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Volume Editors: Arndt Riester & Torgrim Solstad
Universität Stuttgart
Institut für Maschinelle Sprachverarbeitung
Azenbergstraße 12
D-70174 Stuttgart
{arndt, torgrim}@ims.uni-stuttgart.de

Series Editors: Artemis Alexiadou
Universität Stuttgart
Institut für Lingusitik/Anglistik
Heilbronner Strasse 7
D-70174 Stuttgart

Hinrich Schütze
Universität Stuttgart
Institut für maschinelle Sprachverarbeitung
Azenbergstrasse 12
D-70174 Stuttgart

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The SFB 732 brings together scientists from the areas of linguistics, computational linguistics and signal processing at the University of Stuttgart. Their common scientific goals are to achieve a better understanding of the mechanisms that lead to ambiguity control/disambiguation as well as the enrichment of missing/incomplete information and to develop methods that are able to fully describe these mechanisms.

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Contact Information:

Director of the SFB 732:

Prof. Dr. Artemis Alexiadou
artemis@ifla.uni-stuttgart.de

Coordinator of the SFB 732:

Dr. Sabine Mohr
sabine@ifla.uni-stuttgart.de

SFB 732
Universität Stuttgart
Heilbronner Strasse 7
D-70174 Stuttgart

Phone: 0711/685-83115
Fax: 0711/685-83120

Preface

The 13th installment of the annual meeting of the *Gesellschaft für Semantik*, *Sinn und Bedeutung 13*, took place September 30—October 2, 2008 at the University of Stuttgart. Our invited speakers were Gerhard Jäger, Lauri Karttunen, Alex Lascarides, and Claudia Maienborn. In addition, 42 submitted abstracts were selected for presentation. We are deligthed to be able to include 38 of these in the proceedings.

On behalf of the organizers – Ljudmila Geist, Klaus von Heusinger, Hans Kamp, Udo Klein, Fabienne Martin, Edgar Onea, Arndt Riester, and Torgrim Solstad – we would like to thank the speakers, reviewers and student helpers for making SuB13 such an inspiring and enjoyable event. We are also much obliged to Nina Seemann for assisting us with the typesetting of this document.

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Stuttgart, May 20, 2009
Arndt Riester
Torgrim Solstad

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Pragmatic Rationalizability

Gerhard Jäger   Christian Ebert
Dept. of Linguistics and Literature
University of Bielefeld

{gerhard.jaeger,christian.ebert}@uni-bielefeld.de

Abstract

We present a formal game-theoretic model towards the explanation of implicatures based on the computation of *iterated best responses*: literal meaning of signals constitutes their default interpretation, and rational communicators decide about their communicative strategies by iteratively calculating the best response to this default strategy. We demonstrate by means of several examples how the resulting *pragmatically rationalizable* strategies account for different types of implicatures.

1 Signaling Games

In order to introduce the basic concepts of the underlying game-theoretic model (see e.g. Osborne and Rubinstein, 1994, for an introductory textbook on game theory), let us look at a simple scenario where communication makes a decisive difference. Suppose Robin invited Sally for dinner where he wants to serve some thai curry. While slicing the chili he realizes that he is unsure about whether Sally likes her curry hot or not. Robin obviously wants to offer his guest the curry in her preferred way. In other words, they both prefer the outcome where Sally receives her favorite type of curry over the other outcome, where she finds it inedible because of the lack or the abundance of chili.

We may formalize this scenario as follows. There are two possible worlds, w_1 and w_2. In w_1 Sally prefers mild curry; in w_2 she likes it hot. Robin has a choice between two actions: preparing a mild curry would be action a_{mild}, and preparing a hot curry action a_{hot}. Sally knows how she likes her curry, i.e. she knows which world they are in, but poor Robin does not. But although he does not know for sure, he may have some *a priori* belief about Sally's liking, i.e. about the probabilities of each world. Maybe Robin has seen her eat jalapeño spiced taco burgers on another occasion such that he assumes w_2 to be more likely than w_1. In our concrete example, let us assume that he is totally clueless – he assigns both worlds an *a priori* probability of 50%.

