis$(z', x) \wedge$ extlis(z'', x)

Table 12: Model-theoretic spell out of route predicates

Let us now turn to the morphophonological realizations of P[±NINF] at PF. I propose that German provides a PF-instruction to the effect that P[±NINF, ℵ] in the prepositional structure in (433) is realized as /dʊrç/, i.e. *durch*; this is illustrated in (437).

(437)



In order to account for the morphophonological realizations for the route prepositions *durch* ('through'), *um* ('around'), and *über* ('over, across'), we can now expand the PF-instructions for P by the rules in (438d), (438e), and (438f), respectively.

(438) **PF-instructions for P** (sixth version, final):

a.	P	↔	/naːx/	/	[_ [LOC, +TO] ... D[$\neg\exists\phi$]]
b.		↔	/au̯s/	/	_ [LOC, $\aleph$, −TO]
c.		↔	/fɔn/	/	_ [−TO]
d.		↔	/dʊrç/	/	_ [±NINF, $\aleph$]
e.		↔	/ʊm/	/	_ [±NINF, $\beth$]
f.		↔	/yːbɐ/	/	_ [±NINF, $\gimel$]
g.		↔	/ɪn/	/	_ [LOC, $\aleph$]
h.		↔	/an/	/	_ [LOC, $\beth$]
i.		↔	/au̯f/	/	_ [LOC, $\gimel$]
j.		↔	/t͡suː/	/	_ [+TO]
k.		↔	/bai̯/	/	_ [AT]

Finally, let me note that route prepositions with a certain abstract Content feature receive the same morphophonological realization, irrespective of the question of whether they denote route paths containing positive or negative NINF-paths. That is, the difference between [+NINF] and [−NINF] does not figure at PF.

5.5 Functional prepositional structure

In line with Van Riemsdijk (1990), Koopman (2000, 2010), Den Dikken (2010), Noonan (2010), Svenonius (2010), a.o., I assume that fully-fledged prepositions project functional structure. Van Riemsdijk (1990) – who uses the term 'little p' for functional prepositional structure – argues that, in German, elements like *her-auf* ('hither-upon') in (439) can be hosted in the functional prepositional structure.

(439)

a.	(*her-auf)	auf	den	Berg	**her-auf**
	hither-upon	upon	the.ACC	mountain	hither-upon
b.	**her-auf**	auf	den	Berg	(*her-auf)
	hither-upon	upon	the.ACC	mountain	hither-upon

In German, it is typically the case that the lexical preposition is linearized to the left of its DP complement, while the functional prepositional structure is linearized to the right of the DP. That is, (439a) shows the canonical position of the functional prepositional structure.[124] Due to this fact, I represent the functional structure of prepositions to the right, even though the structural representation is independent from the ultimate linearization. The right-headed

[124]Concerning the canonical linearization of lexical and functional prepositional structure Van Riemsdijk observes that Hungarian shows the mirror image of German. In particular, he (1990: 241) states that Hungarian typically shows the linearization [p° [DP P°]], while German typically shows the linearization [[P° DP] p°].

structures I present here should thus be seen as a convenient anticipation of the typical linearization. Note, however, that the functional structure can – under certain circumstances – precede the lexical preposition. This is given in (439b).

With regard to functional prepositional structure, I adopt Den Dikken's (2010) proposal that each fully-fledged (spatial) PP projects (i) an aspectual layer (AspP), (ii) a deictic layer (DxP), and (iii) a complementizer layer (CP). Den Dikken proposes the parallelism of functional structures in (440) across lexical domains.

(440) **Parallelism of functional structures across domains:**

a. verbal domain
$C^{[FORCE]}$ > $Dx^{[TENSE]}$ > $Asp^{[EVENT]}$ > V

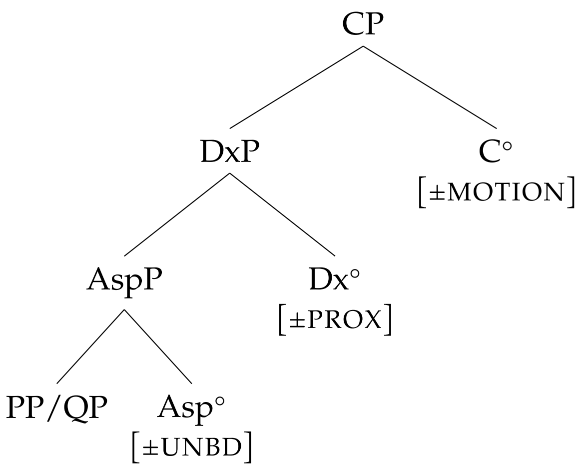
b. nominal domain
$C^{[DEF]}$ > $Dx^{[PERSON]}$ > $Asp^{[NUM]}$ > N

c. spatial prepositions
$C^{[SPACE]}$ > $Dx^{[SPACE]}$ > $Asp^{[SPACE]}$ > P

(Den Dikken 2010: 100, 104)

I assume that the functional categories can host syntacticosemantic (synsem) features, which I briefly present in the following. A crucial question in the domain of spatial prepositions is whether the preposition speaks of a stative or dynamic spatial configuration. The former are typically descriptions of regions, while the latter are descriptions of spatial paths. I thus assume that prepositional C can host the synsem feature [±MOTION]. Prepositional C is addressed in Section 5.5.1. Concerning deixis, I assume that prepositional Dx can host the synsem feature [±PROX] (for proximity). Prepositional Dx is addressed in Section 5.5.2. Concerning aspect, I assume that prepositional Asp can host the synsem feature [±UNBD] (for unbounded). Prepositional Asp is addressed in Section 5.5.3. These considerations give rise to the functional prepositional structure in (441).[125]

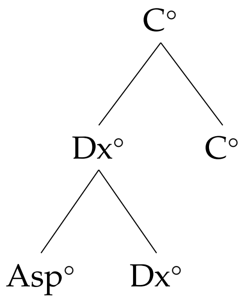
(441)



[125] Note that I henceforth omit Den Dikken's [SPACE].

I assume that Head Movement (Matushansky 2006) derives a Complex Head (Embick and Noyer 2007: 303–304). The Complex Head structure of the functional prepositional structure is depicted in (442).

(442)



Two potential realization patterns of functional prepositional structure figure in this thesis. First, **echo extensions** are postpositional elements that can co-occur with geometric prepositions, either place or path. As noted earlier, the term *echo extension* has been adopted from Abraham (2010). There is, however, some terminological variation. Inspired by Perlmutter's term *shadow pronoun* (Perlmutter 1972), Noonan (2010: 164) refers to echo extensions as *shadow Ps*. Generally, echo extensions consist of a recurrence of the preposition that is preceded by a deictic element. Recall the construction *auf ... her-auf* (lit.: upon ... hither-upon) in (439). The first, unpaired, occurrence of *auf* ('upon') arguably corresponds to the lexical category P. Hence, the complex element *her-auf* (lit.: hither-upon) must correspond somehow to the sequence of functional categories Asp-Dx-C that derives from the Complex Head structure in (442). The morpheme *her* ('hither') is a deictic element and thus corresponds to the functional category Dx, which is addressed in Section 5.5.2. I assume that the second occurrence of *auf*, i.e. the one that forms a unit with *her*, corresponds to the functional category C, which is addressed in Section 5.5.1. Table 13 lists the potential German echo extensions of geometric prepositions according to the abstract topological Content feature residing in the Root position of P. Note that deictic elements that are underlined in Table 13 have become obsolescent in Standard German but are in fact historically attested.[126]

The second construction where the functional structure of prepositions (morphophonologically) is manifest are **unbounded non-geometric path prepositions**. As presented in Section 5.1.3, German has the two prepositional constructions *von ... weg* ('away from') and *auf ... zu* ('towards') that both consist of a prepositional element (i.e. *von* and *auf*) and a postpositional element (i.e. *weg* and *zu*). These prepositional constructions are in fact circumpositions. Both *von ... weg* and *auf ... zu* are (i) unbounded and (ii) non-geometric path prepositions. By assumption, they are the unbounded counterparts of the bounded non-

[126] See Grimm's *Deutsches Wörterbuch* ('German Dictionary'), which is accessible online:
hin-an: `http://www.woerterbuchnetz.de/DWB?lemma=hinan`,
dr-um: `http://www.woerterbuchnetz.de/DWB?lemma=darum`,
hin-um: `http://www.woerterbuchnetz.de/DWB?lemma=hinum`,
her-durch: `http://www.woerterbuchnetz.de/DWB?lemma=herdurch`

	place prepositions			path prepositions		
	P		Dx-C	P		Dx-C
[א]	*in*	...	*dr-in*	*in*	...	*her-/hin-ein*
				aus	...	*her-/hin-aus*
				durch	...	*her-/hin-durch*
[ב]	*an*	...	*dr-an*	*an*	...	*her-/dr-/hin-an*
				um	...	*her-/dr-/hin-um*
[ג]	*auf*	...	*dr-auf*	*auf*	...	*her-/dr-/hin-auf*
				über	...	*her-/dr-/hin-über*

Table 13: Echo extensions of geometric prepositions

geometric path prepositions *von* ('from') and *zu* ('to'). As illustrated in Table 14, I assume that the prepositional elements of non-geometric path prepositions relate to the category P, while the postpositional elements of the unbounded non-geometric path prepositions relate to the functional category Asp; cf. Section 5.5.3.

	bounded			unbounded		
	P		Asp	P		Asp
goal prepositions	*zu*	...	∅	*auf*	...	*zu*
source prepositions	*von*	...	∅	*von*	...	*weg*

Table 14: Bounded and unbounded non-geometric path prepositions

Before discussing the functional prepositional categories in the following sections, it is worth mentioning three things concerning echo extensions of German geometric prepositions. First, it is interesting that echo extensions are straightforwardly felicitous only with topological prepositions and with those projective prepositions that relate to the vertical axis (*über* 'above' and *unter* 'under'). Other spatial prepositions involving geometric information are typically considered to be marked (443).[127] Note that in the case of projective path prepositions (443b), the optional usage of the bare deictic elements *hin* and *her* are grammatical. However, no recurrence of the preposition is possible.

(443) a. Hans saß vor der Hütte (??davor).
Hans sat in front of the.DAT hut there.in front of
'Hans sat in front of the hut.'

b. Hans rannte hinter die Scheune (her/hin-*hinter).
Hans ran behind the.ACC barn hither/thither-behind
'Hans ran behind the barn.'

Second, echo extensions should be distinguished from verbal particles, which can arguably occur in the same position as echo extensions. Consider (444) involving the particle verb *ein-marschieren* ('march in'). The path PP *in das Stadion* is an optional argument of the verb.

[127] Note that *da-* corresponds to *dr-*. It is the form that is used when a consonant follows.

(444) Hans **marschierte** (in das Stadion) **ein**.
Hans marched into the.ACC stadium in
'Hans marched into the stadium.'

This type of verbal particles is clearly related to the functional structure of prepositions. This can be seen from the contrast in the examples (445). When the verb is bare as in (445a), echo extensions are possible. However, when the verb is combined with a verbal particle as in (445b), echo extensions are blocked.

(445) a. Hans konnte in das Stadion (hinein) **marschieren**.
Hans could into the.ACC stadium thither.in march
'Hans could march into the stadium.'

b. Hans konnte in das Stadion (*hinein) **ein-marschieren**.
Hans could into the.ACC stadium thither.in in-march
'Hans could march into the stadium.'

These data suggest that echo extensions and some types of verbal particles share the same structural position, or put differently, that some types of verbal particles correlate to the functional structure of prepositions. Nevertheless, there is a crucial difference between echo extensions, on the one hand, and this kind of verbal particles, on the other. The availability of echo extensions seems to be independent of the verb – as long as they obey the prepositional requirements – (446a), while the availability of verbal particles also depends on the verb in combination with its complement noun (446b).[128]

(446) a. Hans rannte **in** den Wald (**hin-ein**).
Hans ran into the.ACC forest thither-in
'Hans ran into the forest.'

b. Hans **rannte** (in den Wald) ??**ein**.
Hans ran into the.ACC forest in

That is, the analysis of verbal particles, in contrast to the analysis of echo extensions, must focus also on the respective verbs. I have nothing more to say about verbal particles in this thesis. For further discussion of verbal particles across languages and frameworks, I refer the reader to the extensive body of literature on particle verbs: Stiebels and Wunderlich (1994), Den Dikken (1995), Stiebels (1996, 1998), Svenonius (1996, 2003, 2004, 2007a), Zeller (1997, 2001a,b), Olsen (1998), Wurmbrand (1998, 2000), Lüdeling (1999), McIntyre (2001, 2002, 2003, 2004, 2007), Dehé et al. (2002), and contributions therein, Müller (2002), Nicol (2002), Ramchand and Svenonius (2002), Aktaş (2005), Kolehmainen (2005), Romanova (2006), Basilico (2008), Kliche (2008), Mateu (2008), Lechler and Roßdeutscher (2009), Levin and Sells (2009), Heine et al. (2010), Mateu and Rigau (2010), Biskup et al. (2011), Dewell (2011), Haselbach (2011), Roßdeutscher (2011, 2012, 2013), Öhl and Falk (2011), Springorum (2011), Punske (2012), Ramchand (2012), a.o.

[128]So far, the restrictions on verbal particles are not well-understood.

Third, echo extensions must also be distinguished from other kinds of postpositional elements that can co-occur with spatial prepositions. Consider, for instance, the direction-indicating postpositions in (447) and (448).

(447) Die Schnecke kroch auf das Dach **hin-auf/hin-ab/hin-über**.
the snail crept upon the.ACC roof up/down/across
'The snail crept up/down/across onto the roof.'
(Van Riemsdijk 2007: 267)

(448) Sam tauchte in die Dunkelheit **hin-ab**.
Sam dived into the.ACC darkness thither-down
'Sam descended into darkness.'
(Abraham 2010: 267)

These direction-indicating postpositions clearly share some superficial commonalities with echo extensions, namely that they involve some deictic element followed by some prepositional element. In fact, I assume that the deictic element of both echo extensions and direction-indicating postpositions, and their non-deictic elements relate to the same functional categories – the deictic elements relate to the prepositional functional category Dx and the non-deictic elements relate to the prepositional functional category C. However, direction-indicating postpositions differ from echo extensions in several respects, which justifies the assumption that additional direction-related features are involved in the derivation of direction-indicating postpositions.

For one, while the echo extensions in (449a) and (449d) can contain one of the three deictic elements *hin-* ('thither'), *her-* ('hither'), or *dr-* ('there'), the direction-indicating postpositions in (449b) and (449c) can only contain either *hin-* or *her-*, but not *dr-*.

(449) a. Hans sprang auf das Dach **hin-/her-/dr-auf**
Hans jumped up onto the.ACC roof thither-/hither-/there-upon
'Hans jumped onto the roof.'

b. Hans sprang auf das Dach **hin-/her-**/*dr-**ab**
Hans jumped up onto the.ACC roof thither-/hither-/there-down
'Hans jumped down onto the roof.'

c. Hans sprang auf das Dach **hin-/her-**/*dr-**über**
Hans jumped up onto the.ACC roof thither-/hither-/there-over
'Hans jumped over onto the roof.'

d. Hans sprang über das Dach **hin-/her-/dr-über**
Hans jumped over the.ACC roof thither-/hither-/there-over
'Hans jumped over onto the roof.'

Moreover, direction-indicating postpositions can typically co-occur with projective prepositions (450a), unlike echo extensions (450b).

(450) a. Hans lief vor das Haus **hin-über**.
Hans walked in front of the.ACC house thither-over
'Hans walked over in front of the house.'

b. Hans lief vor das Haus *hin-*vor.
Hans walked in front of the.ACC house thither-in front of
'Hans walked in front of the house.'

In this context I want to draw attention to the constructions given in (451), consisting of a place preposition triggering dative and some postpositional element indicating direction. Note, however, that I do not dwell on these in this thesis.

(451) a. Hans rannte **unter** der Brücke **(hin)-durch**.
Hans ran under the.DAT bridge thither-through
'Hans ran under the bridge.'

b. Hans rannte **an** der Hütte **vorbei**.
Hans ran at the.DAT hut past
'Hans ran past our house.'

On a final note, I leave direction-indicating postpositions for further research and refer the reader in particular to Van Riemsdijk (2007), Svenonius (2007a, 2010), Abraham (2010), Noonan (2010) for an in-depth discussion concerning postpositions indicating direction.

5.5.1 C-features

Concerning the functional structure of prepositions, I assume, following Den Dikken (2010), that C (for complementizer) is the highest functional category in the prepositional domain. Prepositional C can host the syntacticosemantic (synsem) feature [±MOTION] that corresponds to the distinction between place and path prepositions established in Section 5.1.1. In particular, [−MOTION] is characteristic for place prepositions, while [+MOTION] is characteristic for path prepositions. That is, C[−MOTION] is tantamount to Den Dikken's (2010: 104) $C^{[PLACE]}$ and C[+MOTION] to his (2010: 104) $C^{[PATH]}$.

Let us first look at the LF-instructions for prepositional C. I propose that the main function of the prepositional C is to introduce the referential argument of spatial PPs. The referential argument of place prepositions is a region and the referential argument of path prepositions is a spatial path. Therefore, I propose the LF-instructions for prepositional C in (452). Consider first the case of path PPs in (452a), i.e. C[+MOTION]. The spatial path w', which serves as the referential argument of a path PP, is an argument of an anticipated Figure/Path Relation $\underline{\overline{R}}_{FPR}$ (Beavers 2012) that is to be contextually instantiated through unification. For instance, when a path PP is combined with a verbal motion predicate, this motion predicate instantiates the anticipated Figure/Path Relation. Consider now the case of place PPs in (452b). The region r', which serves as the referential argument of a place PP, is an argument of an anticipated stative relation $\underline{\overline{R}}_{OCC}$ to the effect that an anticipated Figure $\underline{\overline{y}}$ occupies the region r'. When a place PP is integrated in a verbal stative predicate, this stative predicate instantiates the anticipated relation.

(452) **LF-instructions for C:**

a. C $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{w'} \\ \hline \underline{\overline{R}}_{\text{FPR}}(\underline{\overline{y}}, w', \underline{\overline{e}}) \\ \hline \end{array}$ / _ [+MOTION]

b. $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{r'} \\ \hline \underline{\overline{s}} : \underline{\overline{R}}_{\text{OCC}}(\underline{\overline{y}}, r') \\ \hline \end{array}$ / _ [−MOTION]

Let us now look at the PF-instructions for prepositional C that figure in the context of echo extensions. Echo extensions necessarily consist of two parts, a deictic morpheme, which is hosted in Dx (cf. Section 5.5.2), and a morpheme that is (nearly) equivalent to the respective lexical P. I assume that the recurrence P is related to prepositional C. Table 15 lists the echo extensions according to the abstract Content features that can be involved in P.[129]

	geometric place prepositions			**geometric path prepositions**		
	P		Dx-**C**	P		Dx-**C**
[א]	*in*	...	*dr-**in***	*in*	...	*her-/hin-**ein***
				aus	...	*her-/hin-**aus***
				durch	...	*her-/hin-**durch***
[ב]	*an*	...	*dr-**an***	*an*	...	*her-/dr-/hin-**an***
				um	...	*her-/dr-/hin-**um***
[ג]	*auf*	...	*dr-**auf***	*auf*	...	*her-/dr-/hin-**auf***
				über	...	*her-/dr-/hin-**über***

Table 15: Recurrence of geometric prepositions in echo extensions

At least two factors condition the pronunciation of C: (i) the question of whether Dx is pronounced or not, and (ii) the phonological matrix of P. The example in (453a) shows that echo extensions necessarily consist of two parts. Neither the deictic morpheme (453b), nor the recurrence of P alone (453c) can occur alone.[130]

(453) a. Hans rannte in den Wald **hin-/her-ein**.
Hans ran into the.ACC forest thither-/hither-in
'Hans ran into the forest.'

b. Hans rannte in den Wald *hin/*her.
Hans ran into the.ACC forest thither/hither
'Hans ran into the forest.'

c. Hans rannte in den Wald ??ein.
Hans ran into the.ACC forest in
'Hans ran into the forest.'

[129]Note that in the case when *in* ('in') serves as a path preposition the respective recurring element is *-ein*, which is obviously morphologically related to *in*.

[130]Note that the recurrence of P in (453c) could be understood as a verbal particle, which is not intended here.

Crucially, only a copy of the phonological matrix of P is a licit part of an echo extension. This is illustrated for place prepositions in (454) and for path prepositions in (455).

(454) a. Hans lag **in** der Kiste dr-**in**/*auf/*an.
Hans lay in the.DAT box there-in/upon/on
'Hans lay in the box.'

b. Hans stand **an** der Wand dr-**an**/*auf/*in
Hans stood on the wall there-on/upon/in
'Hans stood at the wall.'

c. Hans saß **auf** dem Tisch dr-**auf**/*in/*an.
Hans sat upon the.DAT table there-upon/in/on
'Hans sat upon the table.'

(455) a. Hans rannte **in** den Wald her-**ein**/*an/*aus/*durch/*...
Hans ran in the.ACC forest hither-in/on/out/through/...
'Hans ran into the forest.'

b. Hans kam **aus** dem Zimmer her-**aus**/*ein/*durch/*um/*...
Hans came out the.DAT room hither-out/in/through/around/...
'Hans came out of the room.'

c. Hans kroch **durch** die Hecke hin-**durch**/*ein/*um/*...
Hans crawled through the.ACC hedge thither-through/into/around/...
'Hans crawled through the hedge.'

d. Hans schwamm **über** den Fluß hin-**über**/*durch/*um/*...
Hans swam over the.ACC river thither-over/through/around/...
'Hans swam across the river.'

The fact that the non-deictic element of an echo extension is (nearly) equivalent to the morphological surface form of the respective preposition suggests a reduplication-type of approach (Haugen 2008, 2011, Haugen and Harley 2013). In fact, I assume that the phonological matrix of the lexical category P is reduplicated under certain conditions and thereby determines the pronunciation of the functional category C. In fact, I propose PF-instructions that take the phonological matrix of categories in the local context into account. In particular, I propose the PF-instructions for prepositional C in (456). At PF, the phonological matrix of P is assigned (copied) to C iff (i) the phonological matrix of Dx is not zero, and (ii) the Root position of P is filled with one of the abstract topological Content features [א], [ב], or [נ].[131] Otherwise, C is silent.[132]

(456) **PF-instructions for prepositional C**:

a. $C \leftrightarrow \wp(P) \quad / \ \wp(Dx) \neq \varnothing \ \wedge \ [\ P[\text{א}] \vee P[\text{ב}] \vee P[\text{נ}]\ ]$

b. $\leftrightarrow \varnothing \quad$ elsewhere

[131] I use '℘' as function at PF that provides the phonological matrix of a terminal node. For instance, ℘(P[LOC, ב]) = /an/; cf. the PF-instructions for P as given in (438) on page 258.

[132] Note that, in order to account for other types of postpositional elements, e.g. extensions indicating direction or verbal particles, the set of PF-instructions for prepositional C must be more comprehensive than given in (456). Nevertheless, for echo extensions, which are in the focus of this thesis, this set of PF-rules suffices.

This correctly predicts that echo extensions are illicit in the context of pseudo-geometric and non-geometric prepositions, because they lack a filling of the Root position of P. Further, it predicts the recurrence of a preposition as part of an echo extension. And lastly, it predicts that echo extensions must involve a phonologically overt deictic element together with a phonologically overt non-deictic element.

Note that copying the phonological matrix of P to prepositional C predicts for the path preposition *in* ('into') the ungrammatical echo extensions *her-/hin-*in*, i.e. /ɪn/, instead of the grammatical echo extensions *her-/hin-**ein***, i.e. /a͜in/. In order to achieve the proper phonological matrix of C , I assume that a morphological Readjustment Rule (cf. Section 3.6) is appropriate. In particular, I propose the Readjustment Rule in (457) that transforms the phonological matrix of C from /ɪn/ (*-in*) to /a͜in/ (*-ein*) in the context of a path preposition, i.e. C[+MOTION].

(457) /ɪn/ → /a͜in/ / ℘(C) = /ɪn/ ∧ C[+MOTION]

5.5.2 Deictic features

This section focuses on the deictic elements that are found as parts of echo extensions in Standard German geometric prepositions including place, goal, source, and route prepositions.[133] In particular, we find the three deictic elements *dr-* (short for *dar-*, 'there'), *her-* ('hither'), and *hin-* ('thither'). Taking the abstract Content features [א], [ב], and [נ] into account, these deictic elements are distributed across place and path prepositions as given in Table 16.

	geometric place prepositions			**geometric path prepositions**		
	P		**Dx**-C	P		**Dx**-C
[א]	*in*	...	***dr**-in*	*in*	...	***her**-/*dr-/**hin**-ein*
				aus	...	***her**-/*dr-/**hin**-aus*
				durch	...	***her**-/*dr-/**hin**-durch*
[ב]	*an*	...	***dr**-an*	*an*	...	***her**-/**dr**-/**hin**-an*
				um	...	***her**-/**dr**-/**hin**-um*
[נ]	*auf*	...	***dr**-auf*	*auf*	...	***her**-/**dr**-/**hin**-auf*
				über	...	***her**-/**dr**-/**hin**-über*

Table 16: Deictic elements in echo extensions

In the context of place prepositions, we only find the morpheme *dr-*. In contrast, in the context of path prepositions, we find *her-*, *hin-*, and *dr-*, except for the case when the abstract Content feature [א] is present. Note in this regard that deictic elements that are underlined in Table 16 became obsolescent in Standard German but are in fact historically attested, cf.

[133]Note that the deictic marking on postpositional elements is generally to a great extent subject to dialectal and regional variation. For a study concerning the regional differences of the element *hin-/her-ein* (lit.: thither-/hither-in), see: `http://www.philhist.uni-augsburg.de/lehrstuehle/germanistik/sprachwissenschaft/ada/runde_2/f24a-b/`

Footnote 126 on page 260. I have nothing to say in this thesis concerning the question of why these forms became obsolescent. I leave this question for future work.

In general, spatial deictic expressions denote locations that are interpreted relative to location of the speaker of an utterance.[134] In fact, I assume that the spatial deixis of the echo extensions in German is best understood in terms of a relation between two regions, a **deictic reference region**, which is the region denoted by the deictic expression, and a **deictic center** (or origo, cf. Bühler 1934, Kaplan 1989), a region which is typically determined by the speaker's self-location at the time of utterance.

The speaker-dependent definition of the deictic center means that the deictic center can constantly change between the interlocutors in a conversation. Consider the English spatial adverb *here* denoting locations that are included in the deictic center. Assume the telephone conversion in (458) between interlocutor A in Stuttgart and interlocutor B in New York. In (458a), *here* denotes the location of interlocutor A, i.e. Stuttgart, while it denotes the location of interlocutor B, i.e. New York, in (458b).

(458) a. Interlocutor A:
"*Here* in Stuttgart, the weather is nice. How is it in New York?"
b. Interlocutor B:
"*Here* in New York, we have bad weather."

Further, the region that is conceptualized as the deictic center can vary with the construal of the speech situation. In (459), the conceptualization of the deictic center varies considerably, ranging from a rather small location in (459a) to a huge location in (459e).

(459) a. *Here* where I am.
b. *Here* in this room.
c. *Here* in Stuttgart.
d. *Here* in Germany.
e. *Here* on this planet.

(adapted from Diessel 2012: 2410)

Assuming a two-way deictic system, we can contrast **proximal** and **distal** deixis. In the case of proximal deixis, the deictic reference region is included in the deictic center, while, in the case of distal deixis, the deictic reference region must not overlap with the deictic center.

Considering the three possible deictic elements *her-* ('hither'), *dr-* ('there'), and *hin-* ('thither') as parts of echo extensions of path prepositions and their adverbial cognates *hier* ('here'), *da* ('there'), and *dort* ('yonder, over there'), German seems to have a three-way deictic system. However, I assume that *her-* and *hier* indicate proximal deixis, and that *hin-* and *dort* indicate distal deixis, while *dr-* and *da* indicate neither proximal nor distal deixis but are

[134]For a general discussion on deixis, I refer to Lyons (1977), Ehrich (1982, 1992), Fillmore (1982, 1997), Cairns (1991), Levinson (2004), Diessel (2012), Harbour (2015), a.o.

underspecified with respect to proximity.[135] The correspondence between the postpositional deictic elements and the spatial adverbs is given in Table 17.

<table>
<tr><th></th><th>proximal deixis</th><th>distal deixis</th></tr>
<tr><td rowspan="2">postpositions</td><td>her- (‘hither’)</td><td>hin- (‘thither’)</td></tr>
<tr><td colspan="2">dr- (‘there’)</td></tr>
<tr><td rowspan="2">adverbs</td><td>hier (‘here’)</td><td>dort (‘over there’)</td></tr>
<tr><td colspan="2">da (‘there’)</td></tr>
</table>

Table 17: Proximal and distal deictic marking in German postpositions and adverbs

In fact, deictic expressions can be underspecified with respect to proximity. Consider English *that*. When used contrastively with *this* as in (460), *that* has a distal interpretation.

(460) *This* one (here) is bigger than *that* one (over there).
(Diessel 2012: 2419)

However, when used in a neutral context as in (461), *this* and *that* are generally interchangeable. That is, *that* can also express proximal deixis.

(461) I like *this*/*that* one better.
(Diessel 2012: 2419)

Following Levinson (2004), Diessel (2012: 2419) argues that "*this* always expresses some sense of proximity, [while] *that* is only interpreted as a distal term if it is used in explicit contrast to *this*; that is, *that* is semantically unmarked for distance, but is interpreted as a distal term by pragmatic contrast via Grice's maxim of quantity ('Be as informative as circumstances permit')." In this sense, *that* is the unmarked deictic demonstrative, while *this* is explicitly marked for proximity. I assume that spatial *dr-*/*da* in German behave similarly to English *that*. That means that their distal interpretations arise in contrast to *her-*/*hier* and, the other way round, their proximal interpretations arise in contrast to *hin-*/*dort*.

Consider in this connection also the data in (462) where geometric prepositions together with echo extensions are combined with spatial adverbials. In the context of place prepositions, *dr-* is compatible both with the proximal deictic adverbial *hier* (462a) and with the distal deictic adverbial *dort* (462b). Likewise, in the case of path prepositions, *dr-* is typically compatible both with the proximal deictic adverbial *hier* (462c) and with the distal deictic adverbial *dort* (462d). However, *her-* is compatible only with the proximal deictic adverbial *hier* (462c), and *hin-* is compatible only with the distal deictic adverbial *dort* (462d)

(462) a. Hans saß **hier** auf dem Tisch **dr**-auf
Hans sat here upon the.DAT table there-upon

b. Hans saß **dort** auf dem Tisch **dr**-auf
Hans sat yonder upon the.DAT table there-upon

[135] For a thorough discussion of these adverbials, I refer to Ehrich (1992: 8–62).

c. Hans sprang **hier** auf den Tisch **her**-/**dr**-/*hin-auf
Hans jumped here upon the.ACC table hither-/there-/thither-upon

d. Hans sprang **dort** auf den Tisch *her-/**dr**-/**hin**-auf
Hans jumped yonder upon the.ACC table hither-/there-/thither-upon

With regard to the functional structure of prepositions, I assume, following Den Dikken (2010), a functional category Dx (for deixis) that can host the syntacticosemantic (synsem) [±PROX] (for proximity). Dx[+PROX] indicates proximal deixis, where the deictic reference region is included in the deictic center, and Dx[−PROX] indicates distal deixis (e.g. Fillmore 1982, Cairns 1991, Den Dikken 2010), where the deictic reference region and the deictic center must not overlap.

Let us now look at the LF-instructions for prepositional Dx as I propose them in (463). As mentioned above, I assume that the spatial deixis appearing in echo extensions of geometric prepositions is best understood in terms of a relation between a deictic reference region r_d and a region r_i that is identified as the deictic center. Following Roßdeutscher (2009), I assume that the deictic reference region r_d is included in the deictic center r_i in the case of proximal deixis.[136] In the case of distal deixis, the deictic reference region r_d and the deictic center r_i must not overlap. In both proximal and distal deixis, the deictic center r_i is presupposed and the deictic reference region r_d is anticipated to be instantiated through unification, i.e. $\underline{\overline{r}}_d$. Typically, the region that comes from the downstairs PP unifies with $\underline{\overline{r}}_d$.

(463) **LF-intructions for Dx:**

a. $$\text{Dx} \leftrightarrow \langle \left\{ \begin{array}{|c|}\hline r_i \\ \hline \\ \hline \end{array} \right\}, \begin{array}{|c|}\hline \\ \hline \underline{\overline{r}}_d \subseteq r_i \\ \hline \end{array} \rangle \qquad / \ \_ \ [\text{+PROX}]$$

b. $$\leftrightarrow \langle \left\{ \begin{array}{|c|}\hline r_i \\ \hline \\ \hline \end{array} \right\}, \begin{array}{|c|}\hline \\ \hline \neg \ \underline{\overline{r}}_d \otimes r_i \\ \hline \end{array} \rangle \qquad / \ \_ \ [-\text{PROX}]$$

This analysis obviously faces a problem in the context of route prepositions. As shown in (464), route prepositions are straightforwardly felicitous with echo extensions involving a deictic element.

(464) Hans rannte durch den Wald hin-durch.
Hans ran through the.ACC forest thither-through
'Hans ran through the forest.'

I proposed in Section 5.4.3 that the semantic representation of route prepositions does not contain regions, but tripartite spatial paths of the form 'tail-NINF-tail'. Thus, there is no region available in a downstairs route PP that the anticipated deictic reference region r_d could unify

[136] See also Roßdeutscher's (2009) analysis of *hin-* ('thither'), *her-* ('hither') and *hin und her* ('back and forth').

with. I propose that this triggers an operation at LF that adjusts the input of the pending DRS-Merge to the effect that the DRSs from Dx° and AspP can be straightforwardly merged. In particular, I propose an adjustment of the Dx-interpretations given in (463) such that the deictic reference region $\underline{\overline{r}}_d$, which is anticipated in (463), is instantiated by the existentially bound discourse referent r'. Furthermore, r' is interpreted as a goal of an anticipated **to**-path $\underline{\overline{v}}$.[137] Thereby, an argument slot is created for the ninf-path v' from the downstairs route PP. Note that r' does not serve as the referential argument of Dx°. Note also that the to-path necessitates the presupposition of an event e^0. Later at the level of VP, this presupposed event can typically be resolved as a proper part of the event e' contributed by the verb, i.e. $e^0 < e'$. Hence, I propose the LF-rule of Dx-Adjustment as given in (465). Dx-Adjustment is available only if P hosts a negative feature P[−NINF].

(465) **Dx-Adjustment at LF:**

a. $$\left\langle \left\{ \begin{array}{|c|}\hline r_i \\ \hline \\ \hline \end{array} \right\}, \begin{array}{|c|}\hline \\ \hline \underline{\overline{r}}_d \subseteq r_i \\ \hline \end{array} \right\rangle \rightarrow \left\langle \left\{ \begin{array}{|c|}\hline r_i \\ \hline \\ \hline \end{array}, \begin{array}{|c|}\hline e^0 \\ \hline \\ \hline \end{array} \right\}, \begin{array}{|c|}\hline r' \\ \hline r' \subseteq r_i \\ \mathsf{to}(\underline{\overline{v}}, r', e^0) \\ \hline \end{array} \right\rangle \quad / \ \mathrm{P}[-\mathrm{NINF}]$$

b. $$\left\langle \left\{ \begin{array}{|c|}\hline r_i \\ \hline \\ \hline \end{array} \right\}, \begin{array}{|c|}\hline \\ \hline \neg\, \underline{\overline{r}}_d \otimes r_i \\ \hline \end{array} \right\rangle \rightarrow \left\langle \left\{ \begin{array}{|c|}\hline r_i \\ \hline \\ \hline \end{array}, \begin{array}{|c|}\hline e^0 \\ \hline \\ \hline \end{array} \right\}, \begin{array}{|c|}\hline r' \\ \hline \neg\, r' \otimes r_i \\ \mathsf{to}(\underline{\overline{v}}, r', e^0) \\ \hline \end{array} \right\rangle \ / \ \mathrm{P}[-\mathrm{NINF}]$$

This type of analysis does not only impose a direction onto otherwise undirected ninf-paths, but, at the same time, it necessarily leads to the configuration that one tail path of the route path is included in the deictic reference region, while the other tail path is not. Figure 44 illustrates this situation. These considerations yield the LF-representation of the prepositional CP *durch den Wald hin-durch* ('through the forest') given in (466). See also the examples (492) on page 285 and (493) on page 287.

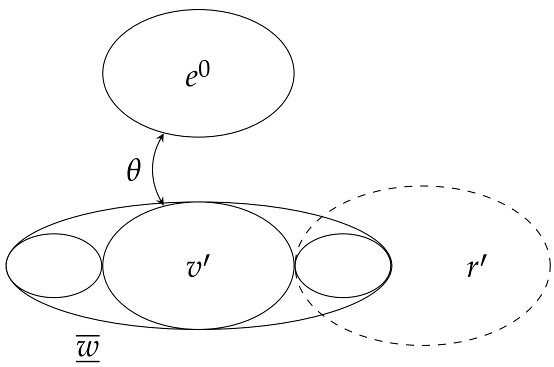


Figure 44: NINF-path v' is a path **to** deictic reference region r' in e^0

[137] Assuming that the ninf-path v' and the deictic reference region r_d relate to each other in this way is insofar reasonable as I hypothesize that motion along spatial paths is generally conceptualized as monotone.