This scenario can be represented formally as follows. In game theory, the preferences are usually encoded by assigning numerical values, called *utilities* or *payoffs*, to each outcome for each player. For instance, as Robin prefers the outcome of performing action a_{mild} in world w_1 over the outcome of performing the same action in w_2, we may assign 1 to the first and 0 to the second outcome and use the $\geq$-order on natural numbers to reflect the preference order. Continuing like that we arrive at the following *utility matrix*. Rows represent possible worlds and columns represent Robin's actions. The first number in each cell gives Sally's payoff for this configuration, and the second number Robin's payoff.

	a_{mild}	a_{hot}
w_1	1,1	0,0
w_2	0,0	1,1

(1)

Without any further coordination between the players, Robin will remain clueless and he will have to prepare one type of curry hoping to guess the right one. His *expected utility/payoff* for performing action a is as follows (given his prior belief p^*, the set of possible worlds W and his utilities $u_R(w,a)$ for the outcome (w,a)):

$$\text{EU}(a) = \sum_{w \in W} p^*(w) \cdot u_R(w,a) \tag{2}$$

In the case at hand he receives an expected payoff of 0.5 for either action, and (because of their identical preferences/utilities) Sally will also receive an expected payoff of 0.5. They can do better though if they communicate. Sally might simply tell Robin her favourite type of curry. Suppose Robin expects that Sally says "*mild*" in w_1 and "*hot*" in w_2. Then the rational course of action for Robin is to perform a_{mild} if he hears "*mild*", and to perform a_{hot} upon hearing "*hot*". In other words, Robin learns the actual world from Sally's utterance, i.e. revises his belief, and acts accordingly. On the other hand, if Sally beliefs that Robin will react to these signals in this way, it is rational for her to say "*mild*" in w_1 and "*hot*" in w_2. If they follow this rational course of behaviour they both will obtain an overall payoff of 1.

So adding the option for communication may improve the payoff of both players. Technically, the original scenario (which is not really a game but a decision problem because Sally has no choice between actions) is transformed into a *signaling game*. Here the sender (Sally in the example) can send signals, and she can make her choice of signal dependent on the actual world. Formally, the sender's behaviour is given by a *sender strategy*, which is a function from possible worlds to signals. The receiver (Robin in the example) can condition his action on the signal received. So a *receiver strategy* is a function from signals to actions. We will represent strategies graphically as tables indicating the corresponding functions:

$$\begin{array}{cc} \text{Sally's strategy } s: & \text{Robin's strategy } r: \\ \left[\begin{array}{lll} w_1 & \rightarrow & \text{"}mild\text{"} \\ w_2 & \rightarrow & \text{"}hot\text{"} \end{array}\right] & \left[\begin{array}{lll} \text{"}mild\text{"} & \rightarrow & a_{\text{mild}} \\ \text{"}hot\text{"} & \rightarrow & a_{\text{hot}} \end{array}\right] \end{array} \tag{3}$$

The above example suggests that rational players will benefit from the option of communication. Things are not that simple though. Consider the following pair of strategies:

$$\begin{array}{cc} \text{Sally's strategy } s': & \text{Robin's strategy } r': \\ \left[\begin{array}{lll} w_1 & \rightarrow & \text{"}hot\text{"} \\ w_2 & \rightarrow & \text{"}mild\text{"} \end{array}\right] & \left[\begin{array}{lll} \text{"}hot\text{"} & \rightarrow & a_{\text{mild}} \\ \text{"}mild\text{"} & \rightarrow & a_{\text{hot}} \end{array}\right] \end{array} \tag{4}$$

If Sally and Robin play these strategies they will also end up with the maximal payoff of 1. Pure reason does not provide a clue to decide between these two ways to coordinate. It is thus consistent with rationality that Sally assumes Robin to use r' and thus to signal according to s', while Robin assumes Sally to use s, and thus will interpret her signals according to r. In this situation, Robin will perform a_{hot} in w_1 and a_{mild} in w_2. Both players would receive the worst possible expected payoff of 0 here.

These considerations ignore the fact that the two signals have a conventional meaning which is known to both players. In our example, we would say that the conventional meaning of "*mild*" is the proposition $[\![mild]\!] = \{w_1\}$ whereas the meaning of "*hot*" is $[\![hot]\!] = \{w_2\}$. Then (s,r) is a priori more plausible than (s',r') because in (s,r) Sally always says the truth and Robin always believes the literal meaning of Sally's message.

However, rational players cannot always rely on the honesty/credulity of the other player. Consider the following scenario. Rasmus also invites Sally for dinner but he cannot stand her. He wants to annoy her by preparing the curry the way she does not like. So while Sally will still prefer to receive her favoured type of curry, Rasmus will be happy only if he manages to prepare her disfavoured type.

	a_{mild}	a_{hot}
w_1	$1,-1$	$-1,1$
w_2	$-1,1$	$1,-1$

(5)

Here the interests of Sally and Rasmus are strictly opposed; everybody can only win as much as the other one looses. Again we assume that Sally can send two signals "*mild*" and "*hot*" with the conventional meaning as above. If Rasmus is credulous, he will react to "*mild*" with a_{hot} and to "*hot*" with a_{mild}. But if Sally believes this and is rational, she will be *dishonest* and send "*hot*" in w_1 (where she actually likes mild curries) and "*mild*" in w_2 (where she actually likes hot curries). But Rasmus might anticipate this. If he is not quite so credulous, he may switch his strategy accordingly, and react to "*mild*" with a_{mild} etc. This again might be anticipated by Sally and she might revert to the lying strategy, which again might be anticipated by Rasmus, etc. In fact, it turns out that *any* strategy is rationalizable in this game.[1] In other words, no real communication ensues. The lesson here is that communication might help in situations where the interests of the players are aligned, but it does not make a difference if these interests are completely opposed.

Gricean Reasoning

The kind of reasoning that was informally employed in the last section is reminiscent to pragmatic reasoning in the tradition of Grice (1975). For instance, information can only be exchanged between rational agents if it is in the good interest of both agents that this information transfer takes place. This intuition is captured by Grice's *Cooperative Principle*. Furthermore, we mentioned the default assumption that messages are used

[1] A strategy s is *rationalizable* if there is a consistent set of beliefs such that s maximizes the expected payoff of the player, given these beliefs and the assumption that rationality of all players is common knowledge.

according to their conventional meaning, unless overarching rationality considerations dictate otherwise. This corresponds to Grice's Maxim of Quality.

To illustrate how game theoretic reasoning can account for pragmatic reasoning let us consider the prime example of a scalar implicature, namely the strengthening of the conventional meaning of "*some*" to "*some but not all*". You can imagine that Robin wants to know who was at the party last night, and Sally knows the answer. In $w_\forall$ all girls were at the party and in $w_{\exists\neg\forall}$ some but not all girls were there. Again, Robin is completely unsure, i.e. he considers each world to be equally likely. Considering Robin's actions let us assume that there are three of them: two actions $a_\forall$ and $a_{\exists\neg\forall}$ that are appropriate in and only in worlds $w_\forall$ and $w_{\exists\neg\forall}$, respectively, and a kind of default action $a_?$. For each world, both Sally and Robin prefer Robin to perform the appropriate action to Robin performing the default action, which they in turn prefer to Robin performing the inappropriate action. The following payoff structure reflects this preference order.