(466) LF-representation of prepositional CP *durch den Wald hin-durch*:

$$\left\langle \left\{ \begin{array}{|c|}\hline r_i \\ \hline \\ \hline \end{array}, \begin{array}{|c|}\hline e^0 \\ \hline \\ \hline \end{array} \right\}, \begin{array}{|c|}\hline \mathbf{w}'\ r'\ v'\ x' \\ \hline \mathsf{durch\text{-}bar}(v',x')\quad \mathsf{ninf}^-(v',w',x') \\ \mathsf{to}(v',r',e^0)\quad \neg\, r' \otimes r_i \\ \mathsf{garden}(x')\quad \underline{\overline{R}}_{\mathrm{FPR}}(\underline{\overline{y}},w',\underline{\overline{e}}) \\ \hline \end{array} \right\rangle$$

Route PPs with echo extensions necessarily lead to telic predicates. That is, they can involve only negative ninf-paths; cf. (431a). The plain route prepositions *durch* ('through'), *um* ('around'), and *über* ('over, across') without echo extensions are aspectually ambiguous to the effect that they give rise to telic and atelic interpretations when combined with manner of motion verbs such as in (467a). In contrast, when the route preposition co-occurs with an echo extension including a deictic element as in (467b), the atelic reading, which involves positive ninf-paths, is no longer available.

(467) a. Hans rannte in/für zwei Stunden durch den Wald.
Hans ran in/for two hours through the forest

b. Hans rannte in/*für zwei Stunden durch den Wald hin-durch.
Hans ran in/for two hours through the forest thither-through

This is because the set of spatial paths denoted by the prepositional CP *durch den Wald hin-durch* is not cumulative and thus the prepositional CP is bounded, which leads to telic aspect, cf. (292) on page 172. The rationale for this is reminiscent of why sets of transitional enter-paths (and leave-paths) – see Section 5.4.2 – are not cumulative (Zwarts 2005b: 761). The set of spatial paths denoted by the prepositional CP *durch den Wald hin-durch* contains no paths that can be concatenated: the tail paths of the respective spatial paths are always in different regions – one tail path is included in the deictic reference region r', while the other tail path is not. Note that this aspectual effect of the deictic elements *hin* ('thither') and *her* ('hither') can also be observed in contexts without any preposition whatsoever. The plain use of the manner of motion verb in (468a) typically gives rise to an atelic predicate. However, when used in combination with one of the deictic elements as in (468b), the atelic reading becomes unavailable and the predicate is telic.

(468) a. Hans rannte ?in/für zwei Stunden.
Hans ran in/for two hours

b. Hans rannte in/*für zwei Stunden hin/her.
Hans ran in/for two hours thither/hither

Let us now look at the PF-instructions of prepositional Dx in the context of echo extensions. As discussed above, *her-* ('hither') expresses proximal deixis, *hin-* ('thither') expresses distal deixis, and *dr-* ('there') is underspecified for proximity. Furthermore, pronouncing prepositional C (cf. Section 5.5.1) is a precondition for pronouncing the functional category Dx. That is, if C is silent, then Dx is also silent. I capture this with the condition '$\wp(\mathrm{C}) \neq \varnothing$' which reads as 'the phonological matrix of C is not zero'. In order to achieve the distribution of deictic elements given in Table 16, we can straightforwardly formulate the PF-instructions for Dx in (469).

(469) **PF-instrunctions for Dx:**

a.	Dx	$\leftrightarrow$ /hɛr/	/ $\wp(C) \neq \varnothing \ \wedge \ \_[+\textsc{prox}]$
b.		$\leftrightarrow$ /hɪn/	/ $\wp(C) \neq \varnothing \ \wedge \ \_[-\textsc{prox}]$
c.		$\leftrightarrow$ /dr/	/ $\wp(C) \neq \varnothing$
d.		$\leftrightarrow$ $\varnothing$	elsewhere

However, the PF-instructions in (469) predict that not only path prepositions but also place prepositions can co-occur with *hin-* and *her-*, which is ungrammatical. Place prepositions can only co-occur with *dr-*.

(470) Hans saß in der Kiste *her-/*hin-/**dr-in**
Hans sat in the.DAT box hither-/thither-/there-in
'Hans sat in the box.'

In order to account for this, I propose a morphological Impoverishment rule (cf. Section 3.4.1) that can target the feature [±PROX] hosted by Dx. In particular, I propose the Proximity Impoverishment rule in (471a), which states that the proximity feature [±PROX] hosted by Dx is necessarily deleted in the context of place prepositions, i.e. in the context of C[−MOTION]. In order to account for the co-occurrence of *dr-* in the context of path prepositions, we can formulate the optional Proximity Impoverishment rule in (471b). However, Proximity Impoverishment may not apply if the abstract Content feature [א] co-occurs with path prepositions, i.e. C[+MOTION]. Note that I leave the principles that guide optional Proximity Impoverishment for further research.

(471) **Proximity Impoverishment:**

a. Delete [±PROX] hosted by Dx in the context of C[−MOTION].
b. Optionally delete [±PROX] hosted by Dx in the context of C[+MOTION], however do not delete [±PROX] if, in addition, P hosts [א].

Let me close this section with a note on some speaker-dependent variation considering the distribution of deictic elements. Note that the conditions concerning the phonological matrix of C in the PF-instructions in (469) are, to some extent, subject to variation. For instance, Noonan (2010) accepts a bare postpositional deictic element in the context of the non-geometric goal preposition *zu* ('to') as given in (472) – which I consider marked, at least.

(472) Sie ist zum Laden (hin) gelaufen.
she is to.the.DAT store thither run
'She ran to the store.'

(Noonan 2010: 172)

The PF-instruction in (469b) principally excludes the deictic element in (472) as ungrammatical. However, for speakers who accept (472), the rules in (469a) and (469b) might in fact be more sophisticated. But note that pseudo-geometric path prepositions are never grammatical with bare deictic postpositional elements (473).

(473) Hans ist auf die Balearen (*hin/*hin-auf) geflogen.
Hans is upon the.ACC Balearics thither/thither-upon flown
'Hans flew to the Balearics.'

This might suggest a reformulation of the PF-instructions in (469a) and (469b) to the effect that (i) the phonological matrix of C is not zero, or (ii) downstairs P hosts the synsem feature [AT], which is characteristic for non-geometric prepositions. However, I leave this for further research.

5.5.3 Aspectual features

Following Den Dikken (2010), I assume that the functional structure of (spatial) prepositions involves the category Asp (for aspect). Arguably, aspect relates to boundedness in one way or another. Hence, I assume that Asp can host the syntacticosemantic (synsem) feature [±UNBD] (for unbounded). This section focuses in particular on the obligatory postpositional elements of unbounded non-geometric path prepositions, which are – I claim – realizations of Asp[+UNBD]. Consider the circumpositional prepositions *auf ... zu* ('towards') and *von ... weg* ('away from') in (474).

(474) a. Hans rannte **auf** den Wald **zu**.
Hans ran upon the.ACC forest to
'Hans ran towards the forest.'

b. Hans rannte **von** dem Wald **weg**.
Hans ran from the.DAT forest away
'Hans ran away from the hut.'

In this thesis, I adopt Piñón's (1993) basic idea that paths *towards X* are inital parts of paths *to X*.[138] That is, unbounded paths *towards X* are partitives of bounded paths *to X*. Piñón follows Verkuyl and Zwarts (1992: 498) who take the view that a PP such as *towards the store* denotes a set of parts of paths *to the store* to the effect that these parts have no fixed end points. In particular, Piñón (1993: 301) proposes that the PP *towards the library* denotes a set of initial subpaths of a path that extends between an implicit starting point and the location of 'the library'. That is, when you are on a path 'towards the library' you are basically on the initial part of a path 'to the library'.[139] I adopt this view and define the three-place LF-predicate towards in (475). I propose that w is a path **towards** r in e iff it is a proper subpath of a path w'

[138] Note that I focus on *auf ... zu* ('towards') in the following. I leave an semantic analysis of *von ... weg* ('away from') for future work.

[139] Krifka (1998: 228) proposes a similar analysis of *towards*.

to r in e' to the effect that e, which is θ-related to w, is an initial subpart of e'. Note that the definitions of the LF-predicates towards in (475) and to in (390b) do not directly refer to each other. Nevertheless, the two definitions overlap to a great extent. Figure 45 illustrates a path w **towards** region r in e as defined in (475).

(475) If θ is a (Strict) Movement Relation for spatial path w and event e, then
$\forall e, r, w[\mathsf{towards}(w, r, e) \leftrightarrow \neg w \subseteq r \wedge \theta(w, e)$
$\wedge\ \exists e', w'[e < e' \wedge \mathsf{INI}(e, e') \wedge \mathsf{non\text{-}mco}(w') \wedge w < w' \wedge \theta(w', e')$
$\wedge\ \forall e'', w''[w'' \leq w' \wedge e'' \leq e' \wedge \theta(w'', e'')$
$\rightarrow [[\mathsf{FIN}(e'', e') \rightarrow w'' \infty r] \wedge [\neg\, \mathsf{FIN}(e'', e') \rightarrow \neg w'' \infty r]]]]]$
"w is a path **towards** r in e iff w is not contained in r; and there is an event e' and a path w', which e and w are proper subparts of; and e is an initial part of e'; and all subpaths $w'' \leq w'$ that are θ-related to final subevents $e'' \leq e'$ are adjacent to r"

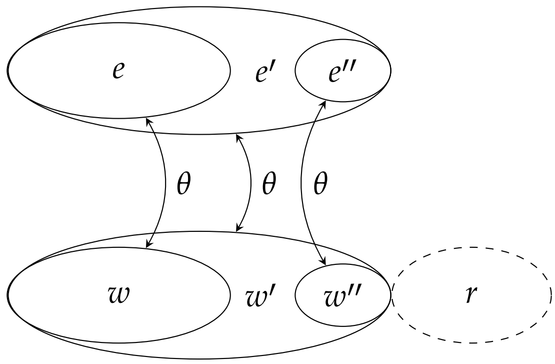


Figure 45: "w is a path **towards** region r in e"

Let us now address the question of how the predicates to and towards relate to each other at LF. In (415) on page 246, I proposed that the predicate to is the interpretation of the light preposition Q above P, if Q hosts the synsem feature [+TO]. In order to arrive at the predicate towards for *auf ... zu*, I assume reinterpretation rules at LF that can target the interpretation of the light preposition Q.In fact, such reinterpretation rules are similar to Readjustment Rules at PF (cf. Section 3.6). In particular, I propose that Asp[+UNBD] triggers a reinterpretation of the light preposition Q at LF to the effect that, in the context of Q[+TO], 'to' changes into 'towards', and likewise, in the context of Q[−TO], 'from' changes into 'away-from'.[140]

(476) **Reinterpretation of Q[±TO] under Asp[+UNBD]:**

a. [$\mathsf{to}(\overline{w}, \overline{r}, \overline{e})$] → [$\mathsf{towards}(\overline{w}, \overline{r}, \overline{e})$] / Q[+TO] ∧ Asp[+UNBD]

b. [$\mathsf{from}(\overline{w}, \overline{r}, \overline{e})$] → [$\mathsf{away\text{-}from}(\overline{w}, \overline{r}, \overline{e})$] / Q[−TO] ∧ Asp[+UNBD]

[140] In this thesis, I omit a discussion of 'away from'. I leave it for future work.

I should mention here that I assume that LF-instructions for prepositional Asp are not needed in order to account for *auf ... zu* ('towards') and *von ... weg* ('away from'). Instead, I assume that prepositional Asp[+UNBD] can affect the interpretation of the downstairs light preposition Q as proposed in (476).

However, there is a flaw in this analysis. Krifka (1998) points to the problem that this analysis necessitates the assumption of the event e' and the path w'. However, the existence of a event e' of X-ing **to** the Ground need not exist in the real world. Krifka (1998: 228) constructs an instance of the imperfective paradox (Dowty 1979). Consider the sentence in (477) where the existence of an event of *walking to the capitol* is implausible.

(477) Mary walked from the university towards the capitol when she was hit by a truck. (Krifka 1998: 228)

Krifka concludes that a proper treatment of such cases has to be couched in a modal representation. In the proposed solution the modal embedding should take place in the definition of the LF-prediate towards.

Let us now look at the PF-instructions for Asp. In contrast to the treatment of Asp at LF, its treatment at PF is straightforward. Consider the forms of the unbounded non-geometric path prepositions in Table 18. In order to account for the postpositional element, I propose the PF-instructions for Asp in (478).

		unbounded non-geometric path prepositions		
		P[AT]		Asp[+UNBD]
goal	Q[+TO]	*auf*	...	*zu*
source	Q[−TO]	*von*	...	*weg*

Table 18: Unbounded non-geometric path prepositions

(478) **PF-instructions for Asp:**

a.	Asp	↔	/t͡suː/	/ _ [+UNBD] ∧ Q[+TO]
b.		↔	/vɛk/	/ _ [+UNBD] ∧ Q[−TO]
c.		↔	∅	elsewhere

What about the realization of P[AT]? The PF-instruction for P in (417c) on page 247 correctly predicts /fɔn/ (*von*) for the source-case Q[−TO]. However, the PF-instruction in (417g) predicts /t͡suː/ (*zu*) for the goal-case Q[+TO], which is obviously wrong. In order to arrive at the correct form /a͜uf/ (*auf*), I propose the morphophonological Readjustment Rule in (479). The phonological matrix of P is changed from /t͡suː/ to /a͜uf/ in the context of Q[+TO] and Asp[+UNBD].

(479) **Readjustment of P under Q[+TO] and Asp[+UNBD]:**
/t͜suː/ → /a͜uf/ / Q[+TO] ∧ Asp[+UNBD]

A further peculiarity of *auf ... zu* is that it takes accusative complements. In Section 6.4, I lay out a morphological case theory for (spatial) prepositions in German. In particular, I propose that the category P inherently assigns dative to DPs in its complement position. Accusative in PPs is achieved, I claim, by a morphological Impoverishment operation that deletes oblique case features, i.e. the case feature that distinguishes accusative from dative. This Impoverishment operation is triggered by certain contexts. One of these contexts is the particular combination Q[+TO] plus Asp[+UNBD]. Accusative case in the context of *auf ... zu* is addressed separately in Section 6.4.2.

For some native speakers of German, the circumposition *auf ... zu* ('towards') is marked when used in instructions for getting somewhere. Imagine a situation where someone asks for the way to the palace, and the instructions would be such that one must go 150 m towards the train station, which is further away, and then turn left into the street leading to the palace asked for. In such a situation, the directions in (480a) involving *auf ... zu* are slightly dispreferred. A more natural way of giving direction is given in (480b), which involves the prepositional construction *in Richtung* ('in the direction of'), the meaning of which is comparable to 'towards' here.

(480) a. (?)Geh 150 m **auf** den Bahnhof **zu** und biege dann links zum
go 150 m upon the.ACC train station to and bend then left to.the.DAT
Palast ab.
palace off
'Go 150 m towards the train station and then turn left to the palace.'

b. Geh 150 m **in Richtung** des Bahnhof-s und biege dann links
go 150 m in direction the.GEN train station-GEN and bend then left
zum Palast ab.
to.the.DAT palace off
'Go 150 m towards the train station and then turn left to the palace.'

The preference for *in Richtung* in (480b), as opposed to *auf ... zu* in (480a), might correspond to the fact that *auf ... zu* is arguably derived from *zu* ('to') and therefore involves the at-region. In Section 5.4.1.3, I argued that an at-region is special to the effect that it must be functionally determined, and that it must be relevant for the Figure to be at an at-region; see, in this regard, also the example in (366). With this in mind, it is clear why (480a), which involves an at-region of the train station, can be odd for some speakers. Being at an at-region of the train station is of no relevance for the Figure in the context of directions she is given. In contrast, the prepositional construction *in Richtung* in (480b) does not carry any relevance implication. In a way, *in Richtung* seems to be a workaround for a non-existing simplex unbounded (pseudo)-geometric goal preposition.

Let me close this section with a brief comment on an aspectual effect in the context of echo extensions of route prepositions. Considering the data in (467), which are repeated here in (481), it seems reasonable to assume that echo extensions of this type are somehow related to the category Asp, e.g. that the recurring element is a realization of Asp[−UNBD].

(481) a. Hans rannte in/für zwei Stunden durch den Wald.
Hans ran in/for two hours through the forest

b. Hans rannte in/*für zwei Stunden durch den Wald hin-durch.
Hans ran in/for two hours through the forest thither-through

In Section 5.5.2, I sketched a potential analysis of the aspectual effect in (481b). In fact, I argued that it is the deictic element of the echo extension rather than Asp[−UNBD] that causes this aspectual effect. When combined with deictic elements such as *hin* ('thither') or *her* ('hither'), route prepositions denote spatial paths where one tail path is included in the deictic reference region, while the other tail path is not. Sets of such spatial paths cannot be cumulative because they contain no paths that can be concatenated whatsoever. Thus, the resulting prepositional CP is bounded.

5.6 Spatial prepositions in verbal contexts

This section briefly sketches how prepositional CPs headed by spatial prepositions can be integrated in various verbal contexts. In particular, I present how various verbal structures containing a prepositional CP are interpreted at LF. Four cases are illustrated: Section 5.6.1 illustrates the geometric place preposition *in* ('in') when it heads a prepositional CP serving as an argument of the stative posture verb *stehen* ('stand'); Section 5.6.2 illustrates the geometric goal preposition *in* ('into') when it heads a prepositional CP serving as an argument of the unaccusative manner of motion verb *rennen* ('run'); Section 5.6.3 illustrates the geometric route preposition *durch* ('through') when it heads a prepositional CP serving as an argument of the transitive motion verb *schieben* ('push'); and Section 5.6.4 illustrates the geometric goal preposition *in* ('into') when it heads a prepositional CP serving as an argument of the unergative verb *pinkeln* ('pee'). As for both the unaccusative motion verb *rennen* and the transitive motion verb *schieben*, I assume that they instantiate Figure/Path Relations in the sense of Beavers (2012); cf. Section 4.4.2. As for the unergative verb *pinkeln*, which belongs to the class of verbs of bodily emission of fluids (Harley 2005), I assume that such verbs instantiate an abstract Figure/Path Relation (FPR) (Beavers 2012) dubbed 'send'. Morphophonologically, the nominal argument of the phonologically null verb conflates with the verb. Semantically, the nominal argument serves as the Figure argument of the abstract FPR send.

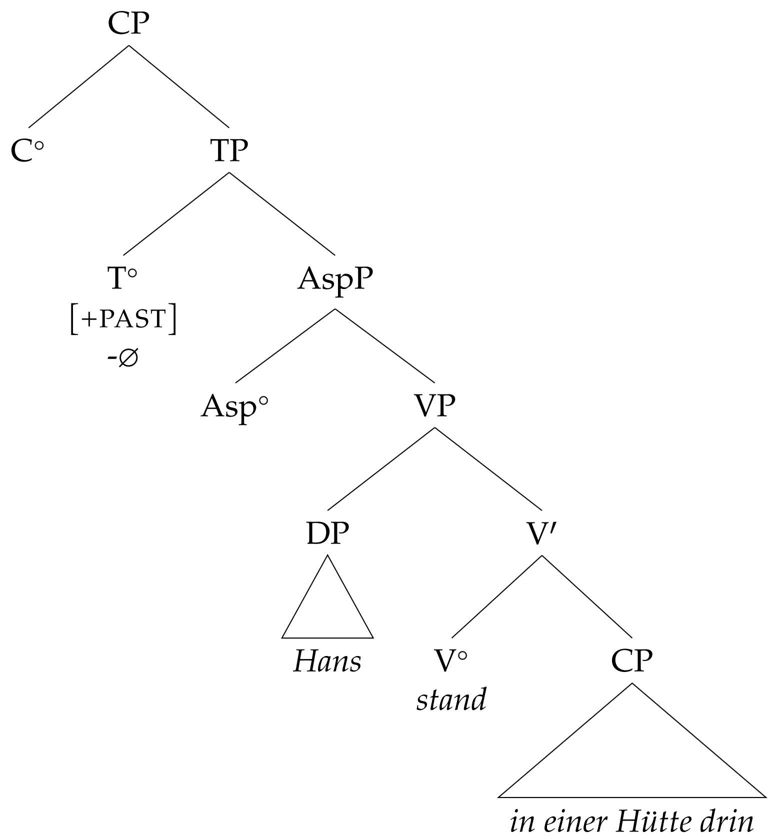
As for the functional structure of the clauses, i.e. the structure above VP or VoiceP involving AspP and TP, I refer the reader to Section 4.1.3, where a potential LF-interpretation is sketched.

5.6.1 Place preposition and stative posture verb

I assume that the clause in (482) instantiates the syntactic structure given in (483). In particular, I assume that the posture verb *stehen* ('stand'), which is used here in the past tense, takes two arguments: (i) a region-denoting prepositional CP, i.e. a fully-fledged place PP, and (ii) a DP, which is merged in the specifier of the VP.

(482) Hans stand (dort) in einer Hütte dr-in.
Hans stood there in a.DAT hut there-in
'Hans stood in a hut (over there).'

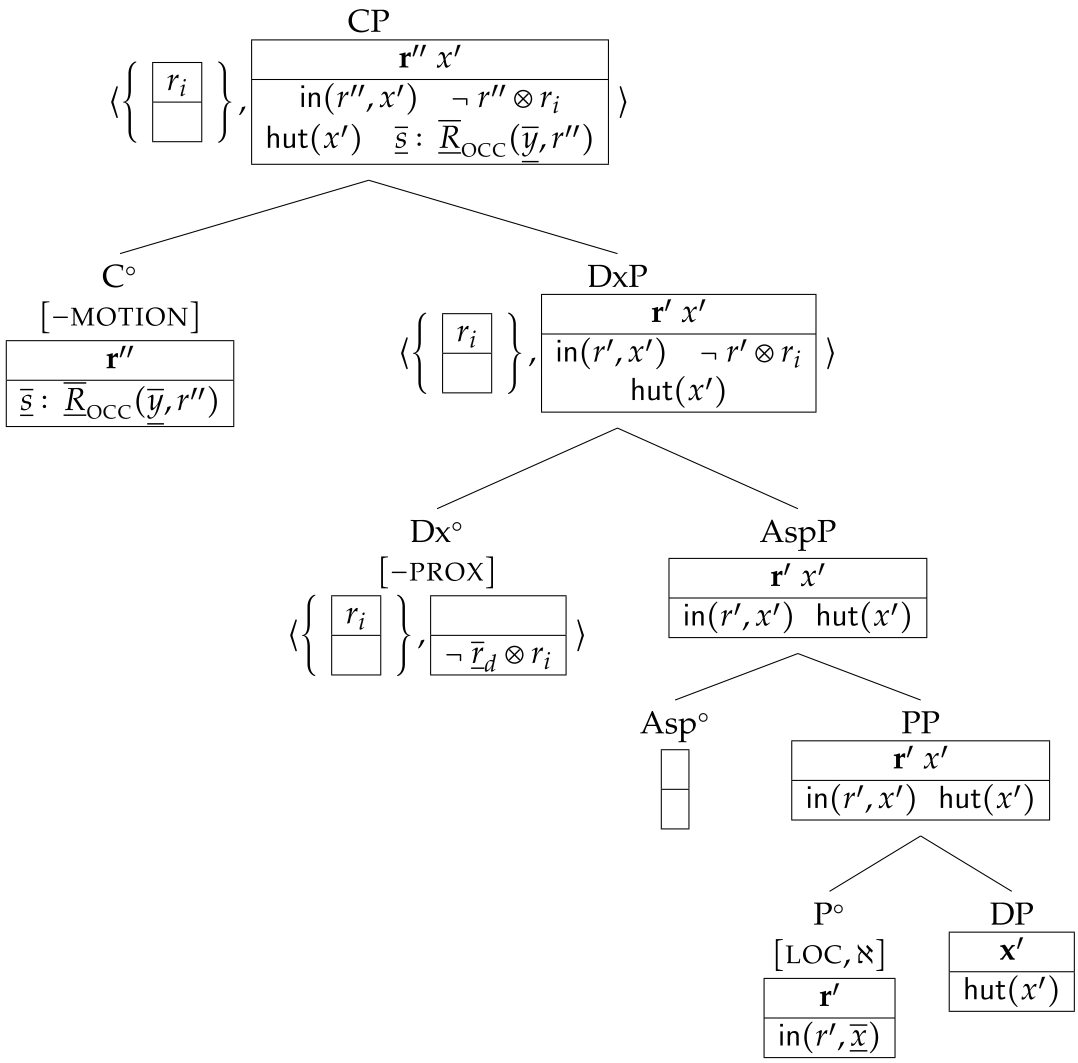
(483)



At LF, the prepositional CP of (482) is interpreted as given in (484). P[LOC, ℵ] is interpreted as referring to an in-region r' of an anticipated material object $\underline{\overline{x}}$. The referential argument of the DP x' unifies with $\underline{\overline{x}}$ at the level of PP. The referential argument of the PP is r'. In this example, Asp° does not host any synsem features, and thus it has a null interpretation. The DRS of the PP is percolated up to AspP. In this example, Dx° hosts one of the synsem features [+PROX] or [−PROX]. As a matter of fact, both [+PROX] and [−PROX] are pronounced as *dr-* in the context of place prepositions. Hence, we cannot determine from the surface form in (482) which one is present in Dx°. However, when the pronominal adverb *dort* ('there') indicating distal deixis is present, we can assume that Dx° hosts [−PROX]. For the sake of simplicity, I do not represent *dort* here. Dx[−PROX] contributes the condition that the anticipated deictic reference region $\underline{\overline{r}}_d$ must not overlap with the presupposed deictic center r_i. The referential argument of AspP r' unifies with the anticipated deictic reference region $\underline{\overline{r}}_d$ at the level of

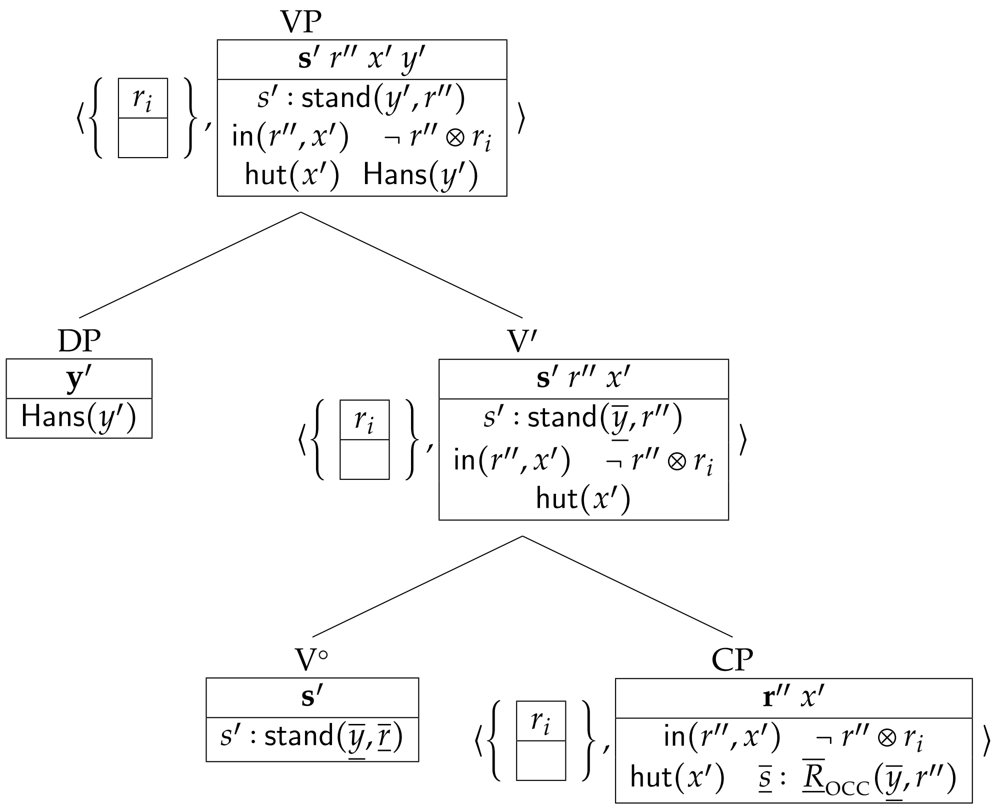
DxP. C[−MOTION] is interpreted as an anticipated stative relation $\underline{\overline{R}}_{\text{OCC}}$ holding between an anticipated Figure $\underline{\overline{y}}$ and the region r'', which is the referential argument of C°. At the level of CP, r'' unifies with r'.

(484)



At LF, the VP of (482) is interpreted as given (485). The prepositional CP serves as an argument of the stative posture verb *stehen* ('stand'). The referential argument of V° is the state s' that can be characterized by the predicate stand relating an anticipated entity $\underline{\overline{y}}$ with an anticipated region $\underline{\overline{r}}$. The anticipated stative relation of the prepositional CP $\underline{\overline{R}}_{\text{OCC}}$ unifies with the stative predicate stand at the level of V′. The referential argument of the prepositional CP r'' unifies with $\underline{\overline{r}}$ at the level of V′. The referential argument of the DP y' unifies with $\underline{\overline{y}}$ at the level of VP.

(485)

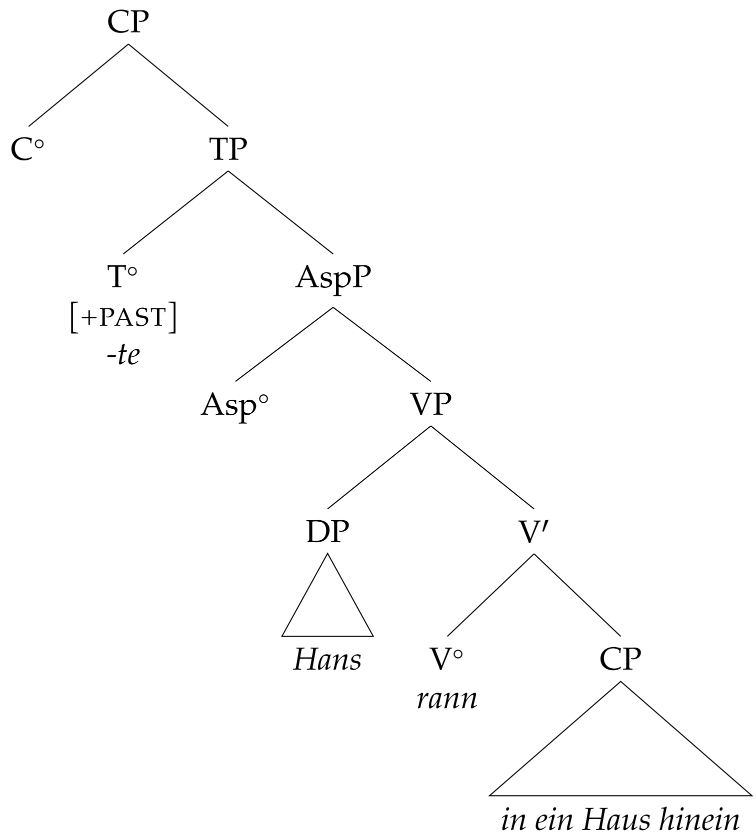


5.6.2 Goal preposition and unaccusative motion verb

I assume that the clause in (486) instantiates the syntactic structure given in (487). In particular, I assume that the unaccusative motion verb *rennen* ('run'), which is used here in the past tense, takes two arguments: (i) a path-denoting prepositional CP, i.e. a fully-fledged path PP, and (ii) a DP, which is merged in the specifier of the VP.

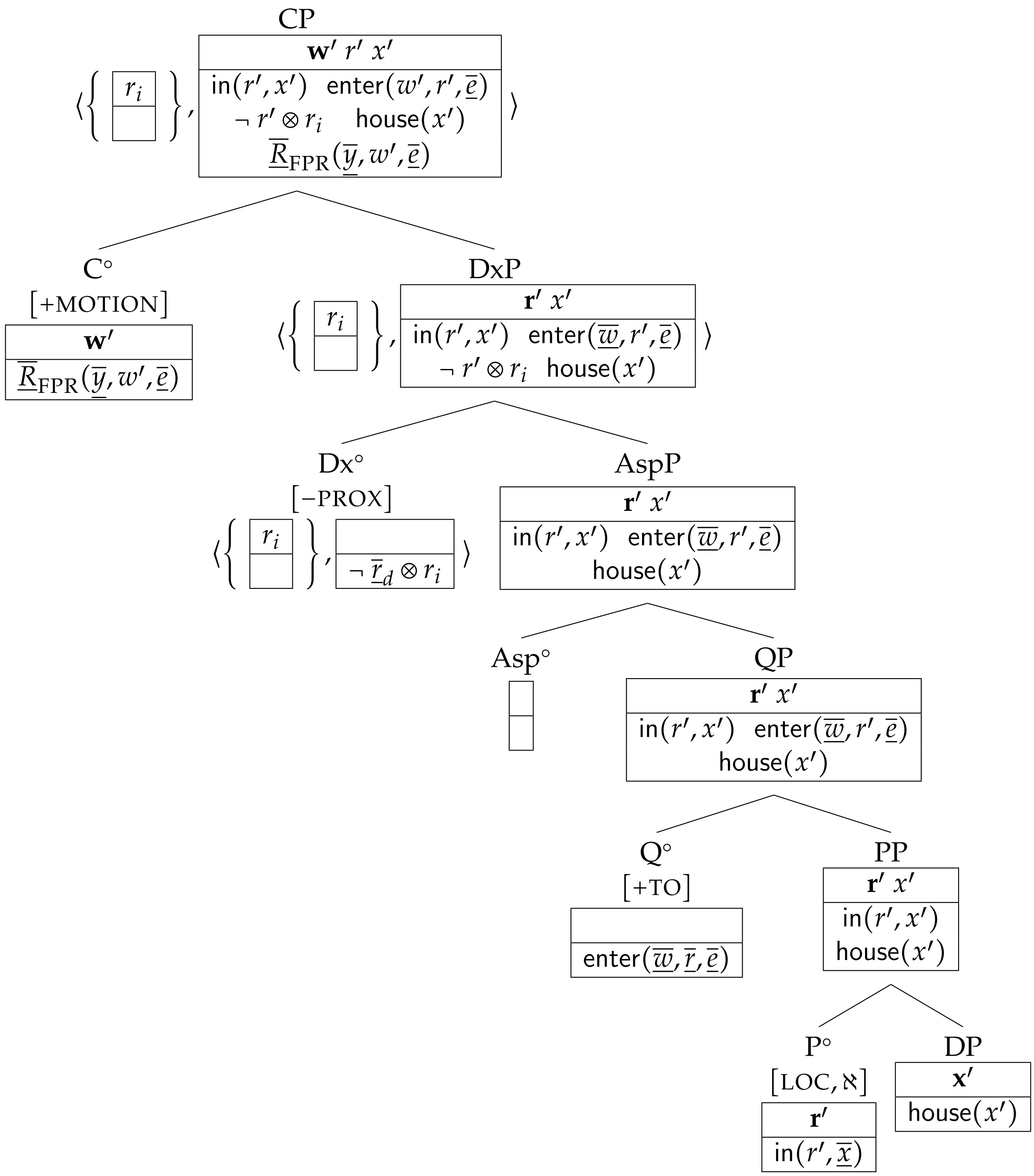
(486) Hans rannte in ein Haus hin-ein.
Hans ran in a.ACC house thither-in
'Hans ran into a house.'