	$a_\forall$	$a_{\exists\neg\forall}$	$a_?$
$w_\forall$	10,10	0,0	9,9
$w_{\exists\neg\forall}$	0,0	10,10	9,9

(6)

Furthermore we have three different messages with their corresponding conventional meaning.

$$\begin{array}{rcl} f_\forall &=& \text{“All girls were at the party.”} \\ f_{\exists\neg\forall} &=& \text{“Some but not all girls were at the party.”} \\ f_\exists &=& \text{“Some girls were at the party.”} \end{array} \qquad \begin{array}{rcl} [\![f_\forall]\!] &=& \{w_\forall\} \\ [\![f_{\exists\neg\forall}]\!] &=& \{w_{\exists\neg\forall}\} \\ [\![f_\exists]\!] &=& \{w_\forall, w_{\exists\neg\forall}\} \end{array}$$

Obviously $f_{\exists\neg\forall}$ is more complex than the other two messages, which are approximately equally complex. This is covered by the assignment of *costs* to signals which the sender has to pay. Formally this is implemented by a cost function c that assigns some numerical value to every signal. Let us say that in this example we have $c(f_\forall) = c(f_\exists) = 0$ and $c(f_{\exists\neg\forall}) = 2$. So the sender's utility is now a three-place function u_S that depends on the actual world, the message sent, and the action that the receiver takes. If $v_S(w,a)$ is the distribution of sender payoffs that is given in the payoff table (6) above, the sender's overall utility is now

$$u_S(w,f,a) \;=\; v_S(w,a) - c(f) \tag{7}$$

According to Gricean pragmatics, Sally would reason about her strategy roughly as follows:

If I am in $w_\forall$ I want Robin to perform $a_\forall$ because this gives me a utility of 10. $a_\forall$ is what he would do if he believed that he is in $w_\forall$. I can try to convince him of this fact by saying $f_\forall$. It is not advisable to say $f_{\exists\neg\forall}$, because if Robin believed it, he would perform $a_{\exists\neg\forall}$, which gives me a utility of a mere -2. Also saying $f_\exists$ is not optimal. If Robin believes it, this will not settle the issue which world we are in for him and thus he will perform $a_?$, because his expected utility in this case is 9 while his expected utility for the other two actions is only 5. This would give me also a utility of 9. So it seems reasonable to send $f_\forall$ in $w_\forall$.

If I am in $w_{\exists\neg\forall}$, it might seem reasonable to say $f_{\exists\neg\forall}$ because if Robin believes it, he will perform $a_{\exists\neg\forall}$, which is my favorite outcome. However, I will have to pay the costs of 2, so my net utility is only 8. If I say $f_\exists$ and Robin believes it, he will perform $a_?$. Since $f_\exists$ is costless for me, my net utility is 9 in this case, which is better than 8. So in $w_{\exists\neg\forall}$ I will send $f_\exists$. After this reasoning, Sally will hence settle on the following strategy:

$$\begin{bmatrix} w_\forall & \rightarrow & f_\forall \text{ ("\textit{All girls were at the party.}")} \\ w_{\exists\neg\forall} & \rightarrow & f_\exists \text{ ("\textit{Some girls were at the party.}")} \end{bmatrix} \tag{8}$$

Robin in turn will anticipate that Sally will reason this way: If I am confronted with the message $f_\forall$, I know that the world is $w_\forall$, hence I will perform $a_\forall$. If I hear $f_\exists$, I know that the world is $w_{\exists\neg\forall}$, hence I will perform $a_{\exists\neg\forall}$ after all. Therefore his strategy will look as follows:

$$\begin{bmatrix} f_\forall \text{ ("\textit{All girls were at the party.}")} & \rightarrow & a_\forall \\ f_\exists \text{ ("\textit{Some girls were at the party.}")} & \rightarrow & a_{\exists\neg\forall} \end{bmatrix} \tag{9}$$

Sally, being aware of this fact, will reason: Taking into consideration Robin's reasoning and his eventual strategy, it is even more beneficial for me to send $f_\exists$ if I am in $w_\exists$ because this will give me the maximal payoff of 10. So I have no reason to change the plan of sending $f_\forall$ in $w_\forall$ and $f_\exists$ in $w_{\exists\neg\forall}$.

Hence she will stick to her strategy in (8). In a further round of deliberation Robin will realize this and thus also stick to his strategy (9). Any further deliberation of Sally and Robin will not change anything.