(487)



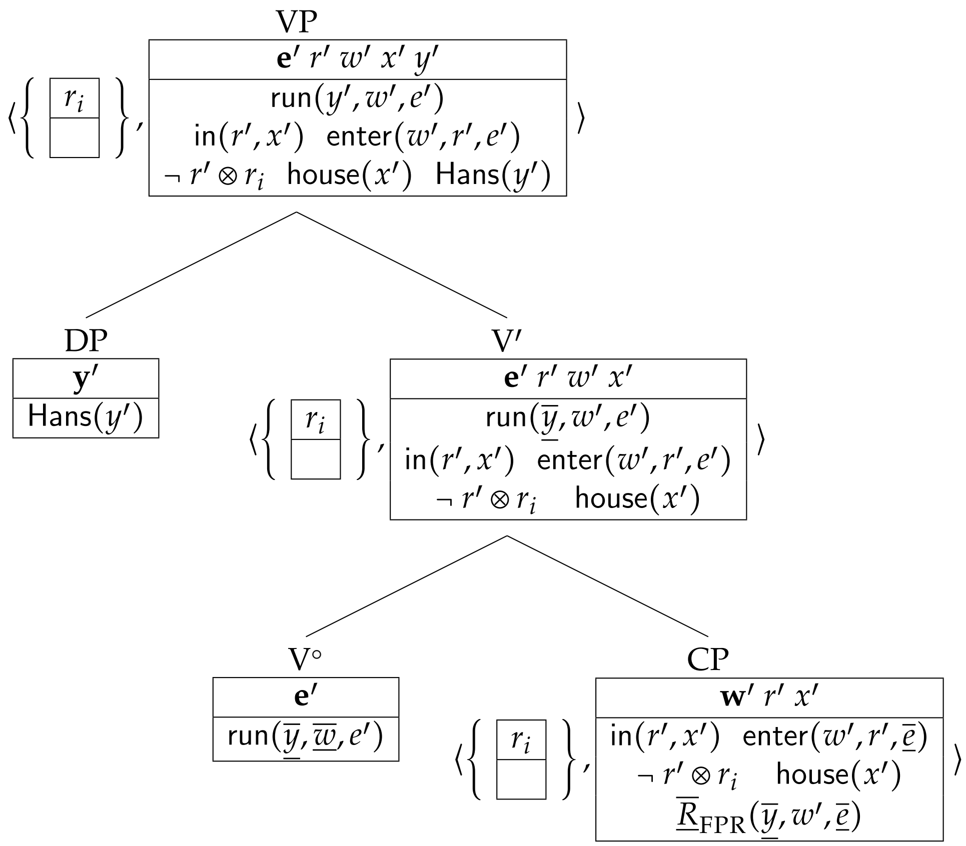
At LF, the prepositional CP of (487) is interpreted as given in (488). P[LOC, $\aleph$] is interpreted as referring to an in-region r' of an anticipated material object $\overline{\underline{x}}$. The referential argument of the DP x' unifies with $\overline{\underline{x}}$ at the level of PP. Q[+TO] is interpreted as contributing an anticipated enter-path $\overline{\underline{w}}$ of an anticipated region $\overline{\underline{r}}$ in an anticipated event $\overline{\underline{e}}$. The referential argument of the PP r' unifies with $\overline{\underline{r}}$ at the level of QP. In this example, Asp° does not contain any synsem features and thus it has a null interpretation. The DRS of the PP is percolated up to AspP. Dx[−PROX] is interpreted as contributing the condition that the anticipated deictic reference region $\overline{\underline{r}}_d$ must not overlap with the presupposed deictic center r_i. The referential argument of AspP r' unifies with $\overline{\underline{r}}_d$ at the level of DxP. C[+MOTION] is interpreted as contributing an anticipated Figure/Path Relation $\overline{\underline{R}}_{FPR}$ holding between an anticipated Figure $\overline{\underline{y}}$, the spatial path w', and an anticipated event $\overline{\underline{e}}$. The referential argument of C° w' unifies with $\overline{\underline{w}}$ at the level of CP.

(488)



At LF, the VP of (487) is interpreted as given in (489). I assume that the unaccusative motion verb *rennen* ('run') contributes the Figure/Path Relation run holding between an anticipated Figure $\underline{y}$, an anticipated path $\overline{w}$, and the event e'. The latter is the referential argument of V°. The anticipated Figure/Path Relation of the prepositional CP $\overline{R}_{\text{FPR}}$ unifies with run at the level of V′. The referential argument of the prepositional CP w' unifies with $\overline{w}$ at the level of V′. The referential argument of the DP y' unifies with $\underline{y}$ at the level of VP.

(489)

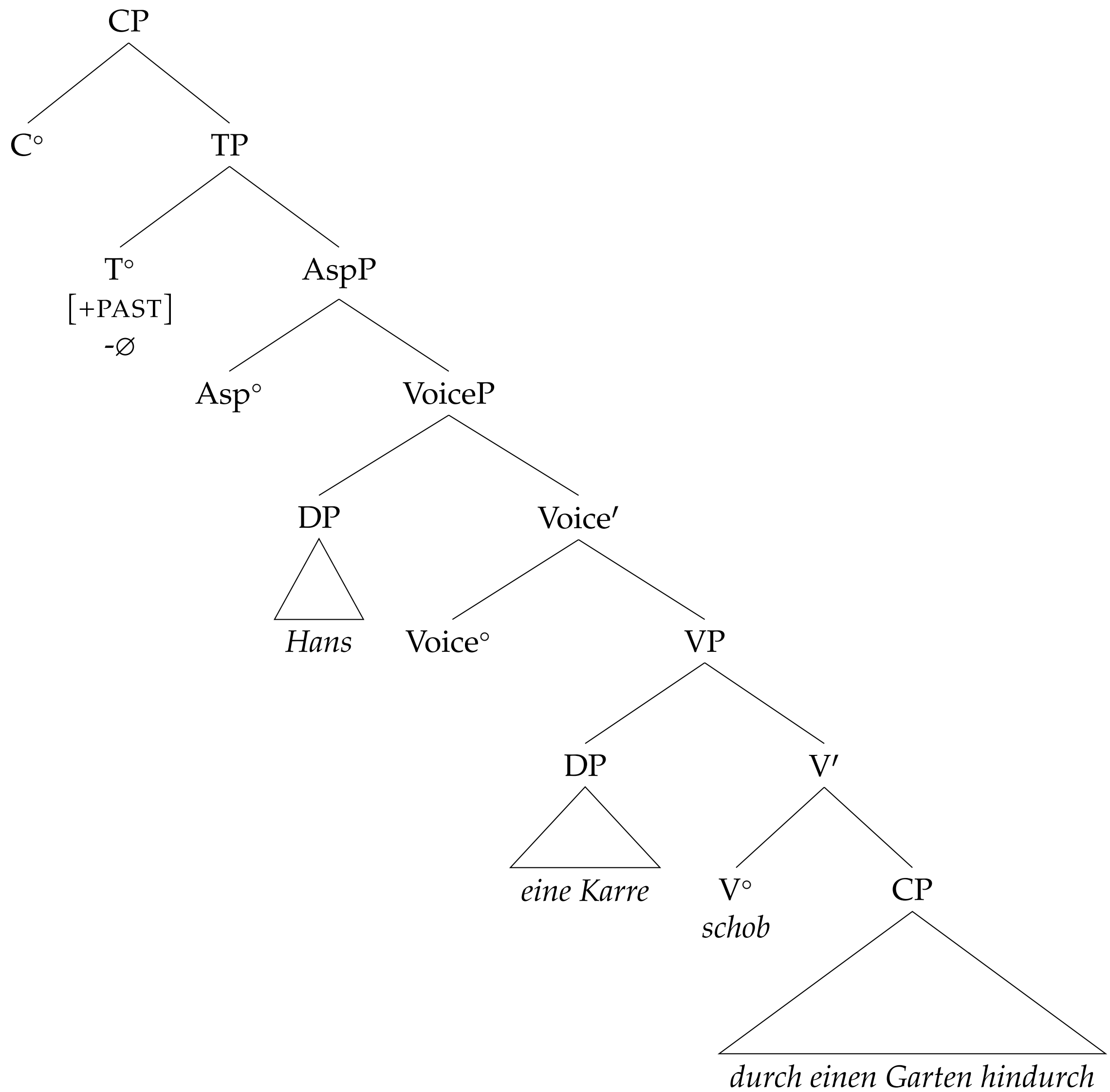


5.6.3 Route preposition and transitive motion verb

I assume that the clause in (490) instantiates the syntactic structure given in (491). In particular, I assume that the transitive motion verb *schieben* ('push'), which is used in the past tense here, takes two arguments: (i) a path-denoting prepositional CP, i.e. a fully-fledged path PP, and (ii) a DP, which is merged in the specifier of the VP. In addition, Voice introduces the agent of the event in its specifier.

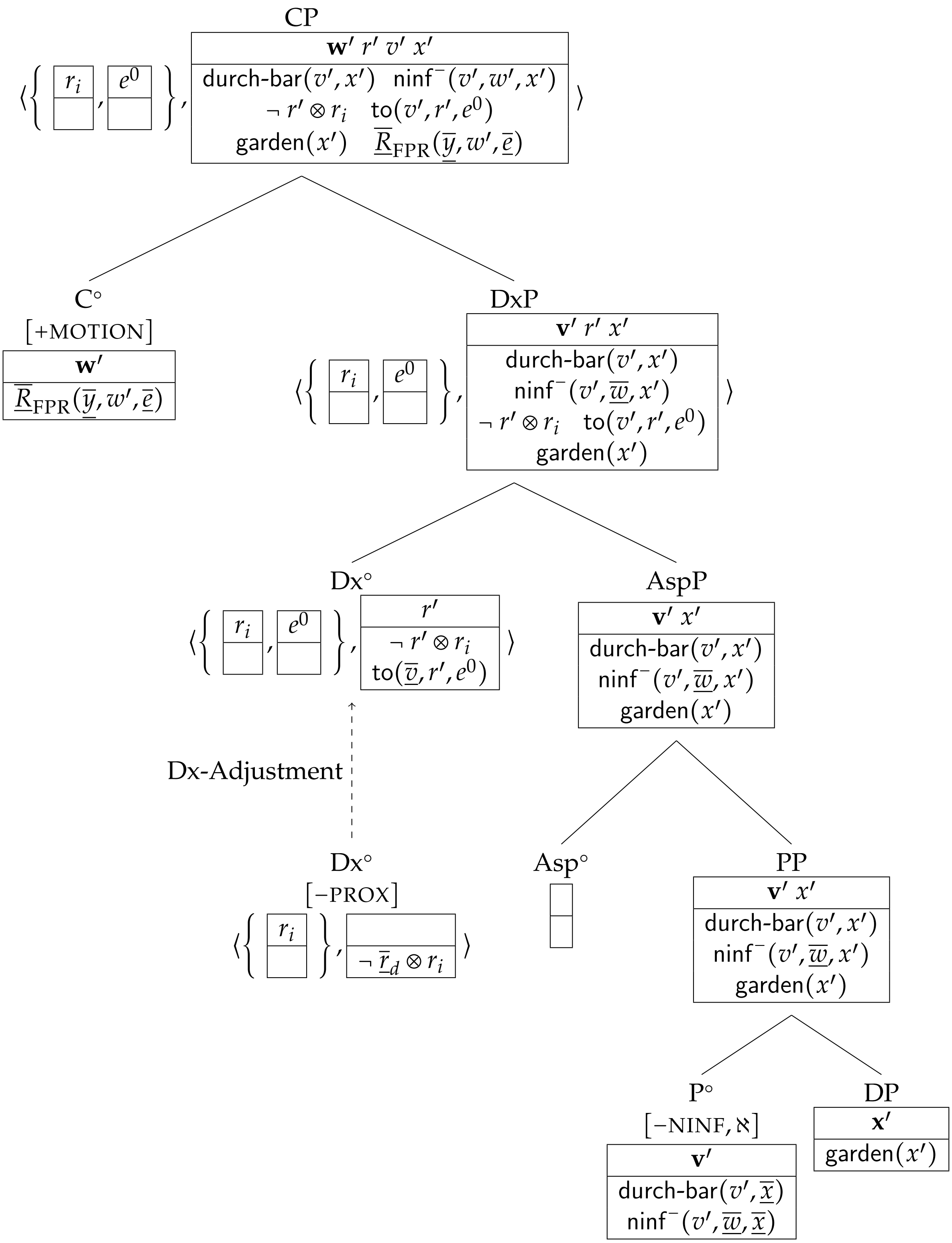
(490) Hans schob eine Karre durch einen Garten hin-durch
Hans pushed a cart through a.ACC garden thither-through
'Hans pushed a cart through a garden.'

(491)



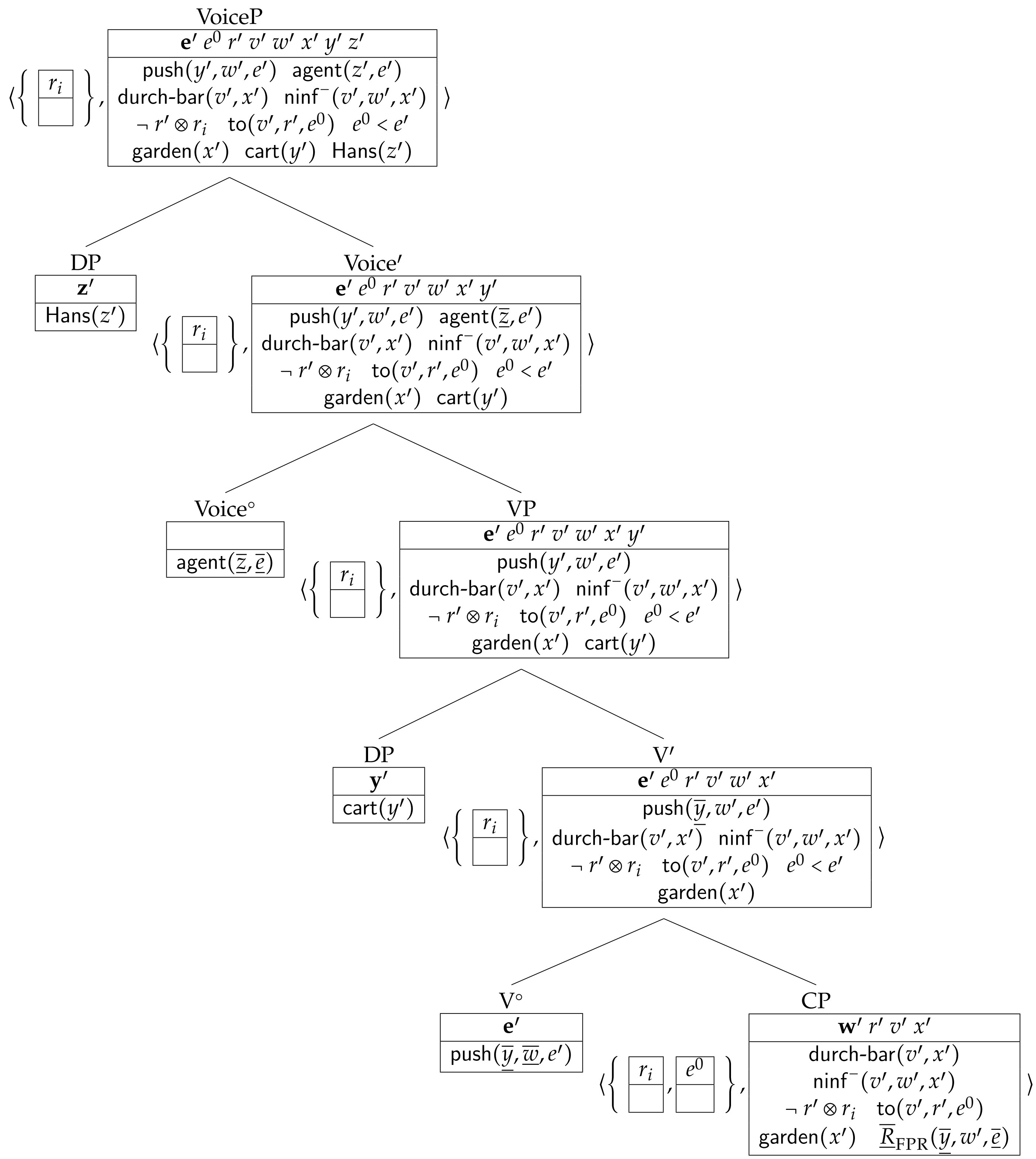
At LF, the prepositional CP of (491) is interpreted as given in (492). P[−NINF] is interpreted as contributing a negative ninf-path v' of an anticipated path $\underline{\overline{w}}$ relative to an anticipated object $\underline{\overline{x}}$. The NINF-path v' is a durch-bar-path of an anticipated material object $\underline{\overline{x}}$. The referential argument of the DP x' unifies with $\underline{\overline{x}}$ at the level of PP. In this example, Asp° does not contain any synsem features and thus it has a null interpretation. The DRS of the PP is percolated up to AspP. Dx[−PROX] is interpreted as contributing the condition that the anticipated deictic reference region $\underline{\overline{r}}_d$ must not overlap with the presupposed deictic center r_i. However, the complement of Dx° does not provide a discourse referent that could unify with $\underline{\overline{r}}_d$. Hence, the LF-operation Dx-Adjustment is triggered. Dx-Adjustment adds the region r' to the DRS of Dx°. The region r' is interpreted as the goal of an anticipated to-path $\underline{\overline{v}}$ in a presupposed event e^0. Note that r' is not the referential argument of Dx°. Now, the referential argument of AspP, which is the NINF-path v', can unify with $\underline{\overline{v}}$ at the level of DxP. C[+MOTION] is interpreted as contributing an anticipated Figure/Path Relation $\underline{\overline{R}}_{\text{FPR}}$ holding between an anticipated Figure $\underline{\overline{y}}$, the spatial path w', and an anticipated event $\underline{\overline{e}}$. The referential argument of C° w' unifies with $\underline{\overline{w}}$ at the level of CP.

(492)



At LF, the VoiceP of (491) is interpreted as given in (493). I assume that the transitive motion verb *schieben* ('push') contributes the Figure/Path Relation push holding between an anticipated Figure $\underline{\overline{y}}$, an anticipated path $\overline{w}$, and the event e'. The latter is the referential argument of V°. The anticipated Figure/Path Relation of the prepositional CP $\underline{\overline{R}}_{\text{FPR}}$ unifies with run at the level of V′. The referential argument of the prepositional CP w' unifies with $\overline{w}$ at the level of V′. At this level, the presupposed event e^0 is resolved as a proper part of e'. The referential argument y' of the DP in the specifier of the VP unifies with $\underline{\overline{y}}$ at the level of VP. Voice° contributes the agent-relation holding between an anticipated entity $\underline{z}$ and an anticipated event $\underline{e}$. The referential argument of VP e' unifies with $\underline{e}$ at the level of Voice′. The referential argument of the DP in the specifier of the VoiceP z' unifies with $\underline{z}$ at the level of VoiceP.

(493)

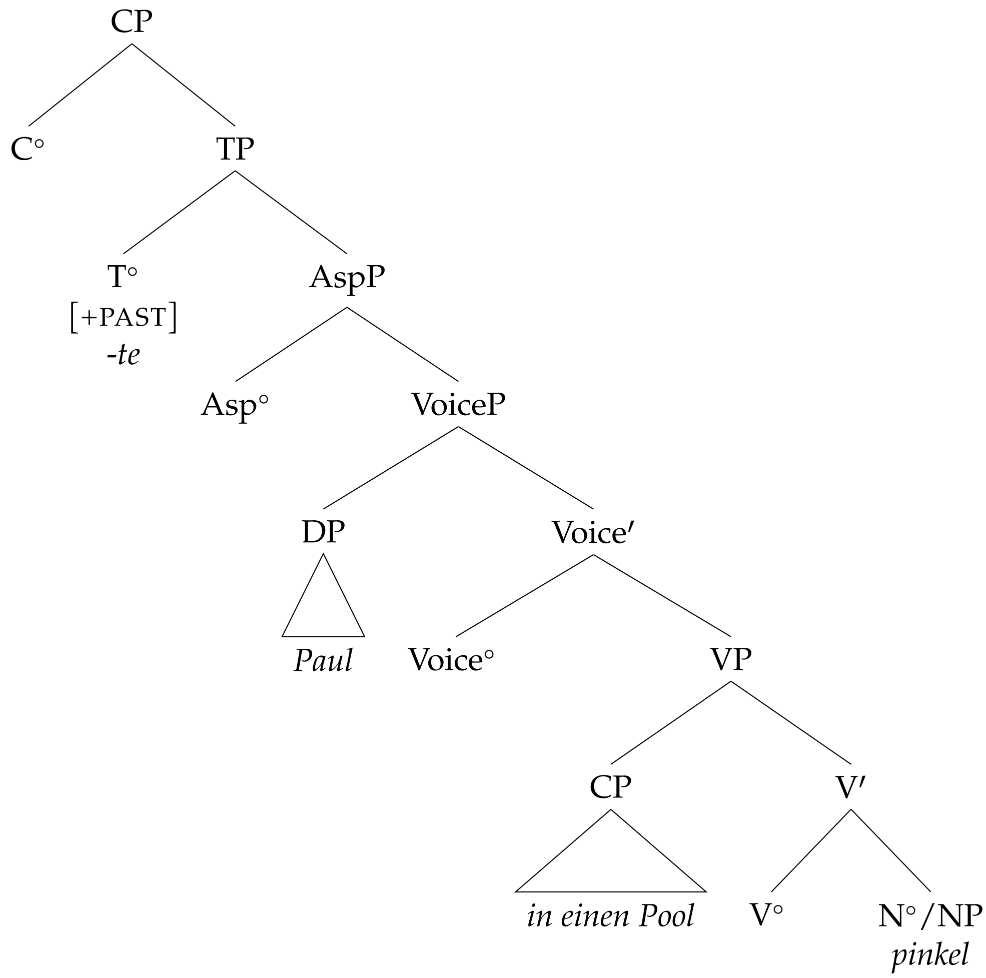


5.6.4 Goal preposition and unergative verb

I assume that the clause in (494) instantiates the unergative structure given in (495). I assume that the unergative verb *pinkeln* ('pee'), which belongs to the class of verbs of bodily emission of fluids, is derived from an initially phonologically null verb V° that takes two arguments: (i) a bare nominal complement, which conflates with the verb,[141] and (ii) a path-denoting prepositional CP. In addition, Voice introduces the agent of the event in its specifier.

(494) Paul pinkelte in einen Pool.
Paul peed in a.ACC pool
'Paul peed into a pool.'

(495)

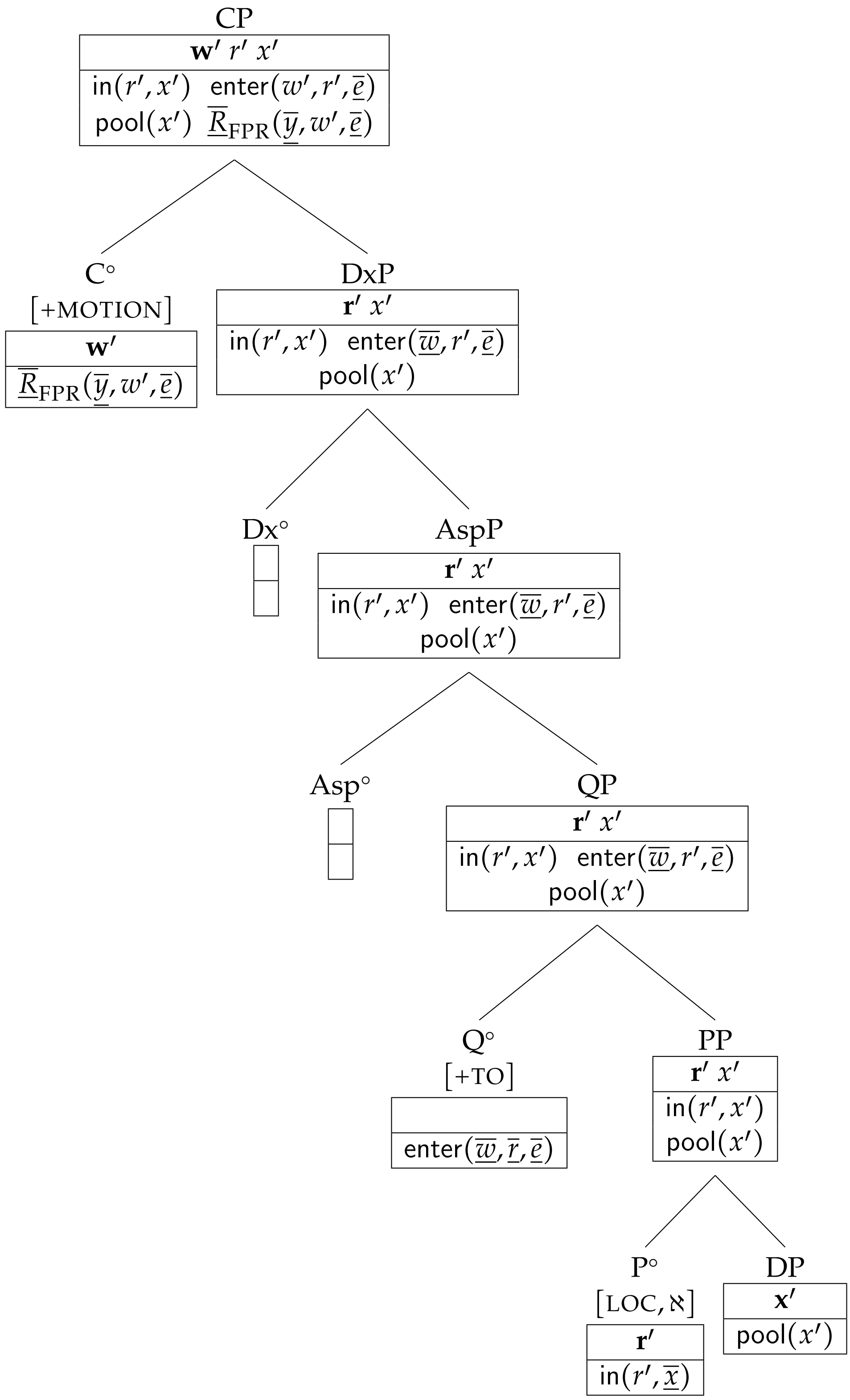


At LF, the prepositional CP of (495) is interpreted as given in (496). P[LOC, א] is interpreted as referring to an in-region r' of an anticipated material object $\underline{x}$. The referential argument of the DP x' unifies with $\underline{x}$ at the level of PP. Q[+TO] is interpreted as contributing an anticipated enter-path $\underline{w}$ of an anticipated region $\underline{r}$ in an anticipated event $\underline{e}$. The referential argument of the PP r' unifies with $\underline{r}$ at the level of QP. In this example, Asp° does not contain any synsem features and thus it has a null interpretation. The DRS of the PP is percolated up to AspP. Likewise, Dx° does not contain any synsem features and thus it has a null interpretation.

[141] For the notion of conflation, I refer the reader to Hale and Keyser (2002).

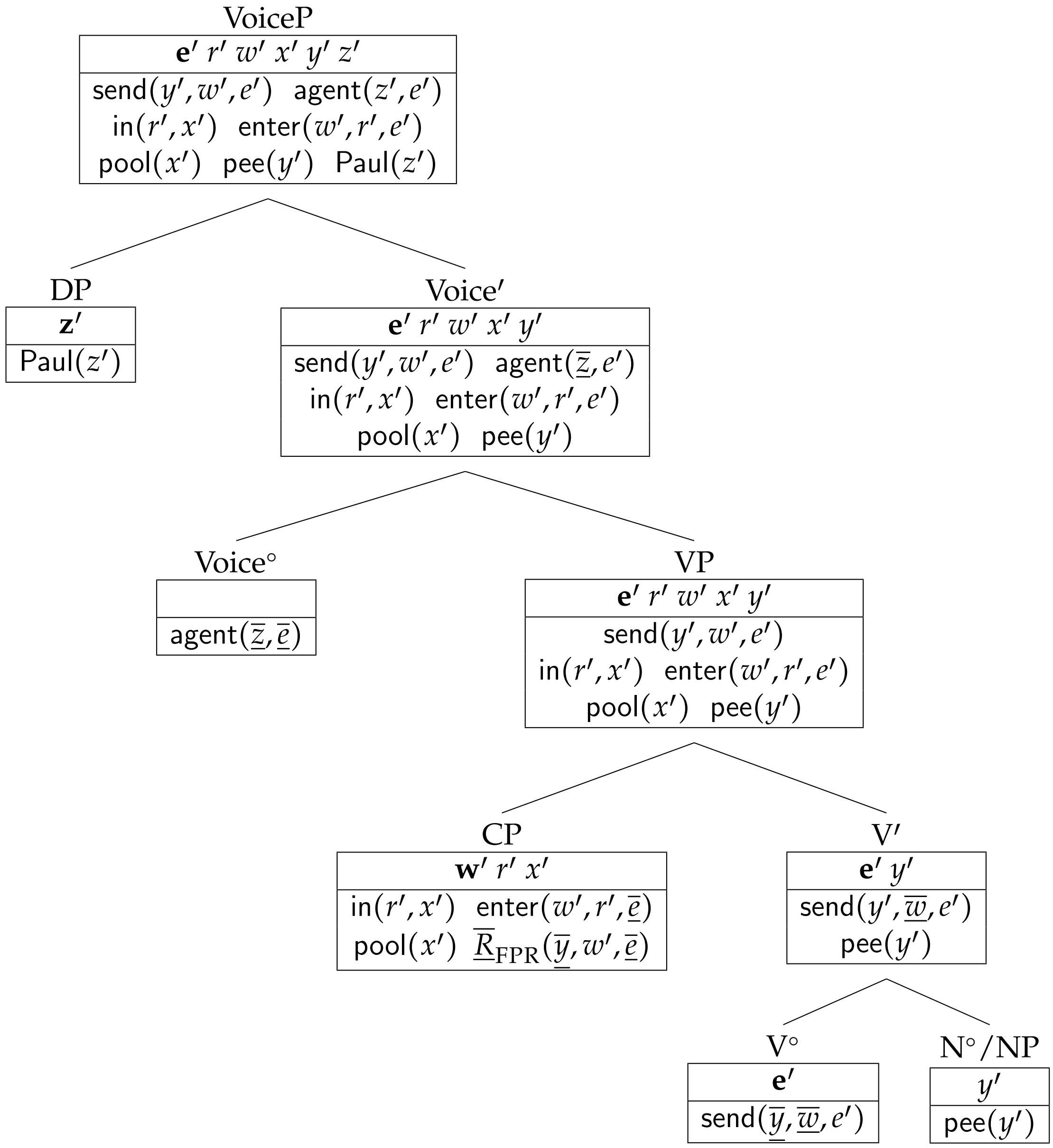
The DRS of the AspP is percolated up to DxP. C[+MOTION] is interpreted as contributing an anticipated Figure/Path Relation $\overline{R}_{FPR}$ holding between an anticipated Figure $\underline{\overline{y}}$, the spatial path w', and an anticipated event $\underline{\overline{e}}$. The referential argument of C° w' unifies with $\underline{\overline{w}}$ at the level of CP.

(496)



At LF, the VoiceP of (495) is interpreted as given in (497). I assume that V° contributes the abstract Figure/Path Relation send holding between an anticipated Figure $\underline{y}$, an anticipated path $\overline{w}$, and the event e'. The latter is the referential argument of V°. The referential argument of N°/NP y' unifies with $\underline{y}$ at the level of V′. The referential argument of the prepositional CP w' unifies with $\overline{w}$ at the level of VP. The anticipated Figure/Path Relation of the prepositional CP $\overline{R}_{\mathrm{FPR}}$ unifies with send at the the level of VP. Voice° contributes the agent-relation holding between an anticipated entity $\underline{z}$ and an anticipated event $\underline{e}$. The referential argument of VP e' unifies with $\underline{e}$ at the level of Voice′. The referential argument of the DP z' unifies with $\underline{z}$ at the level of VoiceP.

(497)



5.7 Summary

This chapter spelled out the syntax, semantics, morphology of spatial prepositions in German. This chapter is the core of this thesis because it illustrates how spatial prepositions could be implemented

Section 5.1 classified spatial prepositions according to several criteria. Section 5.1.1 presented a widely accepted typology of spatial prepositions (e.g. Jackendoff 1983, Piñón 1993, Zwarts 2006, Gehrke 2008, Kracht 2008, Svenonius 2010, Pantcheva 2011). On the one hand, place prepositions denote static locations (regions), while path prepositions, on the other hand, denote dynamic locations (spatial paths). Path prepositions can be directed or undirected. Directed path prepositions are either goal prepositions or source prepositions. Undirected path prepositions are route prepositions. In Section 5.1.2, I introduced a geometry-based classification of spatial prepositions, which is orthogonal to the place/path typology. I propose that spatial prepositions can be (i) geometric prepositions, (ii) pseudo-geometric prepositions, or (iii) non-geometric prepositions. Geometric prepositions refer to geometric relations that can be spelled out, for instance, in a parsimonious, perception-driven model of space (Kamp and Roßdeutscher 2005). Examples are *in* ('in, into'), *aus* ('out of'), *durch* ('through'). Pseudo-geometric prepositions look like geometric prepositions, but do not refer to geometric relations. Instead, they express functional locative relations. The peculiar goal preposition *nach* ('to'), which is obligatorily used, e.g., with determinerless toponyms, turns out to be a special instance of a pseudo-geometric preposition. Pseudo-geometric prepositions behave differently from geometric prepositions in several ways. For example, they do not license a postpositional recurrence of the preposition and the choice of a pseudo-geometric preposition is heavily influenced by denotational properties of the noun it co-occurs with. The non-geometric prepositions *bei* ('at'), *zu* ('to'), and *von* ('from') form a third class of spatial prepositions. They do not only impose semantic selection restrictions distinct from geometric and pseudo-geometric prepositions, but also behave differently with regard to lexical aspect. Section 5.1.3 classified path prepositions into bounded and unbounded path prepositions. This was done according to Kracht's (2002, 2008) classification: bounded source prepositions denote coinitial paths, bounded goal prepositions denote cofinal paths, bounded route prepositions denote transitory paths, unbounded source prepositions denote recessive paths, unbounded goal prepositions denote approximative paths, and unbounded route prepositions denote static paths. Section 5.1.4 mapped these classifications to syntactic structure. The lexical category P is characteristic of prepositions in general. It can host one of the following synsem features: (i) [LOC], which is characteristic of (pseudo)-geometric prepositions (except for route prepositions), (ii) [AT], which is characteristic of non-geometric prepositions; or (iii) [±NINF], which is characteristic of route prepositions. The lexical category P can be dominated by the light preposition Q, which derives goal and source prepositions from place prepositions. Q can host the synsem features [+TO] for goal prepositions or [−TO] for source prepositions. Following (Den Dikken 2010), I adopt the Parallelism Hypothesis, which states that the (functional) categories are structured in parallel across lexical domains, and assume functional structure above the categories P and Q. The functional category Asp dominates P or Q and can host the synsem features [+UNBD] for unbounded aspect or [−UNBD] for bounded aspect. The functional category Dx dominates Asp and can host the synsem features [+PROX] for proximal deixis or [−PROX] for non-proximal (distal) deixis. The functional category C dominates Dx and can host the synsem features [+MOTION] for path prepositions or [−MOTION] for place prepositions.

Section 5.2 touched upon the cartographic decomposition of spatial prepositions. I briefly presented Svenonius' (2006, 2010) cartographic decomposition of place prepositions and Pantcheva's (2011) cartographic decomposition of path prepositions.

Section 5.3 introduced three abstract Content features that relate to geometric concepts and that figure in the derivation of the geometric prepositions: (i) the place and goal preposition *in* ('in, into'), the source preposition *aus* ('out of'), and the route preposition *durch* ('through') share the abstract Content feature [א] relating to interiority; (ii) the place and goal preposition *an* ('on, onto') and the route preposition *um* ('around') share the abstract Content feature [ב] relating to contiguity; and (iii) the place and goal preposition *auf* ('upon, up onto') and the route preposition *über* ('over, across') share the abstract Content feature [נ] relating to verticality. Sections 5.3.1 to 5.3.3 discussed how the abstract Content features manifest themselves semantically. Focusing on [א] (interiority), Section 5.3.1 defined in-regions and durch-bar-paths. Focusing on [ב] (contiguity), Section 5.3.2 defined an-regions and um-bar-paths. Focusing on [נ] (verticality), Section 5.3.3 defined auf-regions and ueber-bar-paths.

Section 5.4 derived the lexical structure of spatial prepositions and spelled out PF-instructions for their morphophonological realization and LF-instructions for their semantic interpretation. Section 5.4.1 addressed place prepositions: geometric place prepositions were the subject of Section 5.4.1.1, pseudo-geometric place prepositions were the subject of Section 5.4.1.2, and non-geometric place prepositions were the subject of Section 5.4.1.3. Section 5.4.2 addressed goal and source prepositions: geometric goal and source prepositions were the subject of Section 5.4.2.1, pseudo-geometric goal and source prepositions were the subject of Section 5.4.2.2, and non-geometric goal and source prepositions were the subject of Section 5.4.2.3. Section 5.4.3 addressed route prepositions.

Section 5.5 derived the functional structure of spatial prepositions and spelled out PF-instructions for their morphophonological realization and LF-instructions for their semantic interpretation. Section 5.5.1 addressed C-features, Section 5.5.2 addressed deictic features, and Section 5.5.3 addressed aspectual features.

Section 5.6 illustrated how a fully-fledged PP, i.e. a prepositional CP, headed by a spatial preposition can be integrated in various verbal contexts.

Appendix A.1 provides a synopsis of the syntactic structures of the German spatial prepositions at issue, their LF-instructions for semantic interpretation and PF-instructions for morphophonological realization, and the necessary morphological and semantic operations.

Chapter 6

Prepositional case

Prepositions determine the case of their complement DP. This chapter will discuss prepositional case in German. I will present (i) the case assignment properties of (spatial) prepositions in German (Zwarts 2006); (ii) several previous approaches to prepositional case (Bierwisch 1988, Arsenijević and Gehrke 2009, Caha 2010, Den Dikken 2010); and (iii) a morphological case theory proposed for the verbal domain Marantz (1991), McFadden (2004). This will pave the way for a proposal of a morphological case approach to spatial prepositions in German that is based on the syntacticosemantic analyses of spatial prepositions presented in Chapter 5.[142]

This chapter is structured as follows. Section 6.1 will present the case assignment properties of spatial prepositions in German. Section 6.2 will present four previous approaches to prepositional case: Den Dikken (2010) in Section 6.2.1; Caha (2010) in Section 6.2.2; Arsenijević and Gehrke (2009) in Section 6.2.3; and Bierwisch (1988) in Section 6.2.4. Section 6.3 will motivate and outline the hypothesis that case is not a phenomenon of the syntax proper, but of the morphological component of the grammar. This section will present a morphological case approach spelled out for the verbal domain (Marantz 1997, McFadden 2007). Section 6.4 will lay out a morphological case theory for simplex spatial prepositions in German that is based on the syntacticosemantic analysis of spatial prepositions presented in Chapter 5. Section 6.5 will summarize this chapter.

6.1 Prepositional case in German

In German, three of four cases occur in the prepositional domain: (i) **dative (dat)**, (ii) **accusative (acc)**, and (iii) **genitive (gen)**. The fourth case, nominative (nom), never occurs as the complement of a preposition. The main focus here is on dative and accusative because

[142] The morphological case approach to prepositions proposed by Haselbach and Pitteroff (2015) presents an early stage of the morphological case theory developed in Section 6.4. The morphological case approach presented in Haselbach and Pitteroff (2015) was jointly developed by Boris Haselbach and Marcel Pitteroff. At that stage, however, the approach was syntacticosemantically not as elaborated as it is here. Moreover, Sections 6.2 and 6.3 overlap with Haselbach and Pitteroff (2015), to some extent. For the most part, this work was carried out by me.

these two cases are mainly assigned by simplex spatial prepositions in German.[143] We should first narrow down the domain we are looking at. This thesis focuses on German morphologically simplex prepositions conveying spatial meaning. As a starting point, let us look at the 16 morphologically-simplex spatial prepositions in German, listed by Zwarts (2006: 94) according to their case assignment properties.

(498) **German morphologically-simplex spatial prepositions assigning ...**

a. **Dative:**
aus ('out of'), *bei* ('at'), *nach* ('to'), *von* ('from'), *zu* ('to')

b. **Accusative:**
durch ('through'), *um* ('around')

c. **Dative or accusative:**
an ('on'), *auf* ('upon'), *hinter* ('behind'), *in* ('in'), *neben* ('next to'), *über* ('above; over, across'), *unter* ('under'), *vor* ('in front of'), *zwischen* ('between')

(cf. Zwarts 2006: 94)

Some prepositions like *bei* ('at') or *aus* ('out of') occur only with a dative complement, while others occur only with an accusative complement; the latter are the route prepositions *durch* ('through') and *um* ('around'). Yet, other simplex spatial prepositions like *an* ('on') or *unter* ('under') occur with either a dative or accusative complement. Along with this case alternation on the complement, there comes a semantic alternation. These prepositions serve as place prepositions with a dative complement, while they serve as goal (path) prepositions with an accusative complement. From a case-perspective, the alternation is referred to as the **dative/accusative alternation**; from a semantic point of view, it is referred to as the **place/goal alternation**.

Let us first look at those prepositions that participate in this alternation. All of them are geometric prepositions, as discussed in Section 5.1.2. The geometric prepositions split into two groups. On the one hand, we can identify the **topological prepositions** *an*, *auf*, and *in*, which this thesis focuses on. On the other hand, we can identify the so-called **projective prepositions**. This term is due to the assumption that the semantics of these prepositions involve a projection onto an axis of a perceptually-anchored coordinate system. The projective prepositions in German are *hinter* ('behind'), *neben* ('next to'), *über* ('above'), *unter* ('under'), and *vor* ('in front of'). With regard to case, the projective prepositions, as well as the preposition *zwischen* ('between'), exhibit the same behavior as the topological prepositions in German, viz. they participate in the dative/accusative alternation. In this thesis, I do not discuss them any further.

At this point, a word on the preposition *über* is in order. On the one hand, *über* has the meaning 'above'. In this reading, it behaves as a projective preposition and thus participates

[143] Note at this point that I use the term 'assign' here in a rather pretheoretical sense, without a commitment to a certain theory of case.

in the dative/accusative alternation. In this sense, it is the counterpart of *unter* ('under'). On the other hand, *über* has the meaning 'over, across'. In this reading, it serves as a route preposition. In fact, when *über* means 'over, across', it behaves like *durch* ('through') and *um* ('around'), in that it co-occurs only with an accusative complement.

Let us consider the spatial usage of *nach* ('to'). As discussed in Section 5.4.2.2, it is a special goal preposition classified as a pseudo-geometric preposition – even though the term is misleading here, as there is no genuine geometric counterpart preposition *nach*. Zwarts (2005a, 2006) claims that, with the spatial reading, *nach* takes a dative complement. This, however, is an assumption rather than an empirical datum. In fact, one condition of *nach* is the absence of ϕ-features on the nominal complement. However, ϕ-features seem to be a precondition for case marking. That is, due to absence of an overt determiner, which typically expresses ϕ-features in German, the 'true' case of the complement of spatial (!) *nach* is never discernible. In contrast to Zwarts, I thus claim that the case-assigning properties of spatial *nach* are uncertain. Note at this point that temporal *nach* ('after') – which takes dative – must not be confused with spatial *nach*. Clearly, these two prepositions share only the phonological exponent; apart from that, they instantiate distinct structures.

Let us now reconsider the typology of spatial prepositions presented in Figure 35 (cf. Section 5.1.1), which is repeated here as Figure 46.

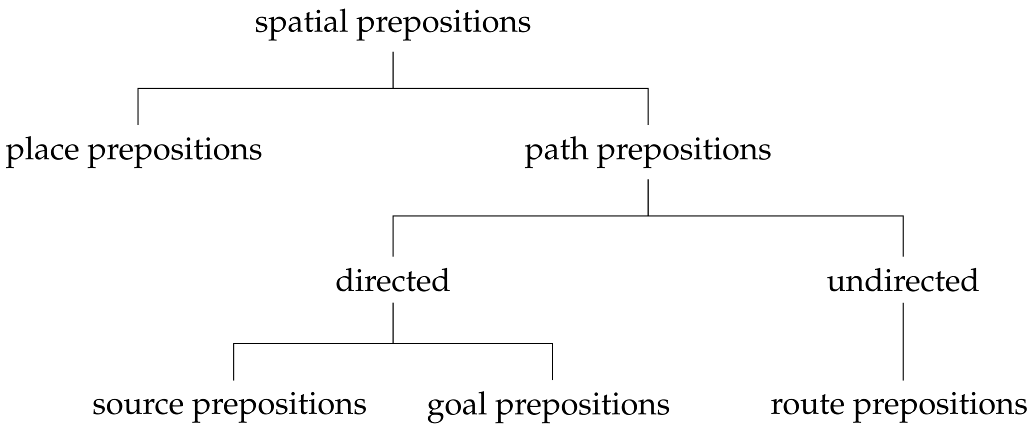


Figure 46: Typology of spatial prepositions (repeated from Figure 35)

Additionally, take into account the divide between non-geometric prepositions, on the one hand, and (pseudo)-geometric prepositions, on the other.[144] If we continue by mapping the prepositions listed in (498) to their case-assigning properties, we achieve Table 19. Note that we can, in German, ignore the projective prepositions, because they behave qua geometric prepositions like the topological prepositions with regard to case.

Ignoring genitive-assigning prepositions for the moment, we can make the generalizations in (499) concerning the German spatial prepositions listed in Table 19.

[144] Henceforth, I will use the term '(pseudo)-geometric' as a collective term for both geometric and pseudo-geometric.

<table>
<tr><th colspan="3"></th><th>with dative</th><th>with accusative</th></tr>
<tr><td colspan="2" rowspan="2">place</td><td>non-geometric</td><td>bei ('at')</td><td>–</td></tr>
<tr><td>(pseudo)-geometric</td><td>an ('on'),
auf ('upon'),
in ('in')</td><td>–</td></tr>
<tr><td rowspan="7">path</td><td rowspan="2">source</td><td>non-geometric</td><td>von ('from')</td><td>–</td></tr>
<tr><td>(pseudo)-geometric</td><td>aus ('out of')</td><td>–</td></tr>
<tr><td rowspan="3">goal</td><td>non-geometric</td><td>zu ('to')</td><td>–</td></tr>
<tr><td rowspan="2">(pseudo)-geometric</td><td>–</td><td>an ('onto'),
auf ('up onto'),
in ('into')</td></tr>
<tr><td colspan="2">nach ('to')</td></tr>
<tr><td rowspan="2">route</td><td>non-geometric</td><td>–</td><td>–</td></tr>
<tr><td>(pseudo)-geometric</td><td>–</td><td>durch ('through'),
über ('across, over'),
um ('around')</td></tr>
</table>

Table 19: Case assignment of spatial prepositions in German

(499) **Case generalizations concerning simplex spatial prepositions in German:**

a. When functioning as goal prepositions, (pseudo)-geometric prepositions take an accusative complement.
b. Route prepositions always take an accusative complement.
c. All other prepositions take a dative complement.

The morphological case theory proposed in this thesis accounts for these generalizations as follows. At PF, the lexical category P inherently assigns dative case features to a DP in its complement position. Accusative case is achieved by morphological deletion of oblique case features in two distinct contexts: (i) with the synsem feature bundle [LOC, +TO], i.e. the feature bundle that is characteristic of (pseudo)-geometric goal prepositions; and (ii) with the synsem feature [±NINF], i.e. the feature that is characteristic of route prepositions.

Let me close this section with a discussion concerning the role of genitive in the prepositional domain. We can observe that genitive case can occur in at least two distinct prepositional contexts.

First, genitive case can occur on the DP-complement of a preposition that apparently incorporates some nominal element. Typically, these prepositions are morphologically complex, like *innerhalb* ('inside, within') or *jenseits* ('beyond'). In fact, such prepositions often find a morphologically-related counterpart in the nominal domain, as depicted in (500), although there are semantic differences.[145] The preposition *innerhalb* seems to incorporate the head

[145] Typically, there is a semantic difference between a complex preposition and its nominal counterpart. Let me illustrate this with the PP *innerhalb des Gartens* ('within the garden') and the corresponding DP *die innere Hälfte des Gardens* ('the inner half of the garden'). In the PP-variant, the **entire space** is partitioned into two halves: (i) the interior of the garden and (ii) the exterior of the garden. That is, the PP refers to entire interior of the garden. In the DP, in contrast, the **space of the garden** is partitioned into two halves: (i) an inner half of the garden and (ii) an outer half of the garden. That is, the DP refers only to the inner half of the garden.

nominal *Hälfte* ('half') and the prenominal adjective *innere* ('inner'), while the preposition *jenseits* seems to incorporate the head nominal *Seite* ('side') and the determiner *jene* ('yonder').

(500) a. [$_P$ inner-halb] ~ [$_{DP}$ die innere Hälfte]
inner-half the inner half

b. [$_P$ jen-seits] ~ [$_{DP}$ jene Seite]
yonder-side yonder side

Ignoring the semantic differences between complex prepositions and their nominal counterparts mentioned in footnote 145, we can observe that the complex prepositions regularly pattern, regarding case assignment, with their nominal counterparts. In particular, they show a semantically-neutral case alternation between genitive and dative. They either directly take a DP complement marked with genitive case (501), which is like their nominal counterparts (502); or they involve the morpheme *von* ('of') and then take a DP complement marked with dative case (503), which is again like their nominal counterparts (504).

(501) a. inner-halb des Garten-s
inner-half the.GEN garden-GEN
'within the garden'

b. jen-seits des Wald-s
yonder-side the.GEN forest-GEN
'beyond the forest'

(502) a. die innere Hälfte des Garten-s
the inner half the.GEN garden-GEN
'the inner half of the garden'

b. jene Seite des Wald-s
that side the.GEN forest-GEN
'that side of the forest'

(503) a. inner-halb von dem Garten
inner-half of the.DAT garden
'within the garden'

b. jen-seits von dem Wald
yonder-side of the.DAT forest
'beyond the forest'

(504) a. die innere Hälfte von dem Garten
the inner half of the.DAT garden
'the inner half of the garden'

b. jene Seite von dem Wald
that side of the.DAT forest
'that side of the forest'

Due to this parallelism, I consider this type of genitive case assignment by these prepositions to be regular. In particular, I assume that what explains genitive and *von*-plus-dative in the nominal domain can also help to explain genitive and *von*-plus-dative in the domain of complex prepositions. Further examples of spatial prepositions that incorporate some nominal element and trigger either genitive or *von*-plus-dative are listed in (505).[146]

(505) **German spatial prepositions with genitive or *von* plus dative**:
abseits (von) ('beside'), *außerhalb (von)* ('outside of'), *diesseits (von)* ('on this side of'), *entlang (von)* ('along'), *fern (von)* ('far [away] from'), *gegenüber (von)* ('opposite'), *inmitten (von)* ('in the middle of, midst of'), *innerhalb (von)* ('within, inside'), *jenseits (von)* ('on the other side of, beyond'), *längs (von)* ('alongside, along'), *links (von)* ('to the left of'), *nahe (von)* ('near to'), *nördlich (von)* ('to the north of'), *oberhalb (von)* ('above'), *östlich (von)* ('to the east of'), *rechts (von)* ('to the right of'), *seitlich (von)* ('at the side of, beside'), *südlich (von)* ('to the south of'), *unterhalb (von)* ('below'), *unweit (von)* ('not far from'), *vis-à-vis (von)* ('vis-à-vis'), *westlich (von)* ('to the west of')

With regard to case assignment in the nominal domain, I refer the reader to Grosz (2008), who puts forth a proposal concerning the *von*-case marking of a nominal's arguments.

Second, genitive case can occur on the DP-complement of (normally non-spatial) prepositions that do not correspond to some nominal element. Interestingly, no such preposition is found in the spatial domain. Examples from other domains are *wegen* ('due to'), *trotz* ('despite'), *laut* ('according to'), or *während* ('during').

One crucial difference with the regular genitive distribution described above is that these prepositions disallow *von*-plus-dative. Instead, these prepositions can take a bare DP-complement with dative case, without any semantic shift. Consider the examples in (506) and (507).

(506) a. trotz des Sturm-s
despite the.GEN storm-GEN
'despite the storm'

b. trotz (*von) dem Sturm
despite of the.DAT storm
'despite the storm'

(507) a. während des Konzert-s
during the.GEN concert-GEN
'during the concert'

b. während (*von) dem Konzert
during of the.DAT concert
'during the concert'

I assume that genitive case assignment by these prepositions is best understood as being idiosyncratic. In Section 6.4.3, I will briefly sketch how the morphological case theory proposed here would tackle idiosyncratic genitive case assignment by prepositions.

[146] Note that some of these prepositions are in fact simplex, like *fern (von)* ('far [away] from'). Nevertheless, all involve a nominal (and/or adjectival) element, which is why I assume that their structure is more complex than the one of 'simplex' prepositions, such as *in* ('in') or *durch* ('through').

6.2 Previous approaches to prepositional case

This section presents some previous approaches to the case-marking properties of simplex spatial prepositions in German. In particular, I will discuss three syntactic approaches and one lexical approach. However, as we will see in the course of the discussion, all four approaches suffer from theoretical stipulations or make wrong empirical predictions.

6.2.1 Den Dikken (2010): Structural case

Den Dikken (2010) takes the view that prepositional case assignment is structural. Following Koopman (2000, 2010), Den Dikken assumes a syntactic decomposition of spatial prepositions into an obligatory locative lexical category P_{loc} for place prepositions and an optional directional lexical category P_{dir}, above P_{loc}, for path prepositions. Additionally, each lexical category can project functional structure on top of it. Recall from Section 5.5 that in Den Dikken's approach P_{loc} may extend to $Asp^{[PLACE]}$, $Dx^{[PLACE]}$, and $C^{[PLACE]}$; and likewise P_{dir} may extend to $Asp^{[PATH]}$, $Dx^{[PATH]}$, and $C^{[PATH]}$. In Den Dikken's approach, structural case means that the functional, rather than the lexical categories, are involved in the assignment of case. In particular, Den Dikken (2010: 115) identifies the functional heads $Asp^{[PLACE]}$ and $Asp^{[PATH]}$ as being responsible for case assignment in the domain of spatial prepositions. He (2010: 114) formulates the case-assignment rule in (508), stating that $Asp^{[PLACE]}$ checks oblique case on the complement of P_{loc}; here, oblique case is dative case (cf. his footnote 40). Furthermore, he claims that $Asp^{[PATH]}$ checks accusative case. Den Dikken follows common approaches to case assignment in assuming that, once assigned, a particular case value cannot be overwritten. This means that once dative is assigned/checked by the downstairs $Asp^{[PLACE]}$, the accusative feature of the upstairs $Asp^{[PATH]}$ ceases.

(508) The DP complement of P_{loc} checks oblique case iff $Asp^{[PLACE]}$ is present in the structure.

(Den Dikken 2010: 114)

In order to account for the case-assignment properties of spatial prepositions in German, Den Dikken (2010) proposes the three structures given in (509).

(509) a. $[_{AspP}\ \underset{\text{<DAT>}}{Asp^{[PLACE]}}\ [_{PP}\ P_{loc}\ \ DP_{\text{<DAT/*ACC>}}\ ]]$

b. $[_{AspP}\ \underset{\text{<ACC>}}{Asp^{[PATH]}}\ [_{PP}\ P_{dir}\ [_{PP}\ P_{loc}\ \ DP_{\text{<ACC/*DAT>}}\ ]]]$

c. $[_{AspP}\ \underset{\text{<ACC>}}{Asp^{[PATH]}}\ [_{PP}\ P_{dir}\ [\ \ldots\ [_{AspP}\ \underset{\text{<DAT>}}{Asp^{[PLACE]}}\ [_{PP}\ P_{loc}\ \ DP_{\text{<DAT/*ACC>}}\ ]]]]]$

(cf. Den Dikken 2010: 114)

The structure in (509a) comprises the functional head P_{loc}, which takes a DP-complement and projects functional structure involving $Asp^{[PLACE]}$, which is assumed to comprise a dative feature. As a result, the DP complement receives dative case. The place prepositions with dative case, i.e. *an* ('on'), *auf* ('upon'), *bei* ('at'), *in* ('in'), etc., instantiate the structure in (509a). In the structure in (509b), the functional head P_{dir} takes a PP headed by P_{loc} as a complement. While P_{dir} projects functional structure involving $Asp^{[PATH]}$ with an accusative feature, P_{loc} does not project functional structure. Crucially, there is no $Asp^{[PATH]}$ with a dative feature in the structure. As a consequence, the DP-complement of P_{loc} receives accusative case from $Asp^{[PATH]}$. The path prepositions with accusative case, i.e. the goal prepositions *an* ('onto'), *auf* ('up onto'), *in* ('into'), etc., and the route prepositions *durch* ('trough') and *um* ('around'), are argued to instantiate the structure in (509b). In the structure in (509c), the functional head P_{dir} takes a fully-fledged locative PP as a complement. That is, the lower P_{loc} projects its own functional structure between P_{loc} and P_{dir}. Crucially, this functional structure involves $Asp^{[PLACE]}$, comprising a dative feature. Thus, the DP-complement of P_{loc} receives dative. The path prepositions with dative, i.e. the source prepositions *aus* ('out of') and *von* ('from'), as well as the goal prepositions *nach* ('to') and *zu* ('to'), are argued to instantiate the structure (509c).

Considering the mere structures in (509), it is not clear why prepositions distribute over the structures the way they are said to do. Relating the dative on the embedded DP to the presence of the functional head $Asp^{[PLACE]}$ in the structure means that the derivation of an alternating preposition involves $Asp^{[PLACE]}$ in the place version, while the derivation of an alternating preposition may not involve $Asp^{[PLACE]}$ in the goal version. In fact, Den Dikken models the place/goal alternation by assuming that a locative preposition, i.e. P_{loc} can either project its own functional structure (yielding a place preposition) or be embedded by a directional P_{dir} without projecting its own functional structure (yielding a goal preposition). However, in the case of source prepositions, P_{loc} is also embedded by P_{dir} but necessarily projects its own functional structure. Zwarts (2006) and Caha (2010) point out that it is not clear what motivates the absence of $Asp^{[PLACE]}$ in (509b) and its presence in (509c), independently from case assignment. It seems that there is no systematic difference that justifies the distribution of $Asp^{[PLACE]}$.

6.2.2 Caha (2010): Peeling off case

Caha (2010) proposes a peeling approach to the dative/accusative alternation in German (in his terminology: locative/directional alternation). First, building on Bayer et al. (2001), he proposes that nominal arguments come with a hierarchically-layered shell structure for case features on top of the DP-level. In particular, Caha assumes that accusative case corresponds to the functional layer F above DP, as given in (510a), and that dative case corresponds to the functional layer K above FP, as given in (510b). This means that accusative case is structurally 'contained' within dative case.[147]

(510) a. Accusative: [F [DP]]
b. Dative: [K [F [DP]]]
(cf. Caha 2010: 205)

Second, Caha assumes that, when a DP moves, it can strand its case layers. This leads to a change of one case into another. For place prepositions, which take a dative complement, Caha proposes the following derivation. The prepositional head P-loc takes KP as its complement (511a). The aspectual prepositional head Asp-loc takes P-locP as its complement and attracts KP from within P-locP to its specifier (511b). Finally, P-locP undergoes remnant movement to the specifier position of an XP, in order to derive the correct linear order (511c).

(511) a. [P-loc KP]
b. [KP [Asp-loc [P-loc ~~KP~~]]]
c. $[_{XP}$ [P-loc ~~KP~~] X [KP [Asp-loc ~~P-locP~~]]]
(cf. Caha 2010: 186, 208)

For goal prepositions with an accusative complement, Caha proposes that the functional head Path merges with the XP from (511c) and sub-extracts FP from within KP to its specifier, as given in (512a). In this way, the dative layer is peeled off, resulting in accusative case on the DP. Finally, XP undergoes remnant movement to the specifier position of a YP, in order to precede the DP, as illustrated in (512b).

(512) a. [FP [Path $[_{XP}$ [P-loc ~~KP~~] ... [[K ~~FP~~] Asp-loc ...]]]]
b. $[_{YP}$ $[_{XP}$ [P-loc ~~KP~~] ... [[K ~~FP~~] Asp-loc ...]] Y [FP [Path ~~XP~~]]]
(cf. Caha 2010: 187, 208)

In order to block accusative case with the source path preposition *aus* ('out of'), Caha assumes that *aus* lexicalizes Path and that the Doubly Filled Nothing principle (Starke 2004), which states that no projection can have both its head-terminal and its specifier present at the same time, blocks the derivation of an accusative nominal. That is, the peeling of FP out of a downstairs KP into the specifier of Path cannot happen. Caha proposes that *durch* ('through'), which does not alternate but exclusively takes an accusative complement, can be accounted for by means of its lexical specification.

One general issue with Caha's case-peeling theory is his claim that case alternations are tied to movement. In other words, the theory predicts that if the case marking on an argument changes from, say, accusative to nominative, like with verbal passives, movement

[147] Note that this is, in principle, comparable to the feature decomposition of case that I discuss in Section 6.3.2. One crucial difference is, however, that I assume that structural case is determined post-syntactically, and thus has no repercussions in the narrow syntax.

of the argument must have taken place. This prediction, however, is wrong for German. It is a well-known fact, at least since Den Besten (1982), that, in German, passive subjects can remain in their VP-internal base-position (see also Haider 1993, 2010; Wurmbrand 2006 shows that the subject does not move covertly). The shift from accusative to nominative in these cases is thus unexpected under Caha's theory, being contingent on movement.

Even though they are implemented differently, the approaches by Den Dikken (2003) and Caha (2010) are akin to one another in that they both relate case (directly or indirectly) to functional heads in the extended projection of prepositions. Dative case is linked to a functional head above the locative preposition (i.e. Asp[PLACE] in Den Dikken's system and Asp-loc in Caha's system) and accusative case is linked to a functional head in the directional domain (i.e. Asp[PATH] in Den Dikken's system and Path in Caha's system).

6.2.3 Arsenijević and Gehrke (2009): External accusative

Arsenijević and Gehrke (2009) propose another syntactic account to the case distribution in the domain of spatial prepositions. Leaving prepositions that assign only one case aside, Arsenijević and Gehrke discuss only those prepositions that appear with two different cases, accompanied by a semantic shift. In particular, they focus on place/goal alternation (in Serbo-Croatian and German), where the goal variant of a preposition surfaces with accusative case, while its place variant surfaces with some other (oblique) case, i.e. instrumental case or locative case in Serbo-Croatian and dative case in German. Arsenijević and Gehrke claim that the case shift to accusative with goal prepositions is not due to preposition-internal structure, as claimed by Den Dikken 2010 or Caha 2010, for instance. Instead, they (2009: 2) argue that "accusative case results from the embedding of the PP in the overall context, and thus that it is part of the PP-external syntax." In fact, they claim that the verbal case domain can extend to a PP under certain conditions. In particular, they suggest that if a PP is in the complement position of a verb, the case domain of the verb is extended and accusative case – if available in the verbal domain for the direct object – is then also available in the PP. This approach seems to run into serious problems in cases where accusative case is not available contextually. Examples of such contexts are passives, as illustrated in (513a); unaccusatives, as illustrated in (513b); or nominal constructions, as illustrated in (513c).

(513) a. Der Schatz wurde in den / *dem Wald gebracht.
the treasure was in the.ACC / the.DAT woods brought
'The treasure was brought into the woods.'

b. Trümmerteile fielen in den / *dem Wald.
debris fell in the.ACC / the.DAT woods
'Debris fell into the woods.'

c. der Weg in den / *dem Wald
the way in the.ACC / the.DAT woods
'the path into the woods'

In these contexts, accusative case is not available in the verbal domain – if present at all – and thus it is not clear where accusative case in the PP should come from. If dative case is the default prepositional case applied in the absence of accusative case, these cases are expected to surface with dative case on the DP, contrary to fact.

6.2.4 Bierwisch (1988): Case from the lexicon

In contrast to the syntactic approaches proposed by Den Dikken (2010), Caha (2010), Arsenijević and Gehrke (2009), the lexicalist approach by Bierwisch (1988) makes the right predictions with respect to prepositional case assignment and it does not face the issues that the syntactic approaches do. Bierwisch accounts for the case assignment properties of prepositions by means of lexical rules. Consider the lexical entries for the prepositions *in* ('in, into') and *an* ('on, onto') in (514), which both participate in the dative/accusative alternation. The entries consist of a surface form, a set of morphosyntactic features in square brackets, and a semantic form part with two variables that are linked into syntax.[148] Ignoring the body of the semantic part for the moment, we can see that the case feature [±OBL], which corresponds to dative case, is tied to the internal argument, i.e. the complement of the preposition. Its value is inversely connected to the value of the morphosyntactic directionality feature [±DIR], via the variable α that ranges over the values '+' and '−'. If the morphosyntactic feature for direction has a positive value [+DIR], the oblique case feature has a negative value [−OBL]. As a result, the internal argument will surface with accusative case. If the directional feature is specified as negative [−DIR], this leads to a positive oblique case feature [+OBL] and thus to dative case. In addition, the variable α conditions the occurrence of the function FIN in the body of the semantic form. If α is positive, FIN contributes the directional (goal) semantics, while, if α is negative, FIN is absent, leading to stationary semantics.

(514) a. /in/, [−V, −N, αDIR], $\lambda y_{[-\alpha\text{OBL}]}\, \lambda x$ [($_\alpha$FIN) [LOC x] $\subset$ LOC y]
b. /an/, [−V, −N, αDIR], $\lambda y_{[-\alpha\text{OBL}]}\, \lambda x$ [($_\alpha$FIN) [LOC x] AT LOC y]
(cf. Bierwisch 1988: 37)

For path prepositions like *aus* ('out of') that are exclusively directional and that only take a dative complement, Bierwisch provides a lexical entry, like that in (515). Here, both the morphosyntactic directional feature [+DIR] and the oblique case feature [+OBL] are specified positively in the lexicon. Note that this specification is in a way hard-wired in the lexicon. In the semantic form, the function INIT provides directional (source) semantics.

(515) /aus/, [−V, −N, +DIR], $\lambda y_{[+\text{OBL}]}\, \lambda x$ [($_\alpha$INIT) [LOC x] $\subset$ LOC y]
(cf. Bierwisch 1988: 35)

[148] Note that Bierwisch assumes a decomposition of the category feature P as [−V, −N].

Even though Bierwisch does not provide a lexical entry for route prepositions like *durch* ('through'), we can assume that a corresponding lexical entry should look as sketched in (516). Route prepositions are exclusively directional and exclusively take a complement with accusative case. Ignoring the body of the semantic form, we can expect that the value of the morphosyntactic directional feature is positive [+DIR], while the oblique case feature on the internal argument must be negative [−OBL], in order to account for accusative case.

(516) /durch/, [−V,−N,+DIR], $\lambda y_{[-\text{OBL}]}\ \lambda x$ [...]

With respect to case assignment, the approach by Bierwisch seems to be superior to the syntactic approaches presented above. However, it is conceptually unappealing to assume that structural verbal case is calculated in the syntax or in the morphology, and that prepositional case is determined (more or less arbitrarily) in another grammatical module, namely the lexicon. Furthermore, word-syntactic frameworks, such as Distributed Morphology (Halle and Marantz 1993), typically reject a separate lexical module preceding the syntactic computation. Such frameworks cannot straightforwardly incorporate Bierwisch's account; they essentially require a (post)-syntactic approach to case.

6.3 Morphological case

This section motivates and outlines the hypothesis that case is not a phenomenon that has repercussions in the syntax proper. Instead, it is argued that case is a morphological phenomenon that builds on syntax. Furthermore, this section elaborates a decompositional view on case to the effect that cases are the morphological realization of composite abstract morphological features.

6.3.1 Abstract Case vs. morphological case

Traditional approaches in generative grammar allocate grammatical case to syntax.[149] In particular, case is considered to be related to nominal licensing via abstract Case. Pesetsky and Torrego (2011) adduce data from Latin, illustrating that the complements of verbs (517) and prepositions (518), but not of nouns (519) and adjectives (520), can show accusative morphology. Instead, the complements of nouns and adjectives show other kinds of case morphology (genitive/ablative) or are prepositional phrases (cf. *in* 'into', *a* 'from').

(517) [$_{\text{VP}}$ scripsit libr-*um*]
wrote book-ACC

(518) [$_{\text{PP}}$ ad Hispani-*am*]
to Spain-ACC

[149] Note that most of the discussion in this section is based on the introductory handbook article on case by Pesetsky and Torrego (2011).

(519) a. [$_{NP}$ amor libertat-*is*]
love liberty-GEN
'love of liberty'

b. *[$_{NP}$ amor libertat-*em*]
love liberty-ACC

c. [$_{NP}$ amor [$_{PP}$ in patriam]]
love into country
'love for one's country'

(520) a. urbs [$_{AP}$ nuda praesidi-*o*]
city naked defense-ABL
'a city deprived of defense'

b. *urbs [$_{AP}$ nuda praesidi-*um*]
city naked defense-ACC

c. [$_{AP}$ liberi [$_{PP}$ a delici-*is*]]
free from luxuries
'free from luxuries'

d. *[$_{AP}$ liberi delici-*as*]
free luxuries-ACC

(Pesetsky and Torrego 2011: 53–54)

These observations lead to the assumption that (accusative) case assignment in languages like Latin is subject to a grammatical rule which can be approximated as in (521).

(521) Accusative case in Latin-type languages

a. V and P assign accusative to an NP complement.

b. N and A do not assign accusative case (to an NP complement).

(Pesetsky and Torrego 2011: 54)

English, unlike Latin, does not have accusative case morphology. Nevertheless, the distribution of complement NPs in English resembles the distribution of accusative NPs in Latin. Nominal complements of verbs (522) and prepositions (523), but not of nouns (524) and adjectives (525), are grammatical.

(522) [$_{VP}$ wrote the book]

(523) [$_{PP}$ to Spain]

(524) a. [$_{NP}$ love of liberty]

b. *[$_{NP}$ love liberty]

c. [$_{NP}$ love [$_{PP}$ for their country]]

(525) a. [$_{AP}$ free from luxuries]

b. *[$_{AP}$ free luxuries]

(Pesetsky and Torrego 2011: 54)

Note that English is not completely free of case morphology. In the English pronominal system, some case morphology has survived. This can easily be seen if the nominal arguments without visible case morphology (526a) are replaced by personal pronouns (526b). The internal argument of the verb *attack* is marked with accusative case, while the external argument is marked with nominative.

(526) a. The butler attacked the robber.
b. He attacked him.

(Haegeman 1994: 155-156)

Relating nominal licensing to **abstract Case** (capitalized), it is assumed that English has a fully-fledged system of abstract Case like Latin or German. But while Latin or German have more or less rich systems of **morphological case** (not capitalized), English has a poor morphological case system – except for the personal pronouns. That is, abstract Case (capitalized) relating to nominal licensing is to be distinguished from morphological case (not capitalized) relating to morphological realization.

With respect to abstract Case, the distribution of nominal arguments in (517)–(520) and (522)–(525) can be captured with the so-called **Case Filter** (Vergnaud 1977, Chomsky 1981), as formalized in (527).

(527) **Case Filter:**
Every overt NP must be assigned abstract Case.

(Haegeman 1994: 167)

In English, verbs and prepositions assign abstract accusative Case to nominal complements which thus pass the Case Filter. Furthermore, it is assumed that English, unlike for instance Latin, lacks other abstract Cases like genitive, which is supposed to be assigned by nouns, or ablative, which is supposed to be assigned by adjectives. Hence, nominal complements of nouns and adjectives are not licensed by abstract Case, and therefore they do not pass the Case Filter. This explains the ungrammaticality of the respective examples.

The difference between English and Latin is (i) that Latin has a richer morphological case system than English and (ii) that Latin has a wider range of abstract Cases. With respect to (i), we can say that Latin has a complex inventory of morphological markers for cases, while English has no case morphology (528a) except for the pronominal system. With respect to (ii), it is assumed that English has only abstract accusative Case, while Latin has more abstract Cases (528b).

(528) Differences between English and Latin:
a. Case morphology in English is phonologically zero.

b. English has accusative case, but does not have genitive, dative, ablative, etc., as Latin does.

(Pesetsky and Torrego 2011: 55)

In this sense, the categories verbs, nouns, adjectives, and prepositions are split into two groups: verbs and prepositions assign accusative Case to their complements, while nouns and adjectives do not assign accusative Case to their complements (529).

(529) **Accusative Case assignment:**
α assigns accusative case to β only if:

a. α is V or P (not N or A); and
b. β is the complement of α.

(Pesetsky and Torrego 2011: 56)

This is, of course, not the whole story on accusative Case assignment. It is observed that a verb cannot assign accusative Case if it lacks an external argument. For instance, the verb *arrive* in (530) does not license an external argument, and also no accusative Case is assigned to its complement, viz. the internal argument.

(530) *It arrived a man.

This condition, which has become known as **Burzio's Generalization** (Burzio 1986), is given in (531). Note that Burzio's Generalization is a condition that explicitly relates accusative Case assignment and nominal licensing.

(531) **Burzio's Generalization:**
If a verb licenses accusative, it has an external argument.

(Pesetsky and Torrego 2011: 58)

Let us now look at the assignment of nominative Case. It is assumed that, at least in English, tensed inflection, i.e. a finite T head, assigns nominative Case to a nominal in its specifier position. Consider the data in (532).

(532) a. We were happy [that Mary won the prize].
b. *We were happy [∅ Mary to win the prize].
c. We would be happy [for Mary to win the prize].

(Pesetsky and Torrego 2011: 56)

The subject of the embedded clause (*Mary*) receives nominative Case in a finite clause (532a). It cannot not receive nominative Case in an infinite clause (532b). Thus it does not pass the Case Filter. For a subject of an infinite clause to be licit, it must be licensed, for example, by a PP as in (532c). This leads to the generalization in (533).

(533) **Nominative Case assignment:**
Finite T assigns nominative Case to its specifier.

(Pesetsky and Torrego 2011: 57)

The Case theory outlined so far not only explains nominal licensing facts, but it also accounts for displacement phenomena encountered in passives (534a),(534b) or unaccusatives (534c). In all these constructions, the verb is unable to assign accusative to the base position of the internal argument, which is indicated here by an underscore. In order to pass the Case Filter, the respective arguments move from their base positions to the specifier of finite T, where they can receive nominative Case. Similarly, non-finite T in (534d) cannot assign nominative to its subject, which thus moves (raises) to the specifier of finite T in the matrix clause.

(534) a. *The book* was put __ [$_{PP}$ under the desk].
b. *Mary* was persuaded __ [$_{CP}$ that we should leave tomorrow].
c. *The door* opened __ suddenly.
d. *Mary* seemed [__ to have written the letter].

(Pesetsky and Torrego 2011: 57)

The Case theory relates nominative Case to T, and accusative Case to V and P. But what about languages like Icelandic that show more case morphology than just accusative and nominative? Consider the Icelandic examples in (535) and (536), which are originally from Andrews (1982). In (535a), the complement of the verb is marked with dative and in (535b) it is marked with genitive.

(535) a. Ðeir luku kirkjunni.
they finished the-church.DAT
b. Við vitjuðum Olafs.
we visited Olaf.GEN

(Pesetsky and Torrego 2011: 61)

Likewise, the subjects of the passive clauses in (536a) and (536b) are marked with dative and genitive, respectively. Note that Zaenen et al. (1985) show that the nominal arguments marked with dative and genitive in (536) are true subjects.

(536) a. Kirkjunni var lokið (af Jóni).
the-church.DAT was finished
b. Olafs var vitjadh (af Jóni).
Olaf.GEN was visited

(Pesetsky and Torrego 2011: 61)

The question is now whether dative and genitive in (535) and (536) are the result of different abstract Cases in Icelandic (i.e. abstract dative Case and abstract genitive Case), or whether they show deviating morphology, obscuring underlying abstract accusative Case in (535) or underlying abstract nominative Case in (536).

It can be shown that, in Icelandic, the dative and genitive arguments discussed above are licensed by abstract accusative Case and abstract nominative Case, like in English, and that the deviating morphological case realizations are simply "paint" that obscures abstract accusative and nominative Case. Such morphological "paint" that is imposed by a verb on its argument(s) is called **quirky case** (Andrews 1982). The relevant piece of evidence for quirky case comes from (537b). While the dative subject in (537a) is licensed by finite T, i.e. abstract nominative Case that is covered with quirky dative case, the subject of the embedded infinitival clause in (537b) is not licensed, because there is no finite T. This shows that "quirky case morphology is not sufficient to license a nominal in a language like Icelandic" (Pesetsky and Torrego 2011: 61).

(537) a. Mér býður við setningafræði.
me.DAT is-nauseated at syntax

b. *Hún reyndist mér bjóða við setningafræði.
he tried me.DAT to-be-nauseated at syntax

(Pesetsky and Torrego 2011: 61–62)

In contrast, languages like Russian and Latin have more abstract Cases than just nominative and accusative. Consider the Russian examples in (538), where it is assumed that the verbs actually assign abstract dative Case (538a) and abstract instrumental Case (538b).

(538) a. Ivan pomog studentam.
Ivan helped students.DAT.PL

b. Maša upravljaet zavodom
Masha manage factory.INSTR.SG

(Pesetsky and Torrego 2011: 62)

If the verbs in these examples are passivized, the internal arguments do not move to the subject position to receive abstract nominative Case, because they are already licensed by an inherent Case assigned from the verb (Chomsky 1986). The derivations in (539) crash, because nominative Case assignment fails.[150]

(539) a. *Bylo pomoženo studentam.
was helped students.DAT.PL

b. *Bylo upravleno zavodom.
was managed factory.INSTR.SG

(Pesetsky and Torrego 2011: 62)

While nominative and accusative are considered to be **structural abstract Cases**, other abstract Cases such as dative or instrumental are considered to be **inherent abstract Cases**. This

[150] In (538), the EPP requirement, stating that every clause needs a subject, is violated.

terminology reflects the fact that the former are related to *structural* conditions. In particular, nominative relates to finite T, and accusative relates to verbs licensing an external argument. Inherent abstract Cases relate to conditions that are *inherent* to particular verbs or other lexical categories.

As mentioned above, there are subjects in Icelandic that bear case morphology other than nominative (e.g. Andrews 1976, Þráinsson 1979, Zaenen et al. 1985, Jónsson 1996, Bobaljik 2008). These subjects are, in fact, assumed to be licensed by abstract nominative Case. However, they surface with quirky case, i.e. morphological "paint", which is why they are referred to as quirky subjects. Consider (540), where the subjects bear quirky dative case.

(540) a. Jóni líkuðu þessir sokkar.
Jon.DAT like.PL these socks.NOM
'Jon likes these socks.'

b. Það líkuðu einhverjum þessir sokkar.
EXPL liked.PL someone.DAT these socks.NOM
'Someone liked these socks.'

(Jónsson 1996: 143, 153)

Zaenen et al. (1985) provide several diagnostics for subjecthood in Icelandic. In the following, I will briefly present three of them. The first subject diagnostic relates to raising. In Icelandic, only subjects can raise. Consider the verb *sakna* ('miss') in (541a) taking a nominative and a genitive argument. In (541b), the embedded subject (*Guðrún*) moves to the object position of the matrix clause, where it receives accusative. The occurrence of the adverbial *í barnaskam mínum* ('in my foolishness'), as being between the matrix object and the embedded clause, corroborates the assumption that displacement took place (Þráinsson 1979: 389–393). The nominative argument and the genitive argument of the verb *sakna* can also permute, as illustrated in (541c). Nevertheless, the embedded object (*Harald*) cannot raise to the matrix object position with either case marking configuration, as illustrated in (541d).

(541) a. Guðrún saknar Haraldar.
Gudrun.NOM misses Harold.GEN

b. Ég taldi Guðrúnu í barnaskap mínum sakna Haraldar.
I believed Gudrun.ACC in foolishness my to-miss Harold.GEN

c. Haraldar saknar Guðrún.
Harold.GEN misses Gudrun.NOM

d. *Ég taldi { Haraldar, Harald } sakna { Guðrún, Gudrúnu }
I believed { Harold.GEN, Harold.ACC } to-miss { Gurdun.NOM, Gudrun.ACC }

(Zaenen et al. 1985: 448)

However, the quirky dative argument of the embedded verb *hjálpa* ('help') raises to the matrix clause, indicating its subjecthood.

(542) Ég tel þeim hafa verið hjálpað í prófinu.
I believe them.DAT to-have been helped in the-exam
(Zaenen et al. 1985: 455)

The second diagnostic for subjecthood relates to subject-verb inversion. If a constituent other than the subject is fronted to the sentence-initial position, then the subject appears immediately after the finite verb. The accusative object in (543a) is fronted to the sentence-initial position, and the verb occurs in the second position immediately followed by the subject. In contrast, (543b), where a prepositional adverbial is fronted, is ungrammatical. This is because the accusative object intervenes between the finite verb and the subject.

(543) a. Refinn skaut Ólafur með þessari byssu.
the-fox.ACC shot Olaf.NOM with this shotgun
b. *Með þessari byssu skaut refinn Ólafur
with this shotgun shot the-fox.ACC Olaf.NOM
(Zaenen et al. 1985: 450)

Again, the quirky dative argument of the verb *hjálpað* in (544) occurs immediately after the finite verb, corroborating the assumption that it is, in fact, a subject.

(544) Í prófinu var honum víst hjálpað.
in the-exam was him.DAT apparently helped
(Zaenen et al. 1985: 456)

The third – and last subject diagnostic that I present here – relates to control constructions. Only subjects can be understood as anaphorically-controlled PROs in Icelandic. For example, in (545) the speaker hopes that they can go home.

(545) Ég vonast til að fara heim.
I hope for to go home
(Zaenen et al. 1985: 454)

The verb *vanta* ('lack') takes an accusative subject and an accusative object (546a). As shown in (546b), subjects with quirky accusative case can also be PRO subjects of infinitives.

(546) a. Mig vantar peninga.
me.ACC lacks money.ACC
b. Ég vonast til að vanta ekki peninga.
I hope for PRO.ACC to lack not money.ACC
(Zaenen et al. 1985: 454)

Again, the quirky dative argument of the verb *hjálpað* in (547) can be targeted by a control construction. This further suggests that the dative argument serves as a subject here.

(547) Ég vonast til að verða hjálpað.
I hope for PRO.DAT to be helped
(Zaenen et al. 1985: 457)

These quirky subjects pose a problem for abstract Case. In particular, the problem is that if subjecthood is a structural property associated with a particular syntactic position, i.e. the specifier of TP, quirky Icelandic subjects must also be assumed to move to this position. This, however, conflicts with a theory that motivates movement by means of the Case Filter, as outlined above.

Consider the examples in (548). In (548a), the double object verb *óska* ('wish') triggers quirky dative case and quirky genitive case on its objects. The object with quirky dative is optional. If the verb is passivized, and the argument with quirky dative is left out, as in (548b), the argument with quirky genitive serves as the subject. In fact, the argument is not licensed as an object by abstract Case. If, however, the argument with quirky dative is present in the passive, as in (548c), then the argument with quirky genitive is licensed as an object by abstract Case, even though no external argument is present (against Burzio's Generalization). So, the question is, how can it be that a passive verb can assign abstract Case to an argument in object position if only a dative argument – which is not an external argument – is present?

(548) a. María óskaði (Ólafi) alls goðs.
Mary.NOM wished Olaf.DAT everything.GEN good.GEN

b. Þess var óskað.
this.GEN was wished

c. Henni var óskað þess.
her.DAT was wished this.GEN
(Marantz 1991: 241)

The example in (548c) presents an instance of a nominal that receives quirky case even though it is not licensed by abstract Case. In (549), we encounter the opposite situation. Here, the external argument of the verb *þykja* ('think, find') is a quirky subject with dative case. Besides, the internal argument bears nominative case. As seen in (540), there are indeed nominative objects in Icelandic that also agree with the verb. "But if tensed inflection with agreement is the source of nominative case on the objects of dative subject verbs, we would expect the object to lose its nominative in an infinitive, because infinitive inflection does not assign nominative" (Marantz 1991: 241–242). However, and although there is no finite T in the embedded clause in (549), the object still bears nominative.

(549) Eg tel [henni hafa alltaf þótt Olafur leiðinlegur]
I believe her.DAT to-have always thought Olaf.NOM boring.NOM
'I believe she always thought Olaf to be boring.'
(Marantz 1991: 242)

Based on these data, Marantz (1991) suggests dissociating nominal licensing (i.e. the assignment of abstract Case) from case morphology. In fact, he claims that abstract Case does not exist at all. In this sense, case morphology never reflects nominal licensing. Instead, Marantz proposes that case is purely a phenomenon of the morphological component of the grammar, hence the name **morphological case theory**. In particular, Marantz claims that the calculation of case morphology for a given nominal is sensitive to the syntactic environment in which the nominal is embedded. A crucial difference between abstract Case theories and morphological case theories concerns the treatment of accusative case on direct objects. Particularly in morphological case theories, accusative case is not related to the licensing of an external argument. However, accusative case is considered to be the marked structural case available in a case domain if there is another argument in the same case domain receiving unmarked structural case, which is nominative case. Before Section 6.3.3 outlines the morphological case theory adopted in this thesis, Section 6.3.2 will present the decomposition of case into composite abstract morphological features.

6.3.2 Feature decomposition of case

In this thesis, I assume that case is the morphological realization of **composite abstract morphological features**. I do not assume that the morphological realizations of case (i.e. nominative, accusative, dative, and genitive in German) are primitives (as implemented for instance by Adger 2003), but I assume that these realizations are built on composite features (Hjelmslev 1935, Jakobson 1936, Bierwisch 1967, Halle 1997, Halle and Vaux 1997, Calabrese 1998, Blevins 2000, Wunderlich 2003, Müller 2004, McFadden 2004, Wiese 2004, Alexiadou and Müller 2008, Harley 2008, a.o.). To capture the four cases of German, I will adopt the trichotomy of abstract case features proposed by McFadden (2004, 2007, 2008). The three binary case features that I assume in this thesis are [±INF] for inferior, [±OBL] for oblique, and [±GEN] for genitive. The decompositional view on case imposes a specificity hierarchy on the morphological case realizations. Nominative is the least specified case, having no feature specification. Accusative is more specific, being [+INF]. Dative is more specific, being [+INF, +OBL]. Genitive is the most specific case in German, being [+INF, +OBL, +GEN]. Table 20 maps the three case features to the four German cases. Note that positive valuation of a case feature is an explicit condition for a certain case to apply. For accusative case, e.g., this means that it applies if and only if the inferior case feature [+INF] is positive and the other case features are not positive. In particular, these other features can be negative or absent. This is indicated by the parenthesized minus in Table 20.

Before discussing these case features individually, let me first present two arguments in favor of modeling case by means of composite features. The first argument for composite case features is that they allow one to generalize over case-assignment patterns, that is, over nominative/accusative-assignment and absolutive/ergative-assignment patterns. For example, we can state that both nominative and absolutive (the unmarked structural cases)

	nominative	accusative	dative	genitive
[±INF]	(−)	+	+	+
[±OBL]	(−)	(−)	+	+
[±GEN]	(−)	(−)	(−)	+

Table 20: Composite morphological case features

require no feature specification, while accusative and ergative (the marked structural cases) require the feature specification [+INF]. Both patterns then differ only with respect to the assignment algorithm for the feature [+INF]. In anticipation of the precise assignment algorithm of case features, we can assume that accusative is the result of assigning [+INF] to the structurally lower argument in a configuration with two structural arguments that do not already bear some case specification, while ergative is the result of assigning [+INF] to the structurally higher argument in a comparable structural configuration.[151]

The second argument in favor of composite case features is that a decomposition of case categories into abstract case features can account for syncretisms more economically. The following example from Alexiadou and Müller (2008) illustrates this. Modern Greek has three major cases:[152] nominative, accusative, and genitive, which Alexiadou and Müller (2008) model with the features [±GOV(erned)] and [±OBL(ique)].[153] Alexiadou and Müller consider nominative to be [−GOV, −OBL], accusative to be [+GOV, −OBL], and genitive to be [+GOV, +OBL]. Note that Alexiadou and Müller discuss a feature decomposition of inflection classes and that a thorough presentation of their analysis would make an illustrative example way too complex. This is why I ignore the inflection classes here and focus on the distribution of nominal suffixes for number and case within only one inflection class – namely, Alexiadou and Müller's inflection class II, which the noun *maxit(i)-* ('fighter') in (550) belongs to. The declension of *maxit(i)-* involves two syncretisms. First, the accusative and genitive forms in the singular are identical (both *maxiti*) and, second, the nominative and the accusative forms in the plural are identical (both *maxites*).

[151] The view that both accusative and ergative are the marked cases with a feature specification [+INF] is challenged by a phenomenon called split ergativity. In languages with split ergativity, such as Hindi (Mohanan 1994, Keine 2007), a situation may arise where ergative and accusative are not in complementary distribution, i.e. they can occur in the very same clause. This can easily be captured by assuming a further case feature reflecting the subjecthood property of arguments that are marked with ergative case, and of those that are marked with accusative case. While the former can serve as the subject, the latter normally cannot. The use of the feature [±SUBJ(ect)] (Wiese 2004, Alexiadou and Müller 2008) could then further sub-distinguish the marked structural (i.e. dependent) cases as ergative and accusative. Ergative would then be specified as [+INF, +SUBJ] and accusative as [+INF, −SUBJ].

[152] Vocative case is ignored here.

[153] Note that Alexiadou and Müller use a slightly different set of composite case features. Nevertheless, this difference is not crucial for the general motivation of feature decomposition of case. The feature [±GOV] is, although conceptually different, comparable to [±INF], and Alexiadou and Müller's feature [±OBL] is comparable to the feature [±GEN] used here.

(550) Declension of Greek *maxit(i)* ('fighter'):

	singular	**plural**
nominative	maxiti-s	maxit-es
accusative	maxiti-∅	maxit-es
genitive	maxiti-∅	maxit-on

(Alexiadou and Müller 2008: 17)

Using a non-decompositional feature system with privative case features, the suffixes for the declesion in (550) could be stated as (551). The six different entries could, of course, be reduced to four entries using disjunctive statements such as [ACC ∨ GEN]. Nevertheless, a privative feature system requires six different (disjunctive) specifications.

(551) Suffixes for Greek inflection class II with privative case features:

a. *-s* ↔ [NOM]
b. ∅ ↔ [ACC]
c. ∅ ↔ [GEN]
d. *-es* ↔ [NOM, +PL]
e. *-es* ↔ [ACC, +PL]
f. *-on* ↔ [GEN, +PL]

Using a decompositional case feature system, these facts can be stated more economically. Reconsider the declension of the Greek noun *maxit(i)*, which I repeat in (552), with the respective decompositional feature specifications.

(552)

	singular	**plural**
nominative	maxiti-s [−GOV,−OBL]	maxit-es [−GOV,−OBL,+PL]
accusative	maxiti-∅ [+GOV,−OBL]	maxit-es [+GOV,−OBL,+PL]
genitive	maxiti-∅ [+GOV,+OBL]	maxit-on [+GOV,+OBL,+PL]

Based on the feature distribution, the specifications of the Greek inflection class II suffixes can be stated as in (553).

(553) Suffixes for Greek inflection class II with decompositional case features

a. *-on* ↔ [+GOV, +OBL, +PL]
b. *-es* ↔ [−OBL, +PL]
c. *-s* ↔ [−GOV, −OBL]
d. ∅ ↔ [ ]

While the specifications for the suffixes *-on* and *-s* precisely match the respective case features, the suffix *-es* and the zero exponent ∅ are underspecified. The suffix *-es* requires only the feature specification [−OBL, +PL] for insertion. No specification for the feature [±GOV] is made, the distinctive feature for nominative case and accusative. Formulated in this underspecified way, the suffix *-es* is a suitable match for nominative and accusative plural. Likewise, the zero exponent is underspecified for both case and number features, which is why it is a suitable match for both accusative and genitive singular, in contrast to the nominative singular suffix *-s*, which is respectively specified.[154]

Let us now go back to the feature system assumed in this thesis and look at the case features [±INF], [±OBL], and [±GEN] in more detail. I adopt the view of McFadden (2004: 211–212) that the primary purpose of the feature [+INF] is to distinguish the marked from the unmarked structural case. While the unmarked structural case (i.e. nominative case in German) is [−INF] or underspecified with respect to this feature, the marked structural case (i.e. accusative case in German) is specified as [+INF]. The feature [±INF] is distributionally similar, though not equal, to the features [±GOVERNED] (Bierwisch 1967, Alexiadou and Müller 2008), [±SUPERIOR] (Halle 1997, Halle and Vaux 1997), or [±OBJ] (Wiese 2004). The difference, however, is that [±INF] can be defined in purely morphological terms without recurring to syntactic notions, such as government (McFadden 2004: 212). The feature [+OBL] is assigned to arguments by certain functional heads (McFadden 2004: 213). It is the characteristic feature for dative case. In fact, I argue in Section 6.4.1 that prepositions – the category P, to be precise – assign dative case features to a DP in their complement position. At a first glance, the use of the feature [±GEN] seems to be redundant, because one could formally model the four case categories in German by means of two binary features. Using the features [±INF] and [±OBL], we could account for nominative case with [−INF, −OBL], for accusative case with [+INF, −OBL], for dative case with [+INF, +OBL], and for genitive case with [−INF, −OBL]. However, this specification of genitive case seems to miss some empirical generalizations. Consider Bierwisch's (1967) arguments, among others, in favor of a distinct feature [±GEN]. One way in which genitive case is special is that it "is the only case for which there is predominantly an overt marking in the singular of non-feminine nouns" (Bierwisch 1967: 247). Consider the German noun *Lehrer* ('teacher'). While the nominative, accusative, and dative forms all equal the base form *Lehrer*, the genitive form is marked with special morphology, viz. *Lehrer-**s***. Besides, Bierwisch notes that genitive case behaves differently in the pronominal domain. While the nominative, accusative, and dative forms of the pronouns are usually monosyllabic in German, the genitive forms are polysyllabic. Consider the declension for the first person pronouns in German: *ich* (1.SG.NOM), *mich* (1.SG.ACC), *mir* (1.SG.DAT), *mein-er* (1.SG.GEN), *wir* (1.PL.NOM), *uns* (1.PL.ACC, 1.PL.DAT), and *un-ser* (1.PL.GEN). Bierwisch further points out that genitive can often be substituted by a PP. In fact, a PP headed by *von* ('of') often serves as genitive suppletion (cf. Section 6.1). A similar regular suppletion for other cases is not attested in German. Furthermore, genitive case is often

[154]Considering only this snippet of the Greek declension, one could of course specify the zero exponent ∅ as [+GOV] in order to account for accusative and genitive singular of inflection class II. However, in order to also account for other inflection classes, where the zero exponent is also found, it is necessary to specify it as in (553).

involved when one expresses possession. For instance, many languages derive possessive adjectives from genitive pronouns (Greenberg 1966: 100). Considering these arguments, I will follow McFadden (2004: 213–214) and assume that the feature [±GEN] is what distinguishes genitive from other cases.

6.3.3 Morphological case assignment

In morphological case theories, case features are typically assumed to figure only in the morphological component of the grammar. With regard to Distributed Morphology, case features are dissociated features, because they are assumed to be added to a DP under specified conditions at PF (Embick and Noyer 2007: 309); see Section 3.3. This section illustrates how such conditions at PF are specified.

An important distinction in (morphological) case theory in general is the one between structural cases and non-structural cases. Structural cases are typically sensitive to structural alternations, while non-structural cases are typically insensitive to structural alternations. One of the most common case alternations is the alternation between active and passive voice in the verbal domain. Consider the active clause in (554a), where the external argument bears nominative case, and the internal argument bears accusative case. If the verb is passivized, as in (554b), the external argument is demoted and the internal argument no longer bears accusative case. Instead, it now bears nominative case. That is, nominative case and accusative case are sensitive to the voice of the verb. They are thus considered to be structural cases.

(554) a. dass sie einen Mantel gekauft hat
that she.NOM a.ACC coat bought has
'that she bought a coat'

b. dass ein Mantel gekauft worden ist
that a.NOM coat bought become is
'that a coat was bought'

(McFadden 2004: 188)

Structural case is computed in argument-structural terms. As observed by Yip et al. (1987), Marantz (1991), Bittner and Hale (1996), McFadden (2004), a.o., there is a distinction between the structural cases. Usually, one of the structural cases is the **unmarked case**, because it behaves as the basic case. In fact, the unmarked case normally appears on the sole argument of verbs that only have one argument (intransitive verbs) or on one argument of verbs that have more than one argument (transitive or ditransitive verbs). This contrasts with the **marked case**, which normally shows up on one argument of verbs that have another argument already bearing the unmarked case. Following this line of reasoning, it is reasonable to see the marked structural case as that case that depends on (the presence of) the unmarked structural case. The fact that the marked case depends on the unmarked case is exactly what is the core of most morphological case theories; a reason why these theories are sometimes referred to as ‘dependent case theories’. In fact, the marked structural case is often referred to as the **dependent case** (Marantz 1991).

Generally, languages split in two groups: (i) accusative languages and (ii) ergative languages.[155] In accusative languages (e.g. English, Icelandic, Latin, German), nominative is the unmarked case and accusative is the marked case.[156] In ergative languages (e.g. Basque, Georgian, Tibetan), absolutive is the unmarked case and ergative is the marked case. The contrast between accusative languages and ergative languages is essentially the distribution of the respective structural cases over the structural arguments. In both accusative and ergative languages, the sole argument of intransitive verbs bears the respective unmarked case; i.e. nominative in accusative languages, and absolutive in ergative languages.[157] The patterns are the opposite for transitive verbs. In the accusative languages, on the one hand, the external argument bears the unmarked case (nominative), while the internal argument bears the marked case (accusative). In ergative languages, on the other hand, the external argument bears the marked case (ergative), while the internal argument bears the unmarked case (absolutive). Table 21 contrasts the nominative/accusative case-assignment pattern of accusative languages with the absolutive/ergative case-assignment pattern of ergative languages.

		accusative languages	**ergative languages**
intransitive verbs	**external arg.**	unmarked (NOM)	unmarked (ABS)
	internal arg.		
transitive verbs	**external arg.**	unmarked (NOM)	marked (ERG)
	internal arg.	marked (ACC)	unmarked (ABS)

Table 21: Accusative languages vs. ergative languages

Non-structural case is assigned to arguments in fixed structural positions. This contrasts with structural case, which is computed in argument-structural terms. Non-structural case is normally not sensitive to structural case alternations, such as the passive diathesis. Let us add a benefactive argument with dative case to the clause in (554). We see that the dative case marking does not change with respect to the voice of the verb. In both the active (555a) and the passive (555b) clause, the benefactive argument bears dative case. Dative qua non-structural case does not figure in the case alternation under passivization.

(555) a. dass sie ihm einen Mantel gekauft hat
that she.NOM him.DAT a.ACC coat bought has
‘that she bought him a coat’

[155]Let us ignore, for the moment, languages that show split-ergativity, i.e. languages with both ergative and accusative case-assignment properties.

[156]English does, in fact, have accusative case. However, this is visible only in the pronominal system. English does not have the morphological means to mark other nominal elements with accusative case.

[157]Intransitive verbs are defined as verbs with only one argument. Those with only an external argument are normally called unergative verbs. Examples from English are *laugh*, *dance*, or *run*. Intransitive verbs with only an internal argument are normally called unaccusative verbs. Typical English examples are *arrive*, *die*, or *come*. See Perlmutter (1978) for one of the first discussions of the unaccusative-unergative distinction.

b. dass ihm ein Mantel gekauft worden ist
that him.DAT a.NOM coat bought become is
'that a coat was bought for him'

(McFadden 2004: 188)

While structural case is assigned post-syntactically to DPs relative to the argument structure, non-structural case is assumed to be assigned to DPs in certain syntactic positions. For example, the benefactive argument bearing dative in (555) can be identified on independent grounds as being base-generated in the specifier position of an applicative phrase. We can thus assume that DPs in the specifier position of applicatives receive non-structural dative case.

Let us now look at two different types of non-structural case. Woolford (2006) argues for two types of non-structural case: (i) **lexical case** and (ii) **inherent case**.[158] Woolford addresses the observation that some instances of non-structural case are more or less regular and predictable on thematic grounds (inherent case), while other instances of non-structural case seem to be arbitrary (lexical case). In fact, she (2006: 126) characterizes the difference between lexical case and inherent case as follows. Lexical case is "lexically selected by particular verbs [and] licensed by V inside the VP proper [...]", while inherent case is a "relatively predictable non-structural [c]ase licensed by little/light v heads above the VP proper [...]." Furthermore, she (2006: 114) adduces the Icelandic data in (556) as instances of lexical case. In particular, the quirky case markings on the subject arguments, i.e. dative in (556a), accusative in (556b), and genitive in (556c), are assumed to be lexically conditioned by the respective verbs. One crucial property of lexical case is that it is not predictable on thematic grounds, i.e. there is no discernible syntactic or semantic reason why these arguments should be excluded from structural case assignment.

(556) a. Bátnum hvolfdi.
boat.DAT capsized
'The boat capsized.'

(Levin and Simpson 1981: (1b))

b. Bátinn rak á land.
boat.ACC drifted to shore
'The boat drifted to the shore.'

(Jónsson 2003: 156)

c. Jóns nýtur ekki lengur við
John.GEN enjoys not longer at
'John is no longer available.'

(Jónsson 2003: 130)

[158] Note that Woolford (2006) assumes abstract Case. Concerning this argument, this is not in opposition with the assumptions made here.

In German, only a few verbs trigger this kind of non-structural case marking. Looking at simplex verbs, we find verbs like *zeihen* ('accuse') as in (557a) or *harren* ('await') as in (557b) as instances of verbs that trigger lexical genitive on an internal argument.[159]

(557) a. Ich bin als Lutheraner aufgewachsen; rechtfertigt mich das, meine
I am as Lutheran grown up justifies me this my
katholischen und jüdischen Mitschüler, die Hindus und Buddhisten
Catholic and Jewish schoolmates the Hindus and Buddhists
Asiens, die Atheisten in Marxismus und Naturwissenschaft des
from Asia the atheists in Marxism and natural science the.GEN
Irrtums zu zeihen?
fallacy to accuse
'I grew up as Lutheran; does this justify me to accuse my Catholic and Jewish schoolmates, the Hindus and Buddhists from Asia, and the atheists in Marxism and natural sciences of fallacy?'

b. Wir alle harren deiner.
we all await you.GEN
'We all wait for you.'

In contrast, Woolford observes that instances of inherent case are, more or less, regularly predictable on thematic grounds. In particular, she argues that this type of case is inherently associated with θ-marking. Let's look at Icelandic again. Dative case in (558) is predictable in so far as benefactives in Icelandic often bear dative case. The picture is similar in German, where benefactives can also show up with dative, as already illustrated in (555).

(558) Þeir gáfu konunginum ambáttina.
they.NOM gave king-the.DAT slave-girl-the.ACC
'They gave the king the slave girl.'

(Maling 2002: 58, Woolford 2006: 112)

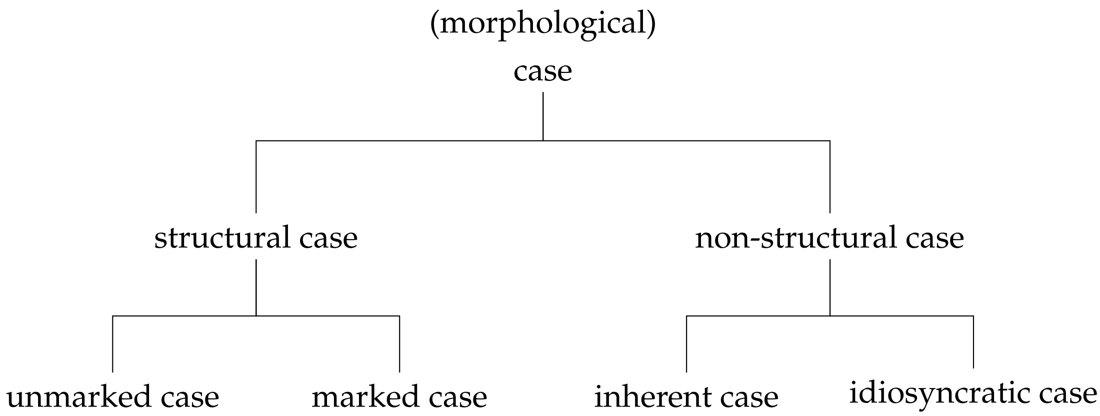
In contrast to Woolford (2006), I do not assume abstract Case in this thesis. Nevertheless, I distinguish between **inherent case** and **idiosyncratic case**, which comes close to Woolford's lexical case. I recast Woolford's typology of non-structural case in the following way. Both inherent and idiosyncratic case are assigned post-syntactically to DPs in certain syntactic positions. An example of inherent case is typically oblique case assignment to the specifier position of applicatives, viz. marking the applied object with dative case in German. While inherent assignment is independent of idiosyncratic contextual material, idiosyncratic case assignment additionally depends on idiosyncratic contextual material. In particular, I assume that the presence of certain Roots (i.e. certain Content features in certain Root positions) can trigger idiosyncratic case assignment. For instance, I assume that the Root $\sqrt{}$harr corresponds to the verb *harren* ('await'). The presence of this Root triggers genitive case on the DP-

[159] Both the example in (557a) and the example in (557b) are excerpts from Von Weizsäcker (1988: 254).

complement of the verb; cf. (557b). Note that this does not mean that the respective Roots assign case. It is only their presence that triggers idiosyncratic case assignment at PF.

Let's take stock. I distinguish structural case from non-structural case. The former is further subdivided into unmarked case and marked (or dependent) case, while the latter is further subdivided into inherent case and idiosyncratic case. Consider the classification in (559).

(559)



Let us now see how the case features for a given DP-argument are calculated within a given syntactic structure, and how they are then assigned to the respective DP-argument at PF, i.e. in the morphological component of the grammar. Marantz (1991) proposes that the assignment of morphological case proceeds along the Case Realization Disjunctive Hierarchy in (560), which orders the morphological case types according to their specificity.

(560) **Case Realization Disjunctive Hierarchy:**

a. lexically-governed case
b. dependent case (accusative and ergative)
c. unmarked case (environment-sensitive)
d. default case

(Marantz 1991: 247)

Lexically-governed case, i.e. non-structural case, precedes the two structural case types: dependent and unmarked case. The dependent (or marked) case, being the more specific one, precedes the unmarked case. Default case, which is supposed to be the least specific case, comes last; it is supposed to be the most general, domain-independent case that applies in contexts where other case cannot apply. Note that I will not discuss default case here any further; instead, I refer the reader to Schütze (2001). As I assume two types of non-structural case, I will refine the Case Realization Disjunctive Hierarchy in (561), such that idiosyncratic case, as the most specific case applying only in very specific contexts, precedes inherent case. Marked (or dependent) case, unmarked case, and default case follow in this order.

(561) **Case Realization Disjunctive Hierarchy (refined):**

a. idiosyncratic case
b. inherent case
c. marked case
d. unmarked case
e. default case

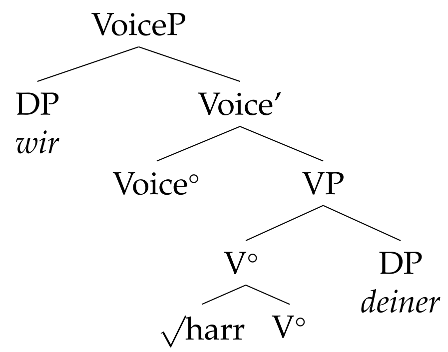
In what follows, I will illustrate the post-syntactic calculation and assignment of the morphological case types of the hierarchy in (561) in their respective order.

Let us first look at the post-syntactic assignment of idiosyncratic case. As mentioned above, idiosyncratic case is assigned to DPs in certain syntactic positions. Additionally, the assignment is conditioned by certain Content material in the respective syntactic head, i.e. in the Root position of the verb. Consider the sentence in (562) with the verb *harren* ('await'), which takes a genitive complement.

(562) Wir harrten deiner.
we awaited you.GEN
'We awaited you.'

For the sake of illustration, let us assume the simplified structure (563) to be underlying the clause (562). Note that it is also assumed that Roots (or Content features) are generally present at the point when case is calculated, i.e. at PF, which is after Spell-Out.

(563)



In order to account for idiosyncratic case assignment to the internal argument of verbs like *harren* ('await') or *zeihen* ('accuse'), we can formulate the post-syntactic, viz. morphological, case rule in (564), which lists the Roots conditioning idiosyncratic case.

(564) **Idiosyncratic case assignment:**
Assign [+INF,+OBL,+GEN] to a DP in the complement of V° that contains one of the following Roots: √harr, √zeih, ...

Admittedly, it is unattractive to list case assignment properties in this way. However, there are only a few Roots that condition idiosyncratic case assignment. Only a few morphologically simplex German verbs take an internal argument with genitive case. Examples are *freuen* ('rejoice over sth.'), *harren* ('await sb./sth.'), *schämen* ('be ashamed of sb./sth.'), *zeihen* ('accuse sb. of sth.'). Examples of morphologically complex verbs with a genitive argument are *bedienen* ('avail oneself of sth.'), *bezichtigen* ('accuse sb. of sth.'), *gedenken* ('commemorate'), *verdächtigen* ('suspect sb. of sth.').

Haider (2010: 261) argues that the few ditransitive verbs in German where the accusative argument precedes the dative argument in the base order are instances where dative is assigned idiosyncratically (i.e. lexically, in Woolford's system). This is unlike McFadden (2004) and Meinunger (2000), for instance, who argue in favor of some verb-internal prepositional structure with a phonologically zero preposition that inherently assigns dative. Examples of this type of ditransitive verbs are *aussetzen* ('expose'), *unterziehen* ('subject'), *zuführen* ('submit to'), and *entziehen* ('withdraw/extract from').

(565) Er setzte die Probe tiefen Temperaturen aus.
he put the.ACC sample low.DAT temperatures out
'He exposed the sample to low temperatures.'

(Haider 2010: 261)

For a thorough discussion of this type of verbs, I refer the reader to Cook (2006).[160] What is nevertheless interesting is that many verbs that presumably assign idiosyncratic case, may it be genitive or dative, are morphologically complex. Instead of simply assuming that these verbs condition idiosyncratic case, a fine-grained syntactic analysis, potentially involving some prepositional element as proposed by Meinunger (2000) and McFadden (2004), and taking their morphological complexity into account may shed light on the case-assigning properties of these verbs. However, I refrain from analyzing these verbs here.

[160] In fact, the verbs *zuführen* and *entziehen* occur with both the 'regular' dative-accusative base word order (566a) and the 'exceptional' accusative-dative (566b) base word order.

(566) a. Dann habe ich dem Wasser die Giftstoffe entzogen.
then have I the.DAT water the.ACC poisons stripped
'Then I stripped the water of poisonous substances.'

b. Es hat die Beschuldigte das Tier der öffentlichen Beobachtung entzogen.
it has the accused the.ACC animal the.DAT public view withdrawn
'The accused withdrew the animal from public view.'

(Cook 2006: 152, 154)

Assuming LFG's Lexical Mapping Theory (Bresnan 2001), Cook (2006) convincingly argues that this difference is related to a difference in conceptual structure. The verb *entziehen* in (566a) ('strip of') assigns the grammatical functions OBJ_θ and OBJ, which map to the semantic roles BENEFICIARY and THEME, respectively, while *entziehen* in (566b) ('withdraw') assigns the grammatical functions OBJ and OBL, which map to the semantic roles THEME and LOCATION, respectively. Assuming that grammatical functions are hierarchically ordered (i.e. OBJ_θ > OBJ > OBL) – reflected in the base word order – and that, in German, both OBJ_θ and OBL are marked with dative case, while OBJ receives structural case (i.e. accusative in the transitive frame), Cook (2006) correctly accounts for this difference.

Consider now the active and passive clauses in (567) involving the ditransitive verb *schenken* ('give'). I will illustrate the assignment of inherent case and the two types of structural case with this example.

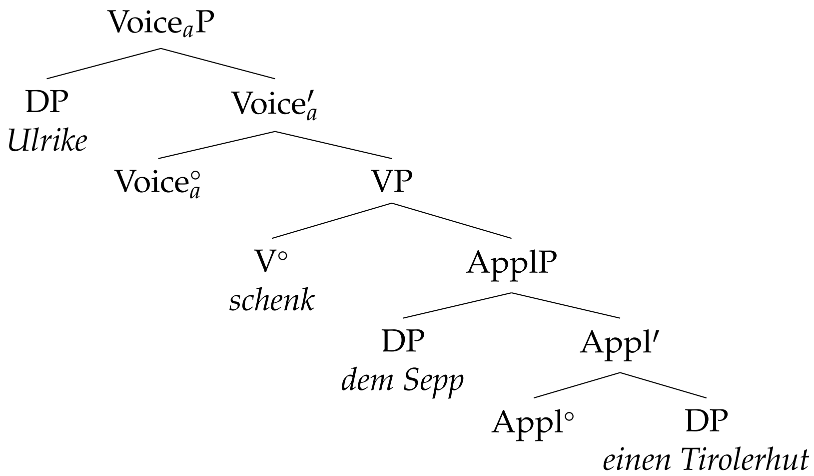
(567) a. Die Ulrike schenkte dem Sepp einen Tirolerhut
the.NOM Ulrike gave the.DAT Sepp a.ACC Tyrolean hat
'Ulrike gave Sepp a Tyrolean hat.'

b. Dem Sepp wurde ein Tirolerhut geschenkt
the.DAT Sepp became a.NOM Tyrolean hat given
'Sepp was given a Tyrolean hat.'

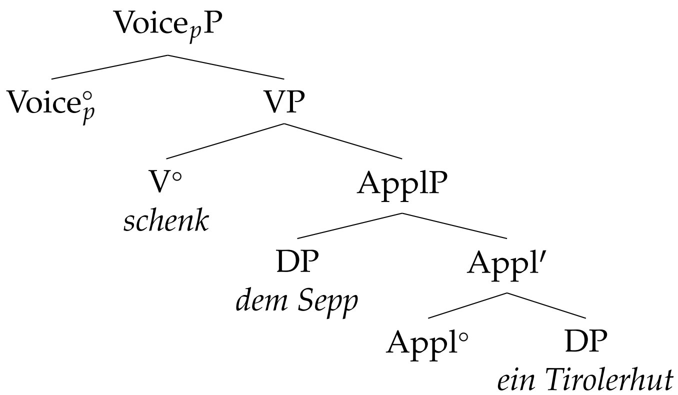
(McFadden 2004: 30)

The active clause in (567a) contains three nominal arguments: an external argument marked with nominative case, an internal argument marked with accusative, and an applied argument (benefactive) marked with dative. In the corresponding passive clause in (567b), the external argument is demoted. The applied argument is still marked with dative, but now the internal argument is marked with nominative, not accusative. Adopting Kratzer's (1996) Voice analysis and Pylkkänen's (2000, 2002) analysis of applicatives, we can assume the structures in (568) for the two clauses in (567).

(568) a.



b.



The structures are identical up to the level of VP. The verb embeds a low applicative construction (Pylkkänen 2000, 2002) that relates two arguments, an applied argument (benefactive) in the specifier position of the applicative and an internal argument in its complement position. The two clauses differ in their voice. Let us assume, for the sake of argument, that active and passive voice corresponds to two distinct voice heads, Voice°_a for active voice, and Voice°_p for passive voice. While the active voice head Voice°_a in (568a) projects a specifier position for an external argument, the passive voice head Voice°_p in (568b) does not project a specifier position (Kratzer 1996).

Let us first look at inherent case assignment, i.e. the dative case of the applied argument. It is typically assumed that inherent case is assigned to a DP in a certain syntactic position. Among others, McFadden (2004) and McIntyre (2009) propose that the specifier of an applicative is an inherent case position and receives dative case features in German. Assuming that dative case is construed by the case features [+INF, +OBL] (cf. Section 6.3.2), we can formulate the post-syntactic rule of inherent case assignment in (569).

(569) **Inherent case assignment:**
Assign [+INF, +OBL] to a DP in the specifier of Appl°.
(adapted from McFadden 2004: 225)

Let us now look at the assignment of the structural case, i.e. nominative and accusative in (567). Having provided the applied argument with dative case features, two arguments remain in the active structure in (568a), and one argument remains in the passive structure in (568b). In the active clause, the external argument and the internal argument are eligible for structural case. The former, which receives nominative case, is the structurally higher argument and the latter, which receives accusative case, is the structurally lower argument. Recall that accusative case is considered to be the marked structural case in contrast to nominative case, which is considered to be the unmarked structural case. That is, structural accusative depends on nominative case. In the passive clause, the internal argument is the single argument eligible for structural case. It thus receives unmarked nominative. Assuming that nominative case is specified by the absence (or negative valuation) of case features, and that accusative case is specified as [+INF], the case distribution on the structural arguments can be accounted for with the post-syntactic rules for structural case assignment in (570).

(570) **Structural case assignment:**
Assign [+INF] to a DP_i if and only if

a. there is a DP_j within the same phase, and
b. DP_j c-commands DP_i, and
c. DP_j does not bear a non-structural case.

(McFadden 2007: 9)

Let us finally take a brief look at how the case assignment algorithm described above would work for the absolutive/ergative assignment pattern.[161] Recall from the discussion

[161] Note that I am omitting a discussion on split ergativity.

above that, in ergative languages, external arguments of transitive verbs receive the marked structural case (ergative), while internal arguments of transitive verbs receive the unmarked structural case (absolutive). Consider the example from Yup'ik ('Western Eskimo') in (571).

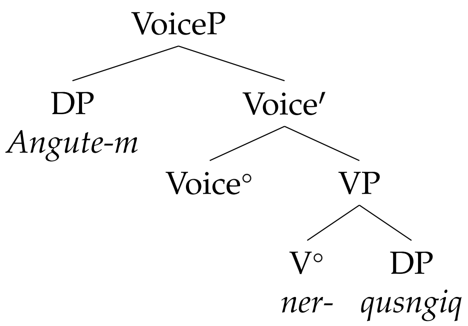
(571) a. Angute-m qusngiq ner-aa.
man-ERG reindeer.ABS eat-[+TRANS].3s
'The man is eating (the) reindeer.'

b. Qusngiq ner'-uq.
reindeer.ABS eat-[−TRANS].3s
'The reindeer is eating.'

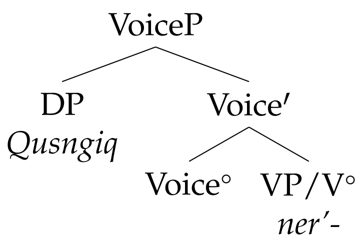
(Bobaljik 1993: 48)

In (571a), on the one hand, the external argument of the transitive verb *eat* surfaces with ergative case, while the internal argument surfaces with absolutive case. In (571b), on the other hand, verb *eat* is used intransitively, such that the internal argument is omitted. It only projects an external argument. Crucially, in the intransitive usage of the verb, the external argument surfaces with absolutive case, unlike in the transitive usage, where the external argument is marked with ergative case. For the sake of illustration, let us assume the structures in (572a) and (572b) for the clauses in (571a) and (571b), respectively. In both clauses, the external argument is projected in the specifier of VoiceP. The two structures differ in that the transitive verb in (572a) takes a complement, while the intransitive verb in (572b) does not.

(572) a.



b.



In both structures, all arguments are eligible for structural case. In particular, no argument is in a position where it receives non-structural case. By simply permuting the DP-indexes in the structural case assignment rule formulated in (570b) can account for the observation that the external argument receives ergative only if the internal argument is present (otherwise it receives absolutive). This has the effect that the higher of the two arguments receives [+INF], i.e. ergative as the marked structural case, only if the lower argument is present. Otherwise, it surfaces with absolutive as the unmarked structural case.

6.4 Morphological case assignment of prepositions

This section lays out a morphological case theory for simplex spatial prepositions in German. First, I will argue that the lexical category P triggers the inherent assignment of the dative case features [+INF, +OBL] to a DP in its complement position. Then, I will argue that those prepositions that assign accusative case are those that contain the synsem feature bundle [LOC, +TO], characteristic of (pseudo)-geometric goal prepositions, or the synsem feature [±NINF], characteristic of route prepositions. I propose that exactly those synsem features trigger the deletion of the oblique case feature [+OBL], resulting in accusative case assignment. Finally, I briefly look at German prepositions that assign genitive, and at how this approach might be extended to other languages.

6.4.1 Prepositions assign inherent dative

In this section, I will argue that dative case features are inherently assigned to DP-complements of prepositions in German. Generally, this is in line with those scholars who assume that dative is the 'default' case in the prepositional domain (Zwarts 2005a, Van Riemsdijk 2007, Abraham 2010). However, regarding morphological case theories, there is a terminological and also theoretical drawback in referring to dative case in the prepositional domain as a default case. In morphological case theories, the notion of *default case* is typically reserved for a morphological case that applies independently of categorial domains in contexts where no other morphological case is applicable (Schütze 2001). That is, default case is considered to be some kind of last-resort case if all other cases fail to apply. I do not assume, however, that dative is that kind of default case in the prepositional domain. In particular, dative is not a last-resort case in the prepositional domain (Caha 2010). Instead, I argue that dative is a non-structural case (as it is typically argued for when regarding the verbal domain) that is inherently assigned by prepositions to DPs in their complement position: very much like when applicatives inherently assign dative case to DPs in their specifier position. Nevertheless, let us first look at the argument in favor of dative as the 'default' case in PPs.

Van Riemsdijk (1983, 2007) argues that dative is the 'default' case in oblique domains in general, and thus also in the prepositional domain. Van Riemsdijk adduces data that contain a case mismatch within German PPs. Some prepositions such as *ohne* ('without') take an accusative complement, but dative appositives to nominals that are marked with accusative case by a preposition are acceptable (573a). This is unlike dative appositives to nominals, which are marked with structural accusative case by a verb (573b). This suggests (i) that dative case must be available inherently in the prepositional domain, and (ii) that the accusative assignment in the prepositional domain differs in a yet-to-be specified way from the accusative assignment in the verbal domain.

(573) a. Der König kam aber [PP *ohne Krone und Zepter*, ***den*** *wichtigsten Symbolen seiner Macht und Würde*].
the king came however without crown.ACC and scepter.ACC the.DAT most important symbols of his power and dignity
'But the king arrived without crown and scepter, the most important symbols of his power and dignity.'

b. Ich besuchte dann Herrn Müller, unseren / *unserem Vertreter in Pforzheim.
I visited then Mr.ACC Müller our.ACC our.DAT representative in Pforzheim
'I then visited Mr. Müller, our representative in Pforzheim.'

(Van Riemsdijk 2007: 278)

Interestingly, we can also find corpus evidence that dative case is available for appositives in PPs headed by prepositions that participate in the place/goal alternation and are used in their goal reading, i.e. with accusative case (574).

(574) Ägypten spielte mit dem Gedanken, einen Kanal vom Mittelmeer über 70 Kilometer bis [PP *in die Qattara-Depression*, ***einer*** [...] *riesigen Wüstenniederung*], zu sprengen.
Egypt played with the thought a canal from.the Mediterranean over 70 kilometers up in the.ACC Qattara Depression a.DAT giant desert depression to blast
'Egypt thought about blasting a canal over 70 kilometers from the Mediterranean up to the Qattara Depression, a giant desert depression [...].'

(Die Tageszeitung)[162]

Haider (2010) discusses similar data for prepositions that take an accusative complement, e.g. *für* ('for') in (575a) and (575b), or a genitive complement, e.g. *trotz* ('despite') in (576a). These prepositions allow an appositive nominal in their complement domain, which is marked with dative case even though the respective prepositions do not assign dative case. Crucially, in a context that is comparable to (575a), but where accusative case is not triggered by a preposition but structurally by a verb, dative case is illicit (575b). Likewise, if the genitive is not triggered by the preposition, but by DP-internal structure, an appositive surfaces with nominative rather than with dative (576b).

(575) a. [PP für eine Weltregierung, als das / **dem** Endziel]
for a.ACC world government as the.ACC / the.DAT ultimate goal

(Leirbukt 1978: 3)

[162] Part of a corpus containing articles from 01.07.1988 until 30.06.1994

b. [$_{PP}$ für Österreich, als den / **dem** schwächeren Partner]
for Austria.ACC as the.ACC / the.DAT weaker partner
(Leirbukt 1978: 4)

c. Österreich, als den / *dem schwächeren Partner unterstützen
Austria.ACC as the.ACC / the.DAT weaker partner support
'support Austria as the weaker partner'
(Haider 2010: 243)

(576) a. [$_{PP}$ trotz eines wenig begabten Mann-es als politisch-**em** Berater]
despite a.GEN little gifted man-GEN as political-DAT adviser
(Lawrenz 1993: 114)

b. die Charakterisierung dieses Mannes als ein gefährliches Subjekt
the characterization this.GEN man.GEN as a.NOM dangerous.NOM fellow
'the characterization of this man as a dangerous fellow'
(Haider 2010: 245)

Let me add further data corroborating the idea that dative is an inherent case in the prepositional domain. In German, there are prepositions that weaken their idiosyncratic case assignment without a semantic shift. Some prepositions that assign genitive case can also occur with a dative complement, but never with an accusative or nominative complement. For example, the preposition *wegen* ('due to') typically takes a genitive complement (577a). However, one can also find dative instead of genitive case, but never accusative or nominative case (577b).

(577) a. Der Zug fiel [$_{PP}$ wegen **eines** Sturm-s] aus.
the train fell due to a.GEN storm-GEN out
'The train was canceled due to a storm.'

b. Der Zug fiel [$_{PP}$ wegen **einem** / *einen / *ein Sturm] aus.
the train fell due to a.DAT a.ACC a.NOM storm out
'The train was canceled due to a storm.'

This semantically neutral alternation is not restricted to the preposition *wegen*, although *wegen* appears to the most frequent case. The alternation occurs also with other prepositions that typically assign idiosyncratic genitive case. Examples are *außer* ('except for'), *gemäß* ('according to'), *laut* ('according to'), *statt* ('instead of'), *trotz* ('despite'), and *während* ('during'). Interestingly, this alternation is not restricted to individual registers, styles, or historic stages of German; it can occur within one and the same PP. In fact, we can find PPs in the SDeWaC-Corpus (Faaß and Eckart 2013) that take a coordination of two DPs as their complement where one of the DPs has 'expected' genitive case, while the other DP has 'unexpected' dative case. Consider the examples in (578) involving the preposition *wegen*. The majority of examples of this kind are such that the DP with genitive case precedes the DP with dative case (578a)–(578c). However, the other order is also attested (578d). Furthermore, other prepositions, such as *trotz*, are also attested (579). Note also that in all examples below, accusative or nominative DPs – instead of the dative DPs within the PPs – would be unacceptable.

(578) a. Ich habe mir diese Memorycard [$_{PP}$ *wegen des Speicherplatz-es und*
I have me this memory card due to the.GEN memory space-GEN and
dem *günstigen Preis*] gekauft.
the.DAT cheap price bought
'I bought this memory card because of its memory space and its low price.'

(SDeWaC, Faaß and Eckart 2013)

b. Der russische Präsident Boris Jelzin hat am Mittwoch mit den vier
the Russian president Boris Yeltsin has on Wednesday with the four
Ministern konferiert, die [$_{PP}$ *wegen des Tschetschenienkrieg-s und*
ministers conferred who due to the.GEN Chechnya war-GEN and
dem *Geiseldrama in Budjonnowsk*] Zielscheiben vehementer Kritik in
the.DAT hostage crisis in Budyonnovsk target vehement critic in
der Staatsduma geworden sind.
the State Duma become are
'On Wednesday, the Russian president Boris Yeltsin conferred with the four ministers who became the target of vehement criticism in the State Duma, due to the war in Chechnya and the hostage crisis in Budyonnovsk.'

(German section of the European Language News Corpus)[163]

c. Die Mutter sorgte sich natürlich immer noch und wollte ihrem Sohn,
the mother worried REFL certainly always still and wanted her son,
wenn er endlich käme, bittere Vorwürfe [$_{PP}$ *wegen seines langen*
if he finally came bitter reproaches due to his.GEN long
Schweigen-s und ***seinem*** *herzlosen Leichtsinn*] machen.
silence-GEN and his.DAT cruel recklessness make
'Of course the mother still worried and she wanted to scold her son, if he finally came, for his long silence and his cruel recklessness.'

(Gutenberg Corpus)[164]

d. Im Alter bleibt man dann meist [$_{PP}$ *wegen* ***dem*** *Herz oder eines*
in.the age stay one then often due to the.DAT heart or a.GEN
Karzinom-s] auf der Strecke.
carcinoma-GEN upon the way
'When people get old, they often die of cardiac diseases or a carcinoma.'

(SDeWaC, Faaß and Eckart 2013)

(579) Der Nachteil des Bildes ist aber, [$_{PP}$ *trotz des guten Kontrast-es*
the disadvantage of the picture is but despite the.GEN good contrast-GEN
und ***dem*** *starken Farbumfang*], die Softheit des Bildes [...].
and the.DAT strong color gamut the softness of the picture
'However, the disadvantage of the picture is its softness, despite its good contrast and the wide color gamut, [...].'

(SDeWaC, Faaß and Eckart 2013)

[163] URL: `http://www.ldc.upenn.edu/Catalog/catalogEntry.jsp?catalogId=LDC95T11` (27.06.2017)
[164] URL: `http://www.gutenberg.org/` (27.06.2017)

Note that this mismatch between genitive and dative case in coordination structures is not attested for genitives that occur outside PPs, e.g. possessive genitives. Consider the example in (580), where the second DP cannot surface with dative case, but necessarily bears genitive case.

(580) die Autos der Lehrenden und der / *den Studierenden
the cars the.GEN teachers and the.GEN the.DAT students
'the cars of the teachers and of the students'

The data presented above indeed suggest that dative case is a kind of default case in the prepositional domain; that is, a last-resort case if – for whatever reason – the actual morphological case fails to apply. However, Caha (2010) adduces an argument that dative cannot be the prepositional default case in the sense of a last-resort case. Consider the two distinct usages of the temporal preposition *vor* ('before, ago') in (581).

(581) a. Die Dinosaurier sind **vor der Eiszeit** ausgestorben.
the dinosaurs are before the.DAT ice age died out
'The dinosaurs died out before the ice age.'

b. Thomas ist **vor einem Jahr** nach Cambridge gegangen.
Thomas is before a.DAT year to Cambridge went
'Thomas went to Cambridge a year ago.'

(Haspelmath 1997: 11)

In the **anterior reading** of *vor* ('before') in (581a), the PP denotes some point in time before the ice age. This reading is typically considered to be the transparent one. In the **distance-past reading** of *vor* ('ago') in (581b), *vor* seems to have a non-compositional meaning, because the PP denotes a point in time located exactly one year before the utterance time, viz. it measures a distance backwards in time.[165]

Caha (2010) proposes that the distance-past reading derives from the anterior reading. He analyzes the surface complement of *vor* in the distance-past reading as a measure phrase that measures the time backwards from some silent deictic element referring to the utterance time (UT). This silent element arguably serves as the underlying complement of the preposition, which has the advantage that a unified anterior reading for *vor* can be assumed. The underlying structure for the distance-past reading of *vor* (582) is sketched in (583). In particular, the measure phrase *ein Monat* ('a month') is arguably base-generated in some specifier position of the PP.

(582) vor einem Monat
before a.DAT month
'one month ago'

(Caha 2010: 191)

[165]Note that I adopt Haspelmath's (1997) terms 'anterior' and 'distance-past' without a commitment to his analysis.

(583) [a month [before = *vor* [UT]]]

(Caha 2010: 192)

Disregarding Caha's precise implementation concerning movement and word order, what is crucial here is the fact that measure phrases normally have access to accusative case, which is illustrated in (584). We can assume that (584), where *vor* exhibits the transparent anterior reading, has a comparable underlying structure to (583), with the only difference being that the overt DP *dem Konzert* ('the concert') occupies the complement position of the preposition, instead of the silent element UT.

(584) einen Monat vor dem Konzert
a.ACC month before the.DAT concert
'a month before the concert'

(Caha 2010: 193)

Considering the fact that measure phrases typically have access to accusative case, it is not clear why *vor* in the distance-past reading takes a dative complement. If dative was a last-resort default case in the prepositional domain, the complement DP of *vor* in the distance-past reading should not bear dative case because, qua measure phrase, it already has accusative case and does not need a last-resort case. In fact, dative case seems to 'overwrite' an underlying measure-phrase accusative case, which would not be expected if dative was a default case. Thus, Caha reasonably concludes that dative in the prepositional domain cannot be a default case in the sense of a last-resort case. Instead, he proposes that dative is assigned in the specifier position of some functional projection above the underlying prepositional structure to which the measure phrase raises (cf. 'raising to dative', Caha 2010: 190–194). Note that I refrain from analyzing *vor* any further in this thesis.

Let us take stock. Dative case is systematically available in the prepositional domain when other cases fail to apply. However, dative does not serve as a last-resort case. Hence, I propose that dative is an inherent case post-syntactically assigned, but not only to the specifier position of applicatives (McFadden 2004: 225), but also to the complement position of prepositions. In particular, I formulate the morphological rule for Prepositional Case Assignment (PCA) in (585).

(585) **Prepositional Case Assignment (PCA):**
Assign [+INF, +OBL] to a DP in the complement position of P°.

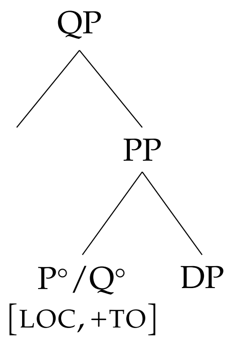
The morphological rule PCA alone predicts that all DP-complements of prepositions receive dative case features. Assuming the morphological rule in (585) that inherently assigns dative case features to a DP in the complement position of a preposition, we need a special explanation for those prepositions with an accusative complement, i.e. (pseudo)-geometric goal and route prepositions. Section 6.4.2 addresses these cases. In Section 6.4.3, I tentatively sketch an analysis for some prepositions that idiosyncratically take a genitive complement.

6.4.2 Impoverishment to accusative

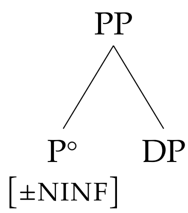
At the end of Section 6.4.1, I proposed the morphological rule for Prepositional Case Assignment (PCA), stating that the lexical category P assigns inherent dative case features to its complement, i.e. [+INF, +OBL]. Recall from Section 6.3.2 that I assume a decomposition of case features, such that accusative case is specified as inferior, i.e. [+INF], while dative case is specified as inferior and oblique, i.e. [+INF, +OBL]. That is, the difference between dative and accusative case relates to the presence of the oblique case feature [+OBL]. Informally speaking, we could also say that accusative case is 'contained' in dative case, which comes close to Caha's (2010) idea of case peeling.[166] So, why do some prepositions apparently assign only an inferior feature, instead of both an inferior feature and an oblique feature? The answer to this question is, I propose, that in fact **all** prepositions assign an inferior case feature **and** an oblique case feature to their complements (so, PCA always applies), but that certain synsem contexts can trigger an additional morphological rule to the effect that oblique case features are deleted. In particular, I propose a morphological Impoverishment rule (cf. Section 3.4.1) that deletes the oblique case feature [+OBL], yielding the change from dative to accusative.

Now, the question is: Under which conditions does such an Impoverishment rule apply? In Section 6.1, we identified (i) (pseudo)-geometric goal prepositions and (ii) route prepositions as those prepositions that take accusative complements, while all other simplex spatial prepositions take dative complements; cf. Table 19. The respective structures of (pseudo)-geometric goal prepositions and route prepositions are given in (586).[167]

(586) a. Structure of **(pseudo)-geometric goal prepositions**:



b. Structure of **route prepositions**:



[166] Note, however, that Caha (2010) assumes the a syntactic repercussion of case features to the effect that they form a syntactic shell structure around DP. Opposed to that, I assume that case features are purely morphological without any repercussion in syntax proper.

[167] (586a) is the structure at PF after Q-to-P-Lowering and subsequent P/Q-Fusion has taken place.

The synsem feature bundle [LOC, +TO], hosted by P/Q, is characteristic of (pseudo)-geometric goal prepositions, while the synsem feature [±NINF], hosted by P, is characteristic of route prepositions. The negatively-valued synsem feature [−TO] is characteristic of source prepositions, which all take dative complements. We can therefore assume that [−TO] is irrelevant for morphological case assignment. Note that we can further assume that the synsem feature [AT], which is characteristic of non-geometric spatial prepositions is also irrelevant for morphological case assignment, because all non-geometric prepositions (*bei* 'at', *zu* 'to', and *von* 'from') take a dative complement. As for route prepositions, we can identify the synsem feature [±NINF] as their characteristic context, irrespective of whether the feature is positive or negative.

Based on these considerations, I propose the **Prepositional Case Impoverishment (PCI)** rule in (587) that deletes the oblique case feature [+OBL] if the structure of a preposition contains the feature bundle [LOC, +TO], accounting for (pseudo)-geometric goal prepositions; or the feature [±NINF], accounting for route prepositions.

(587) **Prepositional Case Impoverishment (PCI):**
Delete [+OBL] in the local context of P/Q[LOC, +TO] or P[±NINF].

At this point, it is important to mention that PCA precedes PCI at PF. This is in line with the assumptions about the PF branch made in Chapter 3. In particular, I assume that PCA is an instance of dissociated feature assignment (cf. Section 3.3) that precedes operations on nodes, such as Impoverishment (cf. Section 3.4.1). In other words, PCA feeds PCI.

PCI predicts accusative case, not only for the (pseudo)-geometric goal prepositions *an* ('onto'), *auf* ('up onto'), and *in* ('into'); and for the route prepositions *durch* ('through'), *über* ('over, across'), and *um* ('around') – it predicts accusative case also for the spatial usage of *nach* ('to'). This is clearly in contradiction to Zwarts (2005a, 2006), who claims that spatial *nach* takes a dative complement. Note, however, that the morphological case of **spatial** *nach* is never discernible. Spatial *nach* is illicit in all contexts where morphological case would be visible, e.g. on a determiner, on an attributive adjective, or on a pronoun. Recall from the discussion in Section 5.4.2.2 that one condition for the insertion of *nach* is the absence of ϕ-features; cf. (411) on page 244. In fact, ϕ-features seem to be a precondition for the realization of case morphology. As soon as case morphology is visible in a respective context, another pseudo-geometric goal preposition (i.e. *an*, *auf*, or *in*) with accusative case is used.

(588) a. Hans reiste **nach** Italien.
Hans traveled to Italy

b. Hans reiste ***nach** / **in** das sonnige Italien.
Hans traveled to / into the.ACC sunny Italy

Note in this respect that the temporal usage of *nach* ('after'), which takes a dative complement, is different. Qua preposition, it involves the lexical category P, which correctly predicts dative case, due to PCA. Furthermore, it should be clear that temporal *nach* has a different structure than spatial *nach*. Crucially, it involves neither the synsem feature bundle [LOC, +TO], nor the synsem feature [±NINF], and its complements are thus not subject to PCI.

Note, however, that the synsem feature bundle [LOC, +TO] and the synsem feature [±NINF] are not necessarily the only contexts that may trigger PCI. In Section 5.1.3, I briefly discussed that the non-geometric goal and source prepositions *zu* ('to') and *from* ('from'), which are bounded, have unbounded counterparts, unlike the (pseudo)-geometric goal and source prepositions. In particular, I argued that the circumpositions *auf ... zu* ('towards') and *von ... weg* ('away from') are the unbounded non-geometric goal and source prepositions. The circumposition *auf ... zu* – which involves P/Q[AT, +TO] and Asp[+UNBD] – takes accusative complements (589a), while the circumposition *von ... weg* – which involves PQ[AT, −TO] and Asp[+UNBD] – takes dative complements (589b).

(589) a. Hans rannte **auf** die Hütte **zu**.
Hans ran upon the.ACC hut to
'Hans ran towards the hut.'

b. Hans rannte **von** der Hütte **weg**.
Hans ran from the.DAT away
'Hans ran away from the hut.'

In order to account for accusative in (589a), I propose that the context P/Q[AT, +TO] plus Asp[+UNBD] also triggers PCI. Note, however, that this feature context does not appear to be a systematic PCI context, but an idiosyncratic one.

Furthermore, it is interesting that many functional usages of the prepositions *an*, *auf*, and *in* selected by certain verbs also take accusative complements; consider (590).

(590) Hans glaubt an eine / *einer bessere Zukunft.
Hans believes on a.ACC a.DAT better future
'Hans believes in a better future.'

If one wants to assume that such PPs also involve a lexical category feature P triggering PCA, one would then argue that such functional contexts also trigger PCI.

Let me close this section with a remark on the data in (573a), (574), and (575a), which I adduced in favor of dative as the inherent prepositional case. These examples involve accusative PPs containing appositive DPs with dative case. The respective PPs are repeated here as (591), (592), and (593).

(591) **ohne** Krone und Zepter, den wichtigsten Symbolen seiner Macht
without crown.ACC and scepter.ACC the.DAT most important symbols of his power and dignity

(592) **in** die Qattara-Depression, einer [...] riesigen Wüstenniederung
in the.ACC Qattara Depression a.DAT giant desert depression

(593) **für** eine Weltregierung, als das / dem Endziel
for a.ACC world government as the.ACC the.DAT ultimate goal

Under the assumption that PCA is the general morphological rule that provides dative case features to complements of prepositions, it is clear, in this kind of data, where the underlying dative comes from. It is the lexical category P that triggers the assignment of an inferior and oblique case feature [+INF, +OBL] to its complement domain. Furthermore, we can assume that both the prepositions *ohne* ('without') and *für* ('for') contain respective (synsem or Content) features that also trigger PCI. Interestingly, the appositive DPs seem to be in a structural position that is not necessarily targeted by PCI, while the local context of the preposition is of course targeted by PCI. In this way, we can account for the fact that appositive DPs in non-dative PPs can surface with dative case. However, I will leave further exploration of this phenomenon for future research.

6.4.3 Outlook for other cases and other languages

In order to account for the idiosyncratic genitive case assignment of prepositions like *wegen* ('due to') and *trotz* ('despite') (cf. Section 6.1), we can formulate the **Idiosyncratic Prepositional Case Assignment (IPCA)** rule in (594). It idiosyncratically assigns the genitive case feature [+GEN] in addition to the inferior and oblique case features [+INF, +OBL], which are regularly assigned by the lexical category P. The IPCA is formulated in such a way that it applies only in certain exceptional contexts. In particular, the presence of certain Roots (or synsem features) triggers the application of IPCA.

(594) **Idiosyncratic Prepositional Case Assignment (IPCA):**
Assign [+INF, +OBL, +GEN] to a DP in the complement position of P° containing one of the following Roots: √wegen, √trotz, √während, ...

In order to account for the phenomenon that prepositions like *wegen* and *trotz* can alternatively take dative complements, instead of genitive complements, without a semantic difference, we can assume that the application of IPCA fades. As IPCA is an idiosyncratic rule, this is no surprise. Consider the PPs in (577), which are repeated here as (595).

(595) a. **wegen** eines Sturm-s
due to a.GEN storm-GEN

b. **wegen** einem Sturm
due to a.DAT storm

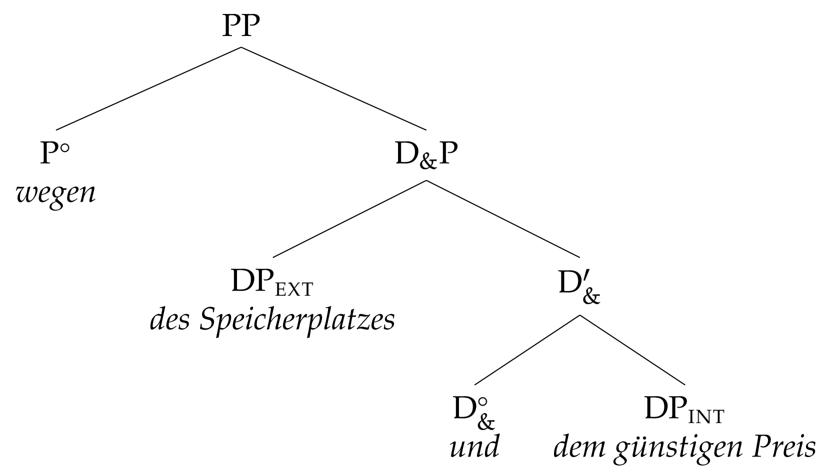
Consider also the PP in (578a), which is repeated here as (596). In PPs of this kind, we find two different case markings on the coordinated DPs: genitive case on the first DP, and dative case on the second DP. It seems that, in these examples IPCA, can only reach out to the closer DP.

(596)

wegen	des	Speicherplatz-es	und	dem	günstigen	Preis
due to	the.GEN	memory space-GEN	and	the.DAT	cheap	price

Adopting an asymmetric analysis of coordination à la Zhang (2010), i.e. where coordinated phrases are assumed to be in a specifier-complement relation, we could analyze the PP in (596) as given in (597). The non-application of IPCA on the second DP can then be understood as a locality effect. Only the so-called external conjunct in the specifier position of $D_{\&}P$ is local enough for IPCA. As for the so-called internal conjunct in the complement position of $D_{\&}P$, regular PCA applies.

(597)



Let me close this section with some cross-linguistic remarks about the morphological case theory for prepositions proposed in this thesis. The first remark concerns the PCA rule. Note that PCA is claimed to be part of PF, i.e. of the morphological component of the grammar. This component is language-specific and can vary from language to language. I do not claim that PCA holds universally. And even if rules comparable to PCA were attested for other languages, it may well be that other languages assign other inherent cases in the prepositional domain. Nevertheless, it seems to be plausible to assume that other Germanic languages with a case system comparable to German, e.g. Icelandic and Faroese, also have a PCA rule involving dative case. With regard to non-Germanic languages it seems to be plausible to assume that prepositions assign an oblique case inherently.

The second remark concerns the PCI rule. The place/goal alternation is attested not only for German (dative/accusative alternation), but also for other Indo-European languages, e.g. Ancient Greek (Smyth 1956), Classical Armenian (Schmitt 1981), Czech (Emonds 2007, Biskup 2009, Caha 2010, 2013), Icelandic (Pétursson 1992, Svenonius 2002), Latin (Hale and Buck 1903), Russian (Arsenijević and Gehrke 2009), and Serbo-Croatian (Arsenijević and Gehrke 2009). Table 22 lists cross-linguistic examples of spatial prepositions participating in the place/goal alternation. From a cross-linguistic perspective, it is interesting that the languages show a certain variety concerning the case co-occurring with place prepositions, but they show no variety concerning the case co-occurring with the respective goal path prepositions. On their goal-path reading, these prepositions always take accusative. That is, several oblique cases figure with place prepositions, while it is the marked structural case, not oblique, which figures with (derived) goal path prepositions. In fact, Caha (2010: 181) formulates the so-called **Law of the Locative-Directional Alternation** in (598).

(598) **The Law of the Locative-Directional Alternation:**
For alternating adpositions, locative interpretation is associated with an oblique case, directional interpretation with accusative.
(Caha 2010: 181)

If we generalized PCI to the extent that it targets all oblique cases and thereby impoverishes the case features to the effect that only the minimally-marked case feature expressing inferiority, i.e. [+INF], remains, then one could claim that this generalized PCI is a common morphological rule across Indo-European languages for marking the place/goal alternation in the prepositional domain.

language	**adposition**	**case with place reading**	**case with goal path reading**
Ancient Greek	*para* ('at')	dative	accusative
Classical Armenian	*i* ('in')	locative	accusative
Czech	*na* ('on') *pod* ('under')	locative instrumental	accusative accusative
Icelandic	*í* ('in')	dative	accusative
Latin	*in* ('in')	ablative	accusative
Russian	*v* ('in') *pod* ('under')	locative instrumental	accusative accusative
Serbo-Croatian	*u* ('in') *pod* ('under')	locative instrumental	accusative accusative

Table 22: Cross-linguistic examples of alternating adpositions (cf. Caha 2010: 181)

My third and last cross-linguistic remark concerns the variety of oblique cases seen in Table 22. Czech, Russian, and Serbo-Croatian, which generally have, qua Slavic languages, a relatively rich system of morphological case, show a further interesting systematicity. Topological place prepositions take complements with locative case, while projective place prepositions take complements with instrumental case. This seems to suggest that topological and projective prepositions involve different structures. This difference, which can be understood in terms of different synsem features, can be held accountable for the respective morphological case-assigning properties. With regard to Slavic prepositions, I refer the reader to Caha (2010, 2013), and leave an implementation in terms of morphological case for further research.

6.5 Summary

This chapter discussed prepositional case in German. I presented (i) the case assignment properties of (spatial) prepositions in German (Zwarts 2006); (ii) several previous approaches to prepositional case (Bierwisch 1988, Arsenijević and Gehrke 2009, Caha 2010, Den Dikken 2010); and (iii) a morphological case theory proposed for the verbal domain Marantz (1991), McFadden (2004). This paved the way for a proposal of a morphological case approach to spatial prepositions in German.

Section 6.1 presented the case assignment properties of spatial prepositions in German. It picked up the classification of spatial prepositions into (i) place prepositions and (ii) path prepositions; the latter subdivide into (ii.a) directed prepositions (goal and source prepositions) and (ii.b) undirected prepositions (route prepositions). This classification was combined with the one proposed in Section 5.1.2, namely that spatial prepositions can be (pseudo)-geometric prepositions or non-geometric prepositions. It turned out that (pseudo)-geometric goal prepositions and route prepositions co-occur with accusative case, while (pseudo)-geometric place and source prepositions and non-geometric prepositions co-occur with dative case. In addition, Section 6.1 briefly presented the German spatial prepositions that assign genitive case.

Section 6.2 presented four previous approaches to prepositional case: Section 6.2.1 presented Den Dikken's (2010) structural approach where prepositional case assignment is linked to functional heads in the extended projection of prepositions; Section 6.2.2 presented Caha's (2010) peeling approach where DPs are assumed to peel off their hierarchically structured case layers under movement; Section 6.2.3 presented Arsenijević and Gehrke's (2009) approach where it is argued that accusative case in spatial PPs stems from PP-external structure; and Section 6.2.4 presented Bierwisch's (1988) lexicalist approach where the case assignment properties of spatial prepositions are assigned to their lexical entries. Some drawbacks of the approaches were discussed, too.

Section 6.3 motivated and outlined the hypothesis that case is not a phenomenon of the syntax proper, but of the morphological component of the grammar. Section 6.3.1 discussed the notions of abstract Case and morphological case (Pesetsky and Torrego 2011). Abstract Case is linked to nominal licensing, while morphological case is linked to the morphophonological realization of case. Section 6.3.2 presented the feature decomposition of case. In particular, this section laid out the idea that the case categories nominative, accusative, dative, and genitive are not grammatical primes, but the result of composite case features: nominative case corresponds to the absence of case features, accusative case corresponds to the feature [+INF] (for inferior), dative case corresponds to the feature bundle [+INF, +OBL] (obl for oblique), and genitive case corresponds to the feature bundle [+INF, +OBL, +GEN] (gen for genitive); cf. Bierwisch (1967), McFadden (2004), a.o. Section 6.3.3 presented a commonly assumed classification of morphological case into (i) structural case and (ii) non-structural case; the former further subdivides into (i.a) unmarked case and (i.b) marked case, while the latter further subdivides into (ii.a) inherent case and (ii.b) idiosyncratic case. This section also spelled out the principles of structural and non-structural morphological case assignment proposed for the verbal domain (Marantz 1991, McFadden 2004, 2007).

Section 6.4 laid out a morphological case theory for simplex spatial prepositions in German. Using corpus data, a.o., I argued in Section 6.4.1 that the lexical category P triggers the inherent assignment of the dative case features [+INF, +OBL] to a DP in its complement position; see the morphological rule for Prepositional Case Assignment (PCA) in (585) on page 332. In Section 6.4.2, I argued that those prepositions that assign accusative case are those that contain the synsem feature bundle [LOC, +TO], characteristic of (pseudo)-geometric goal prepositions, or the synsem feature [±NINF], characteristic of route prepositions. I proposed that exactly those synsem features trigger the deletion of the oblique case feature [+OBL], resulting in accusative case assignment; see the rule of Prepositional Case Impoverishment (PCI) in (587) on page 334. In Section 6.4.3, I briefly looked at German prepositions that assign genitive, and at how this approach might be extended to other languages.

Appendix A.2 provides a synopsis of the morphological case approach to spatial prepositions in German proposed in this thesis.

Chapter 7

Conclusions and prospect for future work

Conclusions

In this thesis, I spelled out the syntax, semantics, and morphology of spatial prepositions in German. I did this by assuming the Y-model of grammar (Chomsky 1995, Marantz 1997, Bobaljik 2002, 2008, Embick and Noyer 2007, Embick and Marantz 2008, Harley 2012, 2014, a.o.), where Syntax is considered to be the only combinatorial engine (Marantz 1997, Bruening 2016). Syntactic structures on which no further syntactic operations are executed constitute Spell-Out. Syntactic structures at Spell-Out interface with the Articulatory-Perceptual (A-P) systems, on the one hand, and with the Conceptual-Intentional (C-I) systems, on the other. The interface representation of the A-P systems is Phonological Form (PF). The operations executed at PF constitute the Morphology. The interface representation of the C-I systems is Logical Form (LF). The operations executed at LF constitute the Semantics. The Y-model of grammar is depicted in Figure 47; cf. the beginning of Chapter 2 and in particular Figure 3 on page 12.

The structure of this thesis reflects the Y-model of grammar. Chapter 2 addressed the syntax, Chapter 3 addressed the morphology, and Chapter 4 addressed the semantics. Then, Chapter 5 spelled out German spatial prepositions with regard to syntax, semantics and morphology. Then, Chapter 6 laid out a morphological case approach to spatial prepositions in German. Let us briefly revisit these chapters individually.

Chapter 2 laid out the syntactic module within the Y-model of grammar. In this thesis, I adopted the tenets of the Minimalist Program (MP) (Chomsky 1995, Adger 2003).

Section 2.1 addressed the notion of 'feature'; features are considered to be the core building blocks of the grammatical theory adopted here. Section 2.1.1 presented the two types of feature systems that are relevant in this thesis: (i) privative features, where features are considered to be an attribute; and (ii) binary features, where features are considered to be pairs consisting of an attribute and a value drawn form a binary domain. Focusing on prepositions, Section 2.1.2 discussed category features. A general division into three types of

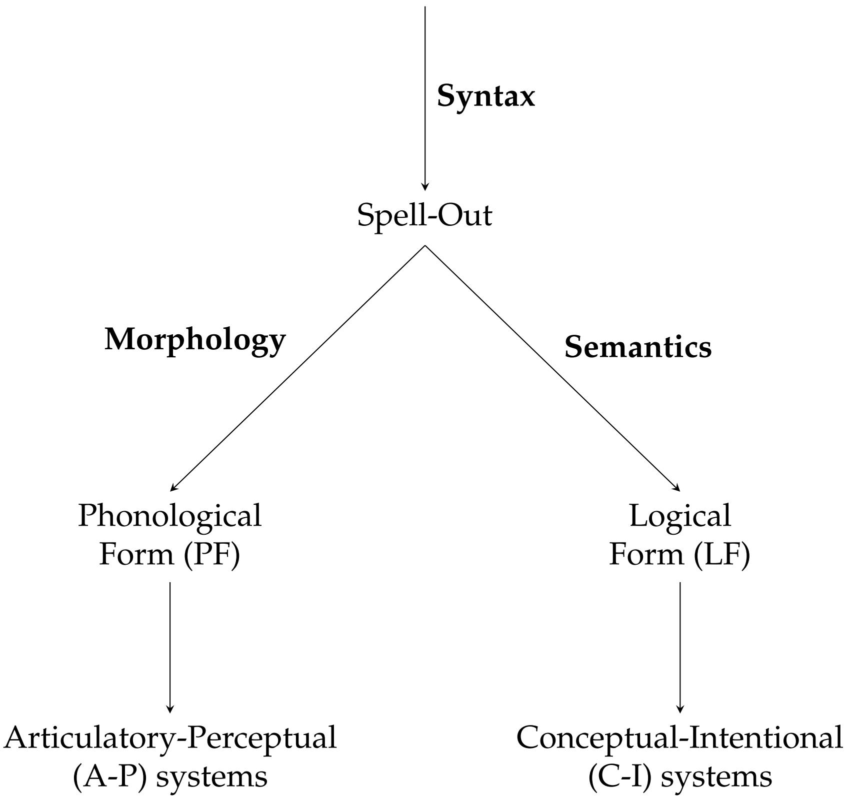


Figure 47: The Y-model of grammar

category features was made: (i) the lexical categories V (verb), N (noun), A (adjective), and P (preposition); (ii) the functional categories C (complementizer) > Dx (deixis) > Asp (aspect); and (iii) light categories such as verbal Voice (Kratzer 1996) or Appl (applicative) (Pylkkänen 2002, McIntyre 2006) and prepositional 'little *p*' (Split P Hypothesis) (Svenonius 2003). The functional categories dominate the lexical categories. Light categories are considered to be in between functional and lexical categories. The Parallelism Hypothesis states that the functional categories, which dominate the lexical categories, are structured in parallel across the lexical domains; cf. Den Dikken (2010: 100 104). Section 2.1.3 briefly addressed syntacticosemantic (synsem) features, i.e. those feature that are drawn from the universal inventory of syntacticosemantic features (Embick 2015: 6). In Section 2.1.4, I introduced Content features, which I consider to be language-specific, conceptually grounded, and non-generative. They can affect the semantic interpretation at LF and the morphological realization at PF. I identified two types of Content features: (i) idiosyncratic Content features, which relate to the arbitrary differences between two grammatical entities, with all else being equal (e.g. the difference between *cat* and *dog*); and (ii) abstract Content features, the function of which is at least two-fold. On the one hand, they can relate to general perceptually-grounded concepts like 'interiority' or 'verticality', while, on the other hand, they can bundle with idiosyncratic Content features and thereby give rise to particular aspects of meaning of the idiosyncratic Content features. This was illustrated with the toponym *Kuba* ('Cuba'), which can denote the island of Cuba or the state of Cuba. Depending on the abstract Content feature the idiosyncratic Content feature bundles with, either of these interpretations is promoted at LF.

Section 2.2 presented the principles according to which structure can be generated in the Minimalist Program (MP) (Chomsky 1995). MP applies Bare Phrase Structure (BPS) as its phrase structure module. Section 2.2.1 laid out the tree-structural relations and projection principles of BPS; Section 2.2.2, the major operations of BPS. Section 2.2.3 derived the notions complement, specifier, and adjunct. Then, that section also discussed the differences between BPS and X-bar Theory (XbT), which is the phrase structure module of Government and Binding (GB) (Chomsky 1981, Haegeman 1994, a.o.), MP's predecessor.

Section 2.3 clarified the status of Roots in the approach proposed here. Adopting the operation Primary Merge (De Belder and Van Craenenbroeck 2015), I defined a Root position as the position that is a sister and a daughter of a minimal projection; cf. (88) on page 56. Consequently, I defined a Root as what is inserted into a Root position; cf. (90) on page 56.

Section 2.4 summarized Chapter 2.

Chapter 3 explored the morphological branch of the Y-model of grammar, that is Phonological Form (PF). In this thesis, I adopted the tenets of Distributed Morphology (DM) (Halle and Marantz 1994, Embick 2015).

Section 3.1 presented the operation Vocabulary Insertion. In DM, morphophonological exponents are inserted late, i.e. after the syntactic derivation, into the terminal nodes of syntax, which are considered to be abstract morphemes. Vocabulary Insertion is controlled by the Subset Principle (Halle 1997: 128); according to the Subset Principle, the phonological exponent of a Vocabulary Item (VI) is inserted into a morpheme if the item matches all or a subset of the grammatical features specified in the terminal node. Insertion does not take place if the VI contains features that are not present in the morpheme. Where several VIs meet the conditions for insertion, the item matching the greatest number of features specified in the terminal node is chosen. Then, Section 3.2 discussed the Late Linearization Hypothesis according to which the elements of a phrase marker are linearized at Vocabulary Insertion (Embick and Noyer 2001: 562). In the Minimalist Program (MP), it is typically assumed that syntax does not commit to a inherent serialization of the terminal nodes (Chomsky 1995, Embick and Noyer 2001, 2007, Hornstein et al. 2005, Bobaljik 2015). At PF, the two-dimensional, hierarchical structure generated by syntax is flattened to a one-dimensional string by the morphological operation Lin (linearization) (Embick and Noyer 2007: 294).

Section 3.3 discussed two instances of ornamental morphology (Embick and Noyer 2007: 305): (i) dissociated nodes, i.e. nodes that are added to a structure under specified conditions at PF; and (ii) dissociated features, i.e. features that are added to a node under specified conditions at PF.

Section 3.4 presented morphological operations on nodes. Section 3.4.1 presented the operation Impoverishment, where certain features are deleted from a node under specified conditions (Bonet 1991, Embick 2015). Section 3.4.2 presented two morphological operations with which one can account for syntax/morphology mismatches: (i) Fusion, where two abstract morphemes fuse to one abstract morpheme, under specified conditions; and (ii) Fission, where one abstract morpheme splits into two abstract morphemes, under specified conditions.

Section 3.5 addressed morphological displacement operations generally referred to as Morphological Merger (Marantz 1988: 261). Two such movement operations at PF, were briefly presented: (i) Lowering, which takes place before Linearization (Embick and Noyer 2001: 561); and (ii) Local Dislocation, which takes place after Linearization (Embick and Noyer 2007: 319).

Section 3.6 presented Readjustment Rules with which one can account for (minor) changes of morphophonological exponents in certain contexts (Embick 2015: 204).

Section 3.7 summarized Chapter 3.

Chapter 4 explored the semantic branch of the Y-model of grammar, that is Logical Form (LF). In this thesis, I adopted the tenets of Discourse Representation Theory (DRT) (Kamp and Reyle 1993, 2011, Kamp et al. 2011) to model LF. As for the model of space, I followed Kamp and Roßdeutscher (2005). As for algebraic structures, I followed Krifka (1998), Beavers (2012).

Section 4.1 presented the semantic construction algorithm. At LF, each terminal node of a syntactic structure receives a context-dependent interpretation. Compositionally, the interpretations of the terminal nodes are combined bottom-up along the syntactic structure by means of unification-based composition rules. As for the representation of LF, Discourse Representation Theory (DRT) (Kamp and Reyle 1993, 2011, Kamp et al. 2011) was chosen; cf. Section 4.1.2. One of the features of DRT is that interpretation involves a two-stage process: (i) the construction of semantic representations referred to as Discourse Representation Structures (DRSs), i.e. the LF-representation proper; and (ii) a model-theoretic interpretation of those DRSs. Section 4.1.3 illustrated the semantic construction algorithm by reproducing a textbook example, involving aspectual information.

Section 4.2 briefly discussed the general conceptualization of 'Figure' and 'Ground' in language, as introduced by Talmy (1975, 2000).

Section 4.3 focused on the model-theoretic aspects relevant for the semantic modeling of spatial prepositions. I presented two models of three-dimensional space: (i) the vector space model of space, as advocated by Zwarts (1997, 2003b, 2005b), Zwarts and Winter (2000); and (ii) the perception-driven model of space, as advocated by Kamp and Roßdeutscher (2005), who base their approach on principles formulated by Lang (1990). In this thesis, I adopted Kamp and Roßdeutscher's (2005) parsimonious, perception-driven model of space. Section 4.3.1 discussed material objects, which can be conceptualized as being one-, two- or three-dimensional. Section 4.3.2 focused on the spatial ontology. In particular, the notions 'region', 'point', 'line', 'line segment', 'direction', 'directed line segment', and 'plane' were introduced. Then, Section 4.3.3 introduced the Primary Perceptual Space (PPS), which spans a three-dimensional space on the basis of our perceptual input (Lang 1990, Kamp and Roßdeutscher 2005). The PPS consists of three axes that are orthogonal to one another: (i) the vertical axis determined by gravity, (ii) the observer axis determined by vision, and (iii) the transversal axis derived from the other two axes as being orthogonal to both. Six orientations are identified on the three axes: up and down are orientations of the vertical axis; fore and back are orientations of the observer axis; and left and right are orientations of the transversal axis. Section 4.3.4 addressed boundaries of material objects and regions and how they can be used to determine the inside and the outside of a material object. Section 4.3.5 briefly discussed how 'spatial contact' of two regions can be modeled. Then, Section 4.3.6 discussed conditions on line segments that figure in the modeling of spatial paths denoted by route prepositions. Two types of conditions are proposed: (i) boundary conditions and (ii) configurational conditions. Boundary conditions manifest themselves to the effect that a line segment is either completely inside or completely outside the material object, i.e. an internal or external line segment of a material object. A crucial property of both boundary conditions is that one must be able to drop a perpendicular from the boundary of the material object onto every point of the line segment. Configurational conditions describe the configuration of line segments as related to material objects or the shape of line segments; three such configurational conditions of line segments are proposed: (i) an L-shaped line segment is a line segment that involves an orthogonal change of direction; (ii) a plumb-square line segment of a material object is a line segment that is horizontally aligned and above the material object (NB: the term is borrowed from a carpentry tool); and (iii) a spear-like line segment of a material object is a line segment that is orthogonal to a cross section of the material object.

Section 4.4 discussed the algebraic foundations. Section 4.4.1 presented the mereological structures that figure for the modeling of spatial paths. In particular, plain/undirected path structures H (Krifka 1998: 203) and directed path structures D (Krifka 1998: 203) were presented. Spatial paths can serve as incremental themes measuring out events (Dowty 1979, 1991, Tenny 1992, Jackendoff 1996, Krifka 1998, Beavers 2012); thus, Section 4.4.2 presented incremental relations between spatial paths and motion events. I briefly presented Beavers' (2012) Figure/Path Relations (FPRs) that account for double incremental themes.

Section 4.5 focused on spatial paths. I briefly presented two approaches to spatial paths: (i) an axiomatic approach, where spatial paths are taken as primitives in the universe of discourse (Piñón 1993, Krifka 1998, Beavers 2012); and (ii) a constructive approach, where spatial paths are defined as continuous functions from the real unit interval $[0, 1]$ to positions in some model of space (Zwarts 2005b: 748). The two approaches have different implications on the notions 'goal' and 'source'. In axiomatic approaches, 'goal' and 'source' are thematic notions that typically derive when motion events and their spatial projections map onto one another. In constructive approaches, 'goal' and 'source' are inherent extremities of spatial paths (Zwarts 2005b: 758). In this thesis, I opted for an axiomatic approach to spatial paths.

Section 4.6 explored the notion of 'prepositional aspect'. Zwarts (2005b: 742) relates prepositional aspect to the distinction between bounded and unbounded reference, which is familiar from the verbal domain, e.g., and which shows itself also in the domain of PPs denoting spatial paths (Jackendoff 1991, Verkuyl and Zwarts 1992, Piñón 1993). Following Zwarts (2005b: 753), I assume that cumulativity is the algebraic property characterizing prepositional aspect: unbounded PPs have cumulative reference, while bounded PPs nodes not have cumulative reference.

Section 4.7 discussed the force-dynamic effect of the German topological preposition *auf* ('upon'), which can be characterized as 'support form below'. In contrast to (Zwarts 2010a), who takes the view that prepositions can be forceful, I argued that prepositions are not forceful but can show force-dynamic effects. Using Talmy's (2000: 413, 415) terms 'Agonist' and 'Antagonist' for the force entities at issue, the force-dynamic effect of *auf* can be characterized to the effect that the complement of the preposition serves as an Antagonist providing a counterforce of an Agonist's tendency to fall down. The equilibrium of forces takes place along the vertical axis and leads to a resultant toward rest.

Section 4.8 summarized Chapter 4.

Chapter 5 spelled out the syntax, semantic, morphology of spatial prepositions in German. This chapter is the core of this thesis because it illustrates how spatial prepositions can be implemented in the Y-model of grammar.

Section 5.1 classified spatial prepositions according to several criteria. Section 5.1.1 presented a widely accepted typology of spatial prepositions (e.g. Jackendoff 1983, Piñón 1993, Zwarts 2006, Gehrke 2008, Kracht 2008, Svenonius 2010, Pantcheva 2011). On the one hand, place prepositions denote static locations (regions), while path prepositions, on the other hand, denote dynamic locations (spatial paths). Path prepositions can be directed or undirected. Directed path prepositions are either goal prepositions or source prepositions. Undirected path prepositions are route prepositions. In Section 5.1.2, I introduced a geometry-based classification of spatial prepositions, which is orthogonal to the place/path typology. I propose that spatial prepositions can be (i) geometric prepositions, (ii) pseudo-geometric prepositions, or (iii) non-geometric prepositions. Geometric prepositions refer to geometric relations that can be spelled out, for instance, in a parsimonious, perception-driven model of space (Kamp and Roßdeutscher 2005). Examples are *in* ('in, into'), *aus* ('out of'), *durch* ('through'). Pseudo-geometric prepositions look like geometric prepositions, but do not refer to geometric relations. Instead, they express functional locative relations. The peculiar goal preposition *nach* ('to'), which is obligatorily used, e.g., with determinerless toponyms, turns out to be a special instance of a pseudo-geometric preposition. Pseudo-geometric prepositions behave differently from geometric prepositions in several ways. For example, they do not license a postpositional recurrence of the preposition and the choice of a pseudo-geometric preposition is heavily influenced by denotational properties of the noun it co-occurs with. The non-geometric prepositions *bei* ('at'), *zu* ('to'), and *von* ('from') form a third class of spatial prepositions. They do not only impose semantic selection restrictions distinct from geometric and pseudo-geometric prepositions, but also behave differently with regard to lexical aspect. Section 5.1.3 classified path prepositions into bounded and unbounded path prepositions. This was done according to Kracht's (2002, 2008) classification: bounded source prepositions denote coinitial paths, bounded goal prepositions denote cofinal paths, bounded route prepositions denote transitory paths, unbounded source prepositions denote recessive paths, unbounded goal prepositions denote approximative paths, and unbounded route prepositions denote static paths. Section 5.1.4 mapped these classifications to syntactic structure. The lexical category P is characteristic of prepositions in general. It can host one of the following synsem features: (i) [LOC], which is characteristic of (pseudo)-geometric prepositions (except for route prepositions), (ii) [AT], which is characteristic of non-geometric prepositions; or (iii) [±NINF], which is characteristic of route prepositions. The lexical category P can be dominated by the light preposition Q, which derives goal and source prepositions from place prepositions. Q can host the synsem features [+TO] for goal prepositions or [−TO] for source prepositions. Following (Den Dikken 2010), I adopt the Parallelism Hypothesis, which states that the (functional) categories are structured in parallel across lexical domains, and assume functional structure above the categories P and Q. The functional category Asp dominates P or Q and can host the synsem features [+UNBD] for unbounded aspect or [−UNBD] for bounded aspect. The functional category Dx dominates Asp and can host the synsem features [+PROX] for proximal deixis or [−PROX] for non-proximal (distal) deixis. The functional category C dominates Dx and can host the synsem features [+MOTION] for path prepositions or [−MOTION] for place prepositions.

Section 5.2 touched upon the cartographic decomposition of spatial prepositions. I briefly presented Svenonius' (2006, 2010) cartographic decomposition of place prepositions and Pantcheva's (2011) cartographic decomposition of path prepositions.

Section 5.3 introduced three abstract Content features that relate to geometric concepts and that figure in the derivation of the geometric prepositions: (i) the place and goal preposition *in* ('in, into'), the source preposition *aus* ('out of'), and the route preposition *durch* ('through') share the abstract Content feature [א] relating to interiority; (ii) the place and goal preposition *an* ('on, onto') and the route preposition *um* ('around') share the abstract Content feature [ב] relating to contiguity; and (iii) the place and goal preposition *auf* ('upon, up onto') and the route preposition *über* ('over, across') share the abstract Content feature [נ] relating to verticality. Sections 5.3.1 to 5.3.3 discussed how the abstract Content features manifest themselves semantically. Focusing on [א] (interiority), Section 5.3.1 model-theoretically defined in-regions and durch-bar-paths. Focusing on [ב] (contiguity), Section 5.3.2 model-theoretically defined an-regions and um-bar-paths. Focusing on [נ] (verticality), Section 5.3.3 model-theoretically defined auf-regions and ueber-bar-paths.

Section 5.4 derived the lexical structure of spatial prepositions and spelled out PF-instructions for their morphophonological realization and LF-instructions for their semantic interpretation. Section 5.4.1 addressed place prepositions: geometric place prepositions were the subject of Section 5.4.1.1, pseudo-geometric place prepositions were the subject of Section 5.4.1.2, and non-geometric place prepositions were the subject of Section 5.4.1.3. Section 5.4.2 addressed goal and source prepositions: geometric goal and source prepositions were the subject of Section 5.4.2.1, pseudo-geometric goal and source prepositions were the subject of Section 5.4.2.2, and non-geometric goal and source prepositions were the subject of Section 5.4.2.3. Section 5.4.3 addressed route prepositions.

Section 5.5 derived the functional structure of spatial prepositions and spelled out PF-instructions for their morphophonological realization and LF-instructions for their semantic interpretation. Section 5.5.1 addressed C-features, Section 5.5.2 addressed deictic features, and Section 5.5.3 addressed aspectual features.

Section 5.6 illustrated how a fully-fledged PP, i.e. a prepositional CP, headed by a spatial preposition can be integrated in various verbal contexts.

Section 5.7 summarized Chapter 5.

Chapter 6 discussed prepositional case in German. I presented (i) the case assignment properties of (spatial) prepositions in German (Zwarts 2006); (ii) several previous approaches to prepositional case (Bierwisch 1988, Arsenijević and Gehrke 2009, Caha 2010, Den Dikken 2010); and (iii) a morphological case theory proposed for the verbal domain Marantz (1991), McFadden (2004). This paved the way for a proposal of a morphological case approach to spatial prepositions in German that is based on the syntacticosemantic analyses of spatial prepositions presented in Chapter 5.

Section 6.1 presented the case assignment properties of spatial prepositions in German. It picked up the classification of spatial prepositions into (i) place prepositions and (ii) path prepositions; the latter subdivide into (ii.a) directed prepositions (goal and source prepositions) and (ii.b) undirected prepositions (route prepositions). This classification was combined with the one proposed in Section 5.1.2, namely that spatial prepositions can be (pseudo)-geometric prepositions or non-geometric prepositions. It turned out that (pseudo)-geometric goal prepositions and route prepositions co-occur with accusative case, while (pseudo)-geometric place and source prepositions and non-geometric prepositions co-occur with dative case. In addition, Section 6.1 briefly presented the German spatial prepositions that assign genitive case.

Section 6.2 presented four previous approaches to prepositional case: Section 6.2.1 presented Den Dikken's (2010) structural approach where prepositional case assignment is linked to functional heads in the extended projection of prepositions; Section 6.2.2 presented Caha's (2010) peeling approach where DPs are assumed to peel off their hierarchically structured case layers under movement; Section 6.2.3 presented Arsenijević and Gehrke's (2009) approach where it is argued that accusative case in spatial PPs stems from PP-external structure; and Section 6.2.4 presented Bierwisch's (1988) lexicalist approach where the case assignment properties of spatial prepositions are assigned to their lexical entries. Some drawbacks of the approaches were discussed, too.

Section 6.3 motivated and outlined the hypothesis that case is not a phenomenon of the syntax proper, but of the morphological component of the grammar. Section 6.3.1 discussed the notions of abstract Case and morphological case (Pesetsky and Torrego 2011). Abstract Case is linked to nominal licensing, while morphological case is linked to the morphophonological realization of case. Section 6.3.2 presented the feature decomposition of case. In particular, this section laid out the idea that the case categories nominative, accusative, dative, and genitive are not grammatical primes, but the result of composite case features: nominative case corresponds to the absence of case features, accusative case corresponds to the feature [+INF] (for inferior), dative case corresponds to the feature bundle [+INF, +OBL] (obl for oblique), and genitive case corresponds to the feature bundle [+INF, +OBL, +GEN] (gen for genitive); cf. Bierwisch (1967), McFadden (2004), a.o. Section 6.3.3 presented a commonly assumed classification of morphological case into (i) structural case and (ii) non-structural case; the former further subdivides into (i.a) unmarked case and (i.b) marked case, while the latter subdivides into (ii.a) inherent case and (ii.b) idiosyncratic case. This section also spelled out the principles of structural and non-structural morphological case assignment proposed for the verbal domain (Marantz 1991, McFadden 2004, 2007).

Section 6.4 laid out a morphological case theory for simplex spatial prepositions in German. Using corpus data, a.o., I argued in Section 6.4.1 that the lexical category P triggers the inherent assignment of the dative case features [+INF, +OBL] to a DP in its complement position; see the morphological rule for Prepositional Case Assignment (PCA) in (585) on page 332. In Section 6.4.2, I argued that the prepositions that assign accusative case are those that contain the synsem feature bundle [LOC, +TO], characteristic of (pseudo)-geometric goal prepositions, or the synsem feature [±NINF], characteristic of route prepositions. I proposed that exactly those synsem features trigger the deletion of the oblique case feature [+OBL], resulting in accusative case assignment; see the rule of Prepositional Case Impoverishment (PCI) in (587) on page 334. In Section 6.4.3, I briefly looked at German prepositions that assign genitive, and at how this approach might be extended to other languages.

Section 6.5 summarized Chapter 6.

Prospects for future work

This thesis has spelled out the syntax, semantics, and morphology of spatial prepositions in German. In addition, it presented a morphological case approach to German spatial prepositions. However, several topics and questions did not get the attention they deserve. And, of course, some new questions arose. In the following, I briefly discuss some of them.

Section 5.6.4 sketched a potential derivation and LF-interpretation of the clause *Paul pinkelte in einen Pool* ('Paul peed into a pool'). It contains the unergative verb *pinkeln* ('pee'), which belongs to the class of verbs of bodily emission of fluids (Harley 2005). Unergative verbs can be analyzed as involving a morphophonologically null verb taking a nominal complement (here: *pinkel*, 'pee') (Hale and Keyser 1993, 2002, Harley 2005, a.o.). Morphophonologically, the nominal complement is assumed to conflate with the verb (Hale and Keyser 2002). Semantically, I proposed that the discourse referent provided by the nominal complement serves as a Figure. In particular, I proposed that this discourse referent saturates the Figure-argument-slot of an abstract Figure/Path Relation dubbed send; cf. Beavers (2012). In this regard, the clause could be paraphrased as *Hans sent pee into the pool*, where 'send' is supposed to be a light verb with highly abstract meaning. If this analysis is on the right track, the question would be whether it could be extended to other instances of unergative verbs, examples of which are given in (599).

(599) Hans blickte/lachte/... in den Sitzungsraum.
Hans looked/laughed/... in the.ACC meeting room
'Hans looked/laughed/... into the meeting room.'

As for unergative verbs, the following contrast should be mentioned. In German, the verb *tanzen* ('dance') has at least two usages that can be told apart by the perfect auxiliary they co-occur with. When taking a direct object as in (600a), the verb *tanzen* behaves like an unergative verb; cf. Haugen (2009) for a Distributed Morphology-type of approach to objects that are semantically, but not morphologically cognate. However, when co-occurring with a goal PP as in (600b), the verb *tanzen* behaves similarly to an unaccusative manner of motion verb like *rennen* ('run'); cf. Section 5.6.2 for a sketch of a potential derivation and LF-interpretation of the unaccusative manner of motion verb *rennen* in combination with a path PP. The question would be what an appropriate syntacticosemantic analysis of verbs showing the kind of 'unergative/unaccusative alternation' exemplified by *tanzen* in (600) should look like.

(600) a. Hans hat den Hochzeitswalzer getanzt.
Hans has the.ACC wedding waltz danced
'Hans danced the wedding waltz.'

b. Hans ist in den Ballsaal getanzt.
Hans is in the.ACC ball room danced
'Hans danced into the ball room.'

The projective prepositions *hinter* ('behind'), *vor* ('in front of'), *über* ('above'), *unter* ('under'), and *neben* ('beside') have not received much attention in this thesis. One could assume a synsem feature that relates to projection on axes of the Primary Perceptual Space (PPS), say [±PROJ]. Recall from Section 4.3.3 that the axes of the PPS are (i) the vertical axis, (ii) the observer axis, and (iii) the transversal axis. Assuming that projective prepositions can be characterized by P[LOC, ±PROJ], one could relate them to the axes of the PPS as given in Table 23.

One question would be whether one could also exploit the abstract Content features [א] (for interiority), [ב] (for contiguity), and [נ] (for verticality) to derive the projective prepositions. As for the vertical axis, which relates to *über* and *unter*, the matter is obvious.

	P[LOC, +PROJ]	P[LOC, −PROJ]
vertical axis	*über* ('above')	*unter* ('under')
observer axis	*vor* ('in front of')	*hinter* ('behind')
transversal axis	*neben* ('beside')	

Table 23: Projective prepositions and the axes of the PPS

Arguably, *über* and *unter* involve the abstract Content feature [ג]. But what about the observer and the transversal axes? Is it reasonable to relate the abstract Content features [א] and [ב] to the other two axes of the PPS? If yes, which feature should relate to which axis?

Projective prepositions raise a further question. In certain respects, they behave like the topological prepositions. For instance, they participate in the place/goal (i.e. dative/accusative) alternation. In other respects, however, topological and projective prepositions behave differently. For instance, measure phrases can attach to PPs headed by projective prepositions (602), but not to PPs headed by topological prepositions (601).

(601) a. Das Buch lag (*10 cm) auf dem Tisch.
the book lay (*10 cm) upon the.DAT table

b. Der Statue stand (??2 Meter) in der Aula.
the statue stood (??2 meter) in the.DAT assembly hall

(602) a. Die Lampe hing (50 cm) über dem Tisch.
the lamp hang (50 cm) above the.DAT table
'The lamp hang (50 cm) above the table.'

b. Die Statue stand (2 Meter) vor der Vitrine.
the statue stood (2 meter) in front of the.DAT glass cabinet
'The statue stood (2 meter) in front of the glass cabinet.'

Considering these data, one should raise the question of what sort of discourse referent is needed at LF in order to properly account for the measurability of the projective PPs such as those in (602). Clearly, regions, as used for the topological prepositions, are not enough.

Many prepositional elements, and in particular those related to the topological preposition *an* ('on'), *auf* ('upon'), and *in* ('in'), lead a double life, as prepositions and verbal particles. This obviously raises the question: Can we exploit abstract Content features in order to account for verbal particles? Concerning verbal particles, I refer the reader to Roßdeutscher (2011, 2012, 2013, 2014).

Ora Matushansky (pc) has made me aware of an interesting question concerning pseudo-geometric prepositions. It seems that pseudo-geometric prepositions are common in the context of weak definites (e.g. Aguilar Guevara 2014). If this turns out to be on the right track, then the following question arises: What is the syntacticosemantic relation between pseudo-geometric prepositions and weak definites?

In Section 4.7, I argued that forces do not primarily figure in the semantics of spatial prepositions; pace Zwarts (2010a). I argued that the topological preposition *auf* ('upon') shows a force-dynamic effect that can be characterized as 'support from below.' However, some non-spatial prepositions such as *gegen* ('against') obviously relate to forces in some way. This becomes clear when one considers the fact that they readily co-occur with force-dynamic verbs such as *drücken* ('push') or *schlagen* ('hit'). One could now generally raise the question of whether forces figure in the semantics of prepositions like *gegen*. If it turns out that forces do figure in the semantics of certain prepositions and if one assumes a DRT-based syntax-semantics interface – as I did in this thesis – where one can separate semantic representations from their model-theoretic interpretations, then the question would be if forces figure at the level of semantic representation, i.e. at LF, or 'only' in the model-theory.

As for morphological case, Section 6.4.3 already sketched some prospects for future work. Here, a central question is: How can one extend the account proposed in this thesis to other languages, in particular to the Slavic languages?

Appendix A

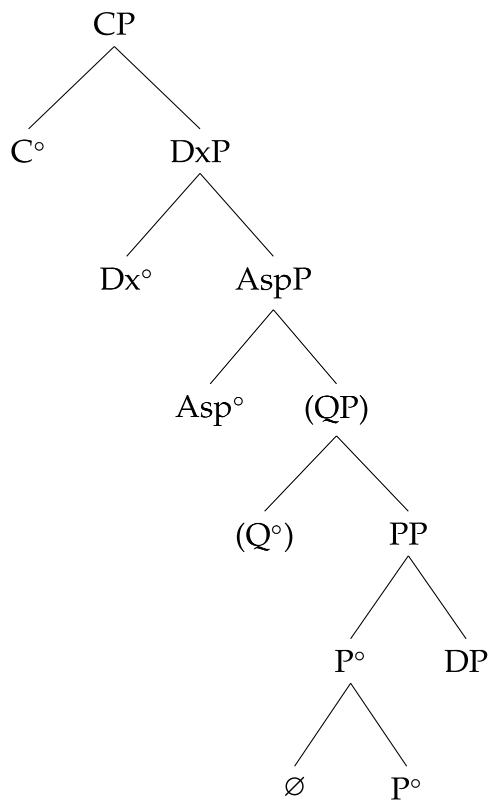
Synopses

A.1 Synopsis of spatial prepositions at the interfaces

Structures

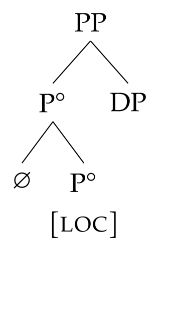
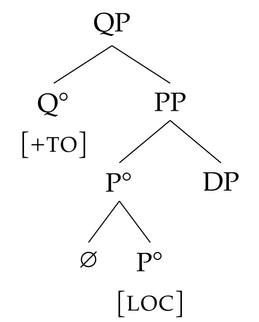
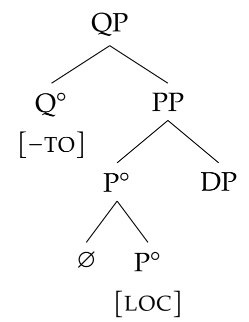
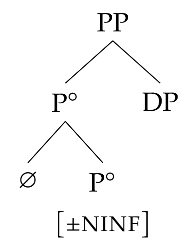
The lexical category P is characteristic of prepositions. The light preposition Q can optionally dominate P; it derives goal and source prepositions. P can undergo Primary Merge and thereby form a Root position (De Belder and Van Craenenbroeck 2015). At Root positions, (abstract) Content features can enter a derivation; by doing so, they become Roots. PP and QP can be dominated by functional structure involving the functional categories C (for complementizer) > Dx (for deixis) > Asp (for aspect) (Van Riemsdijk 1990, Koopman 2000, Den Dikken 2010). The general structure of spatial prepositions is given in (603).

(603)

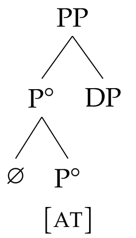
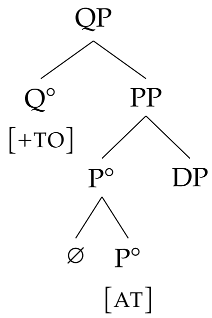
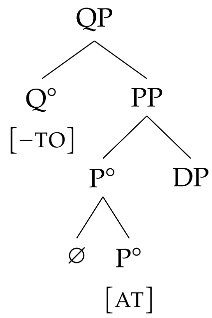


Several syntacticosemantic (synsem) features can reside in the lexical category P < light category Q: P can host [LOC] for (pseudo)-geometric prepositions, [AT] for non-geometric prepositions, [−NINF] for bounded route prepositions, and [+NINF] for unbounded route prepositions. Q derives goal and source prepositions; it can host [+TO] for goal prepositions and [−TO] for source prepositions.

(Pseudo)-geometric prepositions host the synsem feature [LOC], i.e. locative. Route prepositions host the synsem feature [±NINF], i.e. non-initial, non-final. The abstract Content feature that determines the (pseudo)-geometric prepositions *in* (‘in, into’), *aus* (‘out of’), and *durch* (‘through’) is [א] relating to interiority; the abstract Content feature that determines the (pseudo)-geometric prepositions *an* (‘on, onto’) and *um* (‘around’) is [ב] relating to contiguity; and the abstract Content feature that determines the (pseudo)-geometric prepositions *auf* (‘upon, up onto’) and *über* (‘over, across’) is [נ] relating to verticality. Geometric prepositions contain abstract Content features in their Root position, while pseudo-geometric prepositions have an empty Root position. The latter receive an abstract Content feature at PF; an abstract Content feature is copied from within the DP-complement to P.

	place prepositions	**goal path prepositions**	**source path prepositions**	**route path prepositions**
				
[א]	*in* (‘in’)	*in* (‘into’)	*aus* (‘out of’), (*von in* ‘from in’)	*durch* (‘through’)
[ב]	*an* (‘on’)	*an* (‘onto’)	(*von an* ‘from on’)	*um* (‘around’)
[נ]	*auf* (‘upon’)	*auf* (‘up onto’)	(*von auf* ‘from upon’)	*über* (‘over, across’)

Non-geometric prepositions host the synsem feature [AT]; they have an empty Root position.

place preposition	**goal path preposition**	**source path preposition**
		
bei ('at')	*zu* ('to')	*von* ('from')

Several syntacticosemantic (synsem) features can reside in the functional categories: Asp can host [+UNBD] for unbounded aspect (or [−UNBD] for bounded aspect); Dx can host [+PROX] for proximal deixis or [−PROX] for distal deixis; and C can host [+MOTION] for path prepositions or [−MOTION] for place prepositions.

Rules at Logical Form (LF)

(604) **LF-instructions for P**:

a. P ↔ [**v′** | durch-bar$(v', \overline{x})$ ninf$^{\pm}(v', \overline{w}, \overline{x})$] / _ [±NINF, א]

b. ↔ [**v′** | um-bar$(v', \overline{x})$ ninf$^{\pm}(v', \overline{w}, \overline{x})$] / _ [±NINF, ב]

c. ↔ [**v′** | ueber-bar$(v', \overline{x})$ ninf$^{\pm}(v', \overline{w}, \overline{x})$] / _ [±NINF, ג]

d. ↔ [**r′** | in$(r', \overline{x})$] / _ [LOC, א]

e. ↔ [**r′** | an$(r', \overline{x})$] / _ [LOC, ב]

f. ↔ [**r′** | auf$(r', \overline{x})$] / _ [LOC, ג]

g. ↔ [**r′** | func$(r', \overline{x})$] / _ [LOC]

h. ↔ [**r′** | at$(r', \overline{x})$] / _ [AT]

(605) **LF-instructions for Q:**

a. Q $\leftrightarrow$ $\begin{array}{|l|}\hline \\ \hline \text{enter}(\underline{\overline{w}},\underline{\overline{r}},\underline{\overline{e}}) \\ \hline \end{array}$ / [_ [+TO] ... P[LOC]]

b. $\leftrightarrow$ $\begin{array}{|l|}\hline \\ \hline \text{leave}(\underline{\overline{w}},\underline{\overline{r}},\underline{\overline{e}}) \\ \hline \end{array}$ / [_ [−TO] ... P[LOC]]

c. $\leftrightarrow$ $\begin{array}{|l|}\hline \\ \hline \text{to}(\underline{\overline{w}},\underline{\overline{r}},\underline{\overline{e}}) \\ \hline \end{array}$ / _ [+TO]

d. $\leftrightarrow$ $\begin{array}{|l|}\hline \\ \hline \text{from}(\underline{\overline{w}},\underline{\overline{r}},\underline{\overline{e}}) \\ \hline \end{array}$ / _ [−TO]

(606) **Reinterpretation of Q[±TO] under Asp[+UNBD]:**

a. $\begin{array}{|l|}\hline \\ \hline \text{to}(\underline{\overline{w}},\underline{\overline{r}},\underline{\overline{e}}) \\ \hline \end{array} \rightarrow \begin{array}{|l|}\hline \\ \hline \text{towards}(\underline{\overline{w}},\underline{\overline{r}},\underline{\overline{e}}) \\ \hline \end{array}$ / Q[+TO] ∧ Asp[+UNBD]

b. $\begin{array}{|l|}\hline \\ \hline \text{from}(\underline{\overline{w}},\underline{\overline{r}},\underline{\overline{e}}) \\ \hline \end{array} \rightarrow \begin{array}{|l|}\hline \\ \hline \text{away-from}(\underline{\overline{w}},\underline{\overline{r}},\underline{\overline{e}}) \\ \hline \end{array}$ / Q[−TO] ∧ Asp[+UNBD]

(607) **LF-intructions for Dx:**

a. Dx $\leftrightarrow$ $\left\langle \left\{ \begin{array}{|c|}\hline r_i \\ \hline \\ \hline \end{array} \right\}, \begin{array}{|c|}\hline \\ \hline \underline{\overline{r}}_d \subseteq r_i \\ \hline \end{array} \right\rangle$ / _ [+PROX]

b. $\leftrightarrow$ $\left\langle \left\{ \begin{array}{|c|}\hline r_i \\ \hline \\ \hline \end{array} \right\}, \begin{array}{|c|}\hline \\ \hline \neg\, \underline{\overline{r}}_d \otimes r_i \\ \hline \end{array} \right\rangle$ / _ [−PROX]

(608) **Dx-Adjustment at LF:**

a. $\left\langle \left\{ \begin{array}{|c|}\hline r_i \\ \hline \\ \hline \end{array} \right\}, \begin{array}{|c|}\hline \\ \hline \underline{\overline{r}}_d \subseteq r_i \\ \hline \end{array} \right\rangle \rightarrow \left\langle \left\{ \begin{array}{|c|}\hline r_i \\ \hline \\ \hline \end{array}, \begin{array}{|c|}\hline e^0 \\ \hline \\ \hline \end{array} \right\}, \begin{array}{|c|}\hline r' \\ \hline r' \subseteq r_i \\ \text{to}(\underline{v}, r', e^0) \\ \hline \end{array} \right\rangle$ / P[−NINF]

b. $\left\langle \left\{ \begin{array}{|c|}\hline r_i \\ \hline \\ \hline \end{array} \right\}, \begin{array}{|c|}\hline \\ \hline \neg\, \underline{\overline{r}}_d \otimes r_i \\ \hline \end{array} \right\rangle \rightarrow \left\langle \left\{ \begin{array}{|c|}\hline r_i \\ \hline \\ \hline \end{array}, \begin{array}{|c|}\hline e^0 \\ \hline \\ \hline \end{array} \right\}, \begin{array}{|c|}\hline r' \\ \hline \neg\, r' \otimes r_i \\ \text{to}(\underline{v}, r', e^0) \\ \hline \end{array} \right\rangle$ / P[−NINF]

(609) **LF-instructions for C:**

a. C $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{w'} \\ \hline \underline{\overline{R}}_{\text{FPR}}(\underline{\overline{y}}, w', \underline{\overline{e}}) \\ \hline \end{array}$ / _ [+MOTION]

b. $\leftrightarrow$ $\begin{array}{|c|}\hline \mathbf{r'} \\ \hline \underline{\overline{s}} :\ \underline{\overline{R}}_{\text{OCC}}(\underline{\overline{y}}, r') \\ \hline \end{array}$ / _ [−MOTION]

Rules at Phonological Form (PF)

(610) **PF-instructions for P**:

a. P ↔ /naːx/ / [_ [LOC, +TO] ... D[¬∃φ]]
b. ↔ /a͜us/ / _ [LOC, ℵ, −TO]
c. ↔ /fɔn/ / _ [−TO]
d. ↔ /dʊrç/ / _ [±NINF, ℵ]
e. ↔ /ʊm/ / _ [±NINF, ב]
f. ↔ /yːbɐ/ / _ [±NINF, ג]
g. ↔ /ɪn/ / _ [LOC, ℵ]
h. ↔ /an/ / _ [LOC, ב]
i. ↔ /a͜uf/ / _ [LOC, ג]
j. ↔ /t͜suː/ / _ [+TO]
k. ↔ /ba͜i/ / _ [AT]

(611) **PF-instructions for Q:**

a. Q ↔ /fɔn/ / _ [−TO] ∧ ¬∃ P°/Q°
b. ↔ ∅ elsewhere

(612) **Q-to-P-Lowering and subsequent P/Q-Fusion:**
Q° lowers to and fuses with P°.

(613) **PF-instructions for Asp:**

a. Asp ↔ /t͜suː/ / _ [+UNBD] ∧ Q[+TO]
b. ↔ /vɛk/ / _ [+UNBD] ∧ Q[−TO]
c. ↔ ∅ elsewhere

(614) **Readjustment of P under Q[+TO] and Asp[+UNBD]:**
/t͜suː/ → /a͜uf/ / Q[+TO] ∧ Asp[+UNBD]

(615) **PF-instrunctions for Dx:**

a. Dx ↔ /hɛr/ / ℘(C) ≠ ∅ ∧ _ [+PROX]
b. ↔ /hɪn/ / ℘(C) ≠ ∅ ∧ _ [−PROX]
c. ↔ /dr/ / ℘(C) ≠ ∅
d. ↔ ∅ elsewhere

(616) **Proximity Impoverishment:**

a. Delete [±PROX] hosted by Dx in the context of C[−MOTION].
b. Optionally delete [±PROX] hosted by Dx in the context of C[+MOTION], however do not delete [±PROX] if, in addition, P hosts [ℵ].

(617) **PF-instructions for prepositional C**:

a. C ↔ ℘(P) / ℘(Dx) ≠ ∅ ∧ [P[ℵ] ∨ P[ב] ∨ P[ג]]
b. ↔ ∅ elsewhere

(618) /ɪn/ → /a͜in/ / ℘(C) = /ɪn/ ∧ C[+MOTION]

A.2 Synopsis of morphological case assignment

Reconsider the case generalizations in (499), which I repeat here as (619).

(619) **Case generalizations concerning simplex spatial prepositions in German:**

a. When functioning as goal prepositions,
(pseudo)-geometric prepositions take an accusative complement.
(*an* 'onto', *auf* 'up onto', *in* 'into', *nach* 'to')

b. Route prepositions take an accusative complement.
(*durch* 'through', *über* 'across, over', *um* 'around')

c. All other prepositions take a dative complement.
(*an* 'on', *auf* 'upon', *aus* 'out of', *bei* 'at', *in* 'in', *von* 'from', *zu* 'to')

Section 6.4 has proposed the underlined parts of the morphological case-assignment rules in (620), in order to account for these generalizations.

(620) a. **Non-structural case assignment:**

(i) Idiosyncratic case assignment:
Assign [+INF,+OBL,+GEN] to a DP in the complement position of V° that contains one of the following Roots: √harr, √zeih, ..., and to a DP in the complement position of P° that contains one of the following Roots: √wegen, √trotz, ...

(ii) Inherent case assignment (incl. **prepositional case assignment**):
Assign [+INF,+OBL] to a DP in the specifier position of Appl°,
and to a DP in the complement position of P°.

b. **Structural case assignment:**
Assign [+INF] to a DP_i if and only if

(i) there is a DP_j within the same phase, and

(ii) DP_j c-commands DP_i, and

(iii) DP_j does not bear a non-structural case.

c. **Prepositional case impoverishment:**
Delete [+OBL] in the local context of
(i) P/Q[LOC, +TO], (ii) P[±NINF], or (iii) P/Q[AT, +TO] plus Asp[+UNBD], ...

Appendix B

Proofs

B.1 Negative NINF-paths give rise to bounded route PPs

This section proves that a PP such as *durch den Park* ('through the park') with a negative NINF-path is bounded. The DRS in (B.1) is the LF-representation of the bounded PP *durch den Park*.

$$\begin{array}{|c|}\hline \mathbf{w}' \; v' \; x' \\ \hline \mathsf{ninf}^-(v', w', x') \quad \mathsf{durch\text{-}bar}(v', x') \\ \mathsf{the\text{-}park}(x') \\ \underline{\overline{R}}_{\mathrm{FPR}}(\underline{\overline{y}}, w', \underline{\overline{e}}) \\ \hline \end{array} \tag{B.1}$$

Ignoring the anticipated Figure/Path Relation, we can translate this to the intermediate model-theoretic representation:

$$\lambda w \exists v' [\mathsf{ninf}^-(v', w, \textsc{the-park}) \wedge \mathsf{durch\text{-}bar}(v', \textsc{the-park})] \tag{B.2}$$

A PP is bounded iff it does not have cumulative reference. Thus, the hypothesis is that (B.2) is not cumulative. Assume the concatenation $w_1 \circledcirc w_2$ exists.[168] (B.2) is not cumulative iff not all concatenations of paths w_1, w_2 that individually qualify for (B.2) also qualify for (B.2). That is:

$$\neg\forall w_1, w_2 [\exists v' [\mathsf{ninf}^-(v', w_1, \textsc{the-park}) \wedge \mathsf{durch\text{-}bar}(v', \textsc{the-park})] \tag{B.3a}$$

$$\wedge \exists v'' [\mathsf{ninf}^-(v'', w_2, \textsc{the-park}) \wedge \mathsf{durch\text{-}bar}(v'', \textsc{the-park})] \tag{B.3b}$$

[168] Assuming that the concatenation $w_1 \circledcirc w_2$ exists is not trivial. In the case of *durch den Park* ('through the park') you could imagine a scenario where you enter and leave the park (= w_1) and then turn around and enter and leave the park (= w_2) again. As the tail paths of a route path are always qualitatively indistinguishable, such an assumption is reasonable. However, I leave the formal proof that the concatenation $w_1 \circledcirc w_2$ exists for future work.

$$\rightarrow \exists v'''[\mathsf{ninf}^-(v''', w_1 \oslash w_2, \text{THE-PARK}) \wedge \mathsf{durch\text{-}bar}(v''', \text{THE-PARK})]] \tag{B.3c}$$

This is equivalent to:

$$\exists w_1, w_2[\exists v'[\mathsf{ninf}^-(v', w_1, \text{THE-PARK}) \wedge \mathsf{durch\text{-}bar}(v', \text{THE-PARK})] \tag{B.4a}$$

$$\wedge \exists v''[\mathsf{ninf}^-(v'', w_2, \text{THE-PARK}) \wedge \mathsf{durch\text{-}bar}(v'', \text{THE-PARK})] \tag{B.4b}$$

$$\wedge \neg \exists v'''[\mathsf{ninf}^-(v''', w_1 \oslash w_2, \text{THE-PARK}) \wedge \mathsf{durch\text{-}bar}(v''', \text{THE-PARK})]] \tag{B.4c}$$

That is, there is no negative NINF-path v''' of $w_1 \oslash w_2$ such that v''' is a durch-bar-path of 'the park'. We can prove this by contradiction. Assume there is a negative NINF-path v''' of $w_1 \oslash w_2$ such that v''' is a durch-bar-path of 'the park'.

$$\exists w_1, w_2[\exists v'[\mathsf{ninf}^-(v', w_1, \text{THE-PARK}) \wedge \mathsf{durch\text{-}bar}(v', \text{THE-PARK})] \tag{B.5a}$$

$$\wedge \exists v''[\mathsf{ninf}^-(v'', w_2, \text{THE-PARK}) \wedge \mathsf{durch\text{-}bar}(v'', \text{THE-PARK})] \tag{B.5b}$$

$$\wedge \exists v'''[\mathsf{ninf}^-(v''', w_1 \oslash w_2, \text{THE-PARK}) \wedge \mathsf{durch\text{-}bar}(v''', \text{THE-PARK})]] \tag{B.5c}$$

We can substitute the durch-bar-conditions:

$$\exists w_1, w_2[\exists v'[\mathsf{ninf}^-(v', w_1, \text{THE-PARK}) \wedge \mathsf{intlis}(v', \text{THE-PARK}) \wedge \mathsf{spear\text{-}like}(v', \text{THE-PARK})] \tag{B.6a}$$

$$\wedge \exists v''[\mathsf{ninf}^-(v'', w_2, \text{THE-PARK}) \wedge \mathsf{intlis}(v'', \text{THE-PARK}) \wedge \mathsf{spear\text{-}like}(v'', \text{THE-PARK})] \tag{B.6b}$$

$$\wedge \exists v'''[\mathsf{ninf}^-(v''', w_1 \oslash w_2, \text{THE-PARK}) \wedge \mathsf{intlis}(v''', \text{THE-PARK}) \wedge \mathsf{spear\text{-}like}(v''', \text{THE-PARK})]] \tag{B.6c}$$

Identifying the predicate B in the definition of ninf (cf. (430) on page 252) with the boundary condition intlis, we can substitute the ninf-conditions:

$$\exists w_1, w_2[\exists v'[v' < w_1 \;\wedge \mathsf{intlis}(v', \text{THE-PARK}) \tag{B.7a}$$

$$\wedge\; \exists x', y'[x', y' < w_1 \tag{B.7b}$$

$$\wedge\; w_1 = x' \oplus v' \oplus y' \wedge x' \infty v' \infty y' \tag{B.7c}$$

$$\wedge\; \neg\, \mathsf{intlis}(x', \text{THE-PARK}) \wedge \neg\, \mathsf{intlis}(y', \text{THE-PARK})] \tag{B.7d}$$

$$\wedge\; \mathsf{intlis}(v', \text{THE-PARK}) \wedge \mathsf{spear\text{-}like}(v', \text{THE-PARK})] \tag{B.7e}$$

$$\wedge\; \exists v''[v'' < w_2 \;\wedge \mathsf{intlis}(v'', \text{THE-PARK}) \tag{B.7f}$$

$$\wedge\; \exists x'', y''[x'', y'' < w_2 \tag{B.7g}$$

$$\wedge\ w_2 = x'' \oplus v'' \oplus y'' \wedge x'' \infty v'' \infty y'' \tag{B.7h}$$

$$\wedge \neg \mathsf{intlis}(x'', \text{THE-PARK}) \wedge \neg \mathsf{intlis}(y'', \text{THE-PARK})] \tag{B.7i}$$

$$\wedge\ \mathsf{intlis}(v'', \text{THE-PARK}) \wedge \mathsf{spear\text{-}like}(v'', \text{THE-PARK})] \tag{B.7j}$$

$$\wedge\ \exists v'''[v''' < w_1 \oslash w_2 \wedge \mathsf{intlis}(v''', \text{THE-PARK}) \tag{B.7k}$$

$$\wedge\ \exists x''', y'''[x''', y''' < w_1 \oslash w_2 \tag{B.7l}$$

$$\wedge\ w_1 \oslash w_2 = x''' \oplus v''' \oplus y''' \wedge x''' \infty v''' \infty y''' \tag{B.7m}$$

$$\wedge \neg \mathsf{intlis}(x''', \text{THE-PARK}) \wedge \neg \mathsf{intlis}(y''', \text{THE-PARK})] \tag{B.7n}$$

$$\wedge \mathsf{intlis}(v''', \text{THE-PARK}) \wedge \mathsf{spear\text{-}like}(v''', \text{THE-PARK})]] \tag{B.7o}$$

The concatenation operation is defined as the mereological sum – if it exists – for non-overlapping elements. This means that the concatenation $w_1 \oslash w_2$ can be resolved as:

$$w_1 \oslash w_2 = x' \oplus v' \oplus y' \oplus x'' \oplus v'' \oplus y'' \tag{B.8}$$

Due to the adjacency conditions of v', v'' in (B.7c) and (B.7h), there are four disjunctive configurations for $w_1 \oslash w_2$:

$$x' \infty v' \infty y' \infty x'' \infty v'' \infty y'' \tag{B.9}$$

$$x' \infty v' \infty y' \infty y'' \infty v'' \infty x'' \tag{B.10}$$

$$y' \infty v' \infty x' \infty x'' \infty v'' \infty y'' \tag{B.11}$$

$$y' \infty v' \infty x' \infty y'' \infty v'' \infty x'' \tag{B.12}$$

Consider (B.9). We can identify the tail paths x''', y''' of $w_1 \oslash w_2$:

$$x''' = x' \wedge y''' = y'' \tag{B.13}$$

Further, we can identify the NINF-path v''' of $w_1 \oslash w_2$:

$$v''' = v' \oplus y' \oplus x'' \oplus v'' \tag{B.14}$$

It is stated in (B.7o) that v''' is an internal line segment of 'the park'. Due to the universal quantification in the definition of internal line segments in (245) on page 141 (boundary condition), all subparts of v''' must be internal line segments of 'the park'. That is:

$$\text{intlis}(v', \text{THE-PARK}) \wedge \text{intlis}(y', \text{THE-PARK}) \wedge \text{intlis}(x'', \text{THE-PARK}) \wedge \text{intlis}(v'', \text{THE-PARK}) \quad \text{(B.15)}$$

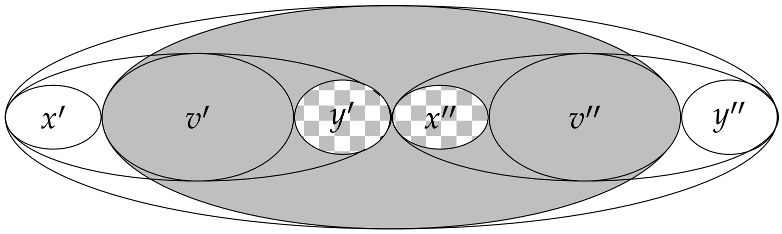
However, it is stated in (B.7d) and (B.7i) that y', x'' are not internal line segments of 'the park'. This leads to a contradiction:

$$\text{intlis}(y', \text{THE-PARK}) \wedge \text{intlis}(x'', \text{THE-PARK}) \quad \text{(B.16a)}$$

$$\wedge \neg\, \text{intlis}(y', \text{THE-PARK}) \wedge \neg\, \text{intlis}(x'', \text{THE-PARK}) \quad \text{(B.16b)}$$

$$\rightarrow \bot \quad \text{(B.16c)}$$

We can diagram this as below; the paths that are internal line segments of 'the park' are shaded gray.



(B.17)

Applying the same reasoning to the other three cases in (B.10)–(B.12), we arrive at parallel contradictions. We can conclude that there is no path $w_1 \oslash w_2$ such that its NINF-path is an internal line segment of 'the park'.

Q.E.D.

B.2 Positive NINF-paths give rise to unbounded route PPs

This section proves that a PP such as *durch den Park* ('through the park') with a positive NINF-path is unbounded. The DRS in (B.18) is the LF-representation of the unbounded PP *durch den Park*.

$\mathbf{w}'\ v'\ x'$
$\text{ninf}^+(v', w', x')$ durch-bar(v', x')
the-park(x')
$\underline{\overline{R}}_{\text{FPR}}(\underline{\overline{y}}, w', \underline{\overline{e}})$

(B.18)

Ignoring the anticipated Figure/Path Relation, we can translate this to the intermediate model-theoretic representation:

$$\lambda w \exists v'[\mathsf{ninf}^+(v', w, \text{THE-PARK}) \wedge \mathsf{durch\text{-}bar}(v', \text{THE-PARK})] \quad \text{(B.19)}$$

A PP is unbounded iff it has cumulative reference. Thus, the hypothesis is that (B.19) is cumulative. Assume the concatenation $w_1 \circledcirc w_2$ exists. (B.19) is cumulative iff all concatenations of paths w_1, w_2 that individually qualify for (B.19) also qualify for (B.19). That is:

$$\forall w_1, w_2[\exists v'[\mathsf{ninf}^+(v', w_1, \text{THE-PARK}) \wedge \mathsf{durch\text{-}bar}(v', \text{THE-PARK})] \quad \text{(B.20a)}$$
$$\wedge \exists v''[\mathsf{ninf}^+(v'', w_2, \text{THE-PARK}) \wedge \mathsf{durch\text{-}bar}(v'', \text{THE-PARK})] \quad \text{(B.20b)}$$
$$\rightarrow \exists v'''[\mathsf{ninf}^+(v''', w_1 \circledcirc w_2, \text{THE-PARK}) \wedge \mathsf{durch\text{-}bar}(v''', \text{THE-PARK})]] \quad \text{(B.20c)}$$

That is, for any w_1, w_2 there is a positive NINF-path v''' of $w_1 \circledcirc w_2$ such that v''' is a durch-bar-path of 'the park'. We can show that this is a tautology.
We can substitute the durch-bar-conditions:

$$\forall w_1, w_2[\exists v'[\mathsf{ninf}^+(v', w_1, \text{THE-PARK}) \wedge \mathsf{intlis}(v', \text{THE-PARK}) \wedge \mathsf{spear\text{-}like}(v', \text{THE-PARK})] \quad \text{(B.21a)}$$
$$\wedge \exists v''[\mathsf{ninf}^+(v'', w_2, \text{THE-PARK}) \wedge \mathsf{intlis}(v'', \text{THE-PARK}) \wedge \mathsf{spear\text{-}like}(v'', \text{THE-PARK})] \quad \text{(B.21b)}$$
$$\rightarrow \exists v'''[\mathsf{ninf}^+(v''', w_1 \circledcirc w_2, \text{THE-PARK}) \wedge \mathsf{intlis}(v''', \text{THE-PARK}) \wedge \mathsf{spear\text{-}like}(v''', \text{THE-PARK})]] \quad \text{(B.21c)}$$

Identifying the predicate B in the definition of ninf (cf. (430) on page 252) with the boundary condition intlis, we can substitute the ninf-conditions:

$$\forall w_1, w_2[\exists v'[v' < w_1 \;\wedge \mathsf{intlis}(v', \text{THE-PARK}) \quad \text{(B.22a)}$$
$$\wedge\; \exists x', y'[x', y' < w_1 \quad \text{(B.22b)}$$
$$\wedge\; w_1 = x' \oplus v' \oplus y' \wedge x' \infty v' \infty y' \quad \text{(B.22c)}$$
$$\wedge\; \mathsf{intlis}(x', \text{THE-PARK}) \wedge \mathsf{intlis}(y', \text{THE-PARK})] \quad \text{(B.22d)}$$
$$\wedge\; \mathsf{intlis}(v', \text{THE-PARK}) \wedge \mathsf{spear\text{-}like}(v', \text{THE-PARK})] \quad \text{(B.22e)}$$
$$\wedge\; \exists v''[v'' < w_2 \;\wedge \mathsf{intlis}(v'', \text{THE-PARK}) \quad \text{(B.22f)}$$
$$\wedge\; \exists x'', y''[x'', y'' < w_2 \quad \text{(B.22g)}$$
$$\wedge\; w_2 = x'' \oplus v'' \oplus y'' \wedge x'' \infty v'' \infty y'' \quad \text{(B.22h)}$$
$$\wedge\; \mathsf{intlis}(x'', \text{THE-PARK}) \wedge \mathsf{intlis}(y'', \text{THE-PARK})] \quad \text{(B.22i)}$$
$$\wedge\; \mathsf{intlis}(v'', \text{THE-PARK}) \wedge \mathsf{spear\text{-}like}(v'', \text{THE-PARK})] \quad \text{(B.22j)}$$

$$\rightarrow \exists v'''[v''' < w_1 \circledcirc w_2 \wedge \mathsf{intlis}(v''', \textsc{the-park}) \tag{B.22k}$$

$$\wedge \exists x''', y'''[x''', y''' < w_1 \circledcirc w_2 \tag{B.22l}$$

$$\wedge w_1 \circledcirc w_2 = x''' \oplus v''' \oplus y''' \wedge x''' \infty v''' \infty y''' \tag{B.22m}$$

$$\wedge \mathsf{intlis}(x''', \textsc{the-park}) \wedge \mathsf{intlis}(y''', \textsc{the-park})] \tag{B.22n}$$

$$\wedge \mathsf{intlis}(v''', \textsc{the-park}) \wedge \mathsf{spear\text{-}like}(v''', \textsc{the-park})]] \tag{B.22o}$$

The concatenation operation is defined as the mereological sum – if it exists – for non-overlapping elements. This means that the concatenation $w_1 \circledcirc w_2$ can be resolved as:

$$w_1 \circledcirc w_2 = x' \oplus v' \oplus y' \oplus x'' \oplus v'' \oplus y'' \tag{B.23}$$

Due to the adjacency conditions of v', v'' in (B.22c) and (B.22h), there are four disjunctive configurations for $w_1 \circledcirc w_2$:

$$x' \infty v' \infty y' \infty x'' \infty v'' \infty y'' \tag{B.24}$$

$$x' \infty v' \infty y' \infty y'' \infty v'' \infty x'' \tag{B.25}$$

$$y' \infty v' \infty x' \infty x'' \infty v'' \infty y'' \tag{B.26}$$

$$y' \infty v' \infty x' \infty y'' \infty v'' \infty x'' \tag{B.27}$$

Consider (B.24). We can identify the tail paths x''', y''' of $w_1 \circledcirc w_2$:

$$x''' = x' \wedge y''' = y'' \tag{B.28}$$

It is stated in (B.22d) and (B.22i) that x', y'' are internal line segments of 'the park'. It is further stated in (B.22n) that x''', y''' are internal line segments of 'the park'. This leads to a tautology:

$$\mathsf{intlis}(x''', \textsc{the-park}) \wedge \mathsf{intlis}(x', \textsc{the-park}) \tag{B.29a}$$

$$\wedge \mathsf{intlis}(y''', \textsc{the-park}) \wedge \mathsf{intlis}(y'', \textsc{the-park}) \tag{B.29b}$$

$$\rightarrow \top \tag{B.29c}$$

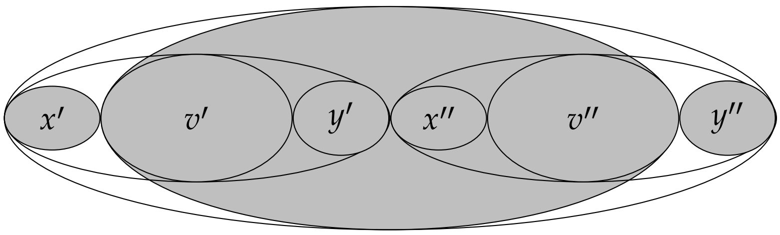
Further, we can identify the NINF-path v''' of $w_1 \circledcirc w_2$:

$$v''' = v' \oplus y' \oplus x'' \oplus v'' \tag{B.30}$$

It is stated in (B.22o) that v''' is an internal line segment of 'the park'. Due to the universal quantification in the definition of internal line segments in (245) on page 141 (boundary condition), all subparts of v''' must be internal line segments of 'the park'. It is stated in (B.22a) and (B.22f) that v', v'' are internal line segments of 'the park'. Likewise, it is stated in (B.22d) and (B.22i) that y', x'' are internal line segments of 'the park'. This leads to a tautology:

$$\text{intlis}(v''', \text{THE-PARK}) \quad \text{(B.31a)}$$
$$\wedge\ \text{intlis}(v', \text{THE-PARK}) \wedge \text{intlis}(y', \text{THE-PARK}) \quad \text{(B.31b)}$$
$$\wedge\ \text{intlis}(x'', \text{THE-PARK}) \wedge \text{intlis}(v'', \text{THE-PARK}) \quad \text{(B.31c)}$$
$$\rightarrow \top \quad \text{(B.31d)}$$

We can diagram this as below; the paths that are internal line segments of 'the park' are shaded gray.

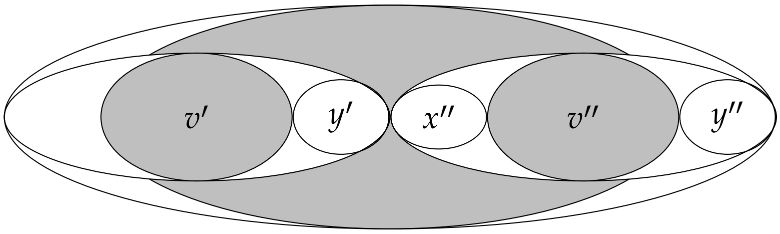


(B.32)

It is further stated in (B.22o) that v''' is an spear-like line segment of 'the park'. Due to the existential quantification of spear-like line segments in (249) on page 145 (configurational condition), at least one subpart of v''' must be a spear-like line segment of 'the park'. It is stated in (B.22e) and (B.22j) that v', v'' are spear-like line segments of 'the park'. This leads to a tautology:

$$\text{spear-like}(v''', \text{THE-PARK}) \quad \text{(B.33a)}$$
$$\wedge\ [\text{spear-like}(v', \text{THE-PARK}) \vee \text{spear-like}(v'', \text{THE-PARK})] \quad \text{(B.33b)}$$
$$\rightarrow \top \quad \text{(B.33c)}$$

We can diagram this as below; the paths that are spear-like line segments of 'the park' are shaded gray.



(B.34)

Applying the same reasoning to the other three cases in (B.25)–(B.27), we arrive at parallel tautologies. We can conclude that for all $w_1 \oslash w_2$ there is a NINF-path that is an internal line segment of 'the park' and a spear-like line segment of 'the park'.

Q.E.D.

Appendix C

Grapheme/phoneme mapping

Table 24 lists the phonemic IPA-representations[169] (cf. Duden 6, Klosa et al. 2000).

graphemic representation	**phonemic representation**
an	/an/
auf	/a͜uf/
aus	/a͜us/
bei	/ba͜i/
dr	/dr/
durch	/dʊrç/
ein	/a͜in/
Haiti	/haˈiːti/
her	/hɛr/
hin	/hɪn/
Hispaniola	/hɪspˈani̯oːla/
in	/ɪn/
Kuba	/ˈkuːba/
nach	/naːx/
über	/yːbɐ/
um	/ʊm/
von	/fɔn/
weg	/vɛk/
zu	/t͜suː/

Table 24: Grapheme/phoneme mapping

[169] URL: `https://www.internationalphoneticassociation.org/` (27.06.2017)

Appendix D

Picture credits

Page 2, Figure 1: *Cu-map.png*. [Public Domain], via Wikimedia Commons. https://commons.wikimedia.org/w/index.php?curid=137715. *Guantanamo.jpg*. [Public Domain], via Wikimedia Commons. https://commons.wikimedia.org/w/index.php?curid=990012. Further derivative work by Boris Haselbach.

Page 124, Figure 9: Part of *"Profil Perdu 16 + 17"*, one-continuous-line-drawing by Boris Schmitz, 2014. http://borisschmitz.tumblr.com/post/96490797197/profil-perdu-16-17. Further derivative work by Boris Haselbach.

Page 137, Figure 10: *Koordinatensysteme L+R.svg*. By Qniemiec (LRHREGEL de.png) [CC0], via Wikimedia Commons. https://commons.wikimedia.org/wiki/File%3AKoordinatensysteme_L%2BR.svg. Further derivative work by Boris Haselbach.

Page 144, Figure 15: *Cc&j-fig24–plumb square.png*. By Paul N. Hasluck (Cassells' Carpentry and Joinery) [Public domain], via Wikimedia Commons. https://commons.wikimedia.org/wiki/File%3ACc%26j-fig24--plumb_square.png.

Page 145, Figure 17: *olive-155932_1280.png*. [CC0], via Pixabay. https://pixabay.com/photo-155932/. Further derivative work by Boris Haselbach.

Page 173, Figure 33.a: *Explain on under between by in over thrue 20.svg*. By Thirunavukkarasye-Raveendran (Own work) [CC BY-SA 3.0 (http://creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons. https://commons.wikimedia.org/wiki/File%3AExplain_on_under_between_by_in_over_thrue_20.svg. Further derivative work by Boris Haselbach.

Page 173, Figure 33.b: *Explain on under between by in over thrue 21.svg*. By Thirunavukkarasye-Raveendran (Own work) [CC BY-SA 3.0 (http://creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons. https://commons.wikimedia.org/wiki/File%3AExplain_on_under_between_by_in_over_thrue_21.svg. Further derivative work by Boris Haselbach.

Page 219, Figure 40: 'Greater Antilles; Inset map of Jamaica'. In *The Citizen's Atlas of the World*, by John Bartholomew. Published by John Bartholomew & Son limited, Edinburgh; 10th Edition, 1952.

Page 223, Figure 41: Campaign poster by Green Party (Bündnis 90/Die Grünen), Baden-Württemberg state election 1996. Permalink: http://www.landesarchiv-bw.de/plink/?f=1-830257

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Eigenständigkeitserklärung

Hiermit versichere ich, dass ich die vorliegende Arbeit selbstständig verfasst und keine anderen Quellen und Hilfsmittel als die angegebenen benutzt habe. Passagen und Gedanken aus fremden Quellen sind als solche kenntlich gemacht.

Declaration of Authorship

I hereby declare that I have created this work completely on my own and used no other sources or tools than the ones listed. Passages and ideas from other sources have been clearly indicated.

Stuttgart, 12.10.2017 Boris P. Haselbach