This iterated reasoning procedure explains the emergence of the scalar implicature. It leads to a sender strategy where $f_\exists$ is sent if and only if $\{w_{\exists\neg\forall}\}$ is true. In other words, the literal meaning of $f_\exists$, which is $\{w_\forall, w_{\exists\neg\forall}\}$, has been pragmatically strengthened to a proper subset $\{w_{\exists\neg\forall}\}$. The information that $w_\forall$ is not the case is a scalar implicature — "*some*" is pragmatically interpreted as "*some but not all*".

As in the examples discussed in the previous section, the inferences that are used here start with a default assumption that messages are used according to their literal interpretation, but this is only a provisional assumption that is adopted if this is not in contradiction with rationality.

2 Iterated Best Response

The reasoning pattern that is used here makes implicit use of the notion of the *best response* of a player to a certain probabilistic belief. A best response (that need not be unique) to such a belief is a strategy that maximizes the expected payoff of the player as compared to all other strategies at his disposal, given this belief state. For a player to be *rational* means then to always play some best response, given his belief.

Let us now assume the position of an external observer who wants to formally model the notion of a best response, say Sally's best response to her belief about Robin's strategies. If we denote the set of strategies available to Robin at some point with R, we know that 1. Sally believes that Robin will play some strategy from R, 2. Sally holds all strategies in R possible, i.e. she cannot exclude any strategy for sure. Despite that we do not have any further information about Sally's belief – maybe she holds all strategies in R equally possible, or maybe she considers some strategies more likely than others. The best we can do as external observer is to take all possible beliefs for Sally into account.

Formally we can do this by modeling a belief of Sally as a probability distribution over the set of strategies R such that it does not assign zero probability to any element of R (i.e. Sally cannot exclude any strategy for sure). Let us therefore define the following sets of probability distributions over X for a non-empty and finite set X:

$$\Delta(X) \doteq \left\{ p \in X \to [0,1] \,\middle|\, \sum_{x \in X} p(x) = 1 \right\} \tag{10}$$

$$\Delta^+(X) \doteq \left\{ p \in X \to (0,1] \,\middle|\, \sum_{x \in X} p(x) = 1 \right\} \tag{11}$$

The difference is subtle but important. Both $\Delta(\cdot)$ and $\Delta^+(\cdot)$ can be used to model probabilistic beliefs. If we say that a player holds a belief from $\Delta(X)$, say, this means that he may exclude some elements from X with absolute certainty. On the other hand, if he holds a belief from $\Delta^+(X)$, then he may have certain guesses, but he is not able to exclude any element from X with certainty. In the case discussed above, Sally's believe about Robin's strategies R is modeled some $\rho \in \Delta^+(R)$. Hence any best response of Sally's to any such belief is a *potential best response* for Sally against R. All that we as an external observer can predict with certainty if we assume Sally to be rational, is that she will play some potential best response against R.

The iterative inference process that was used in the computation of the implicature above can be informally described as follows. At start, Sally provisionally assumes that Robin is entirely credulous, and that he conditions his actions only on the literal interpretation of the message received. Let us call the set[2] of credulous strategies R_0.

Sally's turn. Sally might ponder any strategy that is a potential best response against R_0. Let us call this set of strategies S_0.

Robin's turn. Robin might ponder all strategies that are potential best responses against S_0. The set of these strategies is R_1.

Sally's turn. Sally might ponder any strategy that is a potential best response against R_1. Let us call this set of strategies S_1.

Robin's turn ...

In general, S_n and R_{n+1} are the set of strategies that are potential best responses against R_n and S_n, respectively. If a certain strategy cannot be excluded by this kind of reasoning, i.e. if there are infinitely many indices i such that it occurs in S_i or R_i, then we call it a *pragmatically rationalizable strategy*.

Contexts

In the scalar implicature example, the described reasoning of Sally and Robin went in circles at some point. Therefore, all strategies they considered possible at this point were pragmatically rationalizable. These were exactly the strategies in (8) and (9), which described the scalar implicature.

[2] There might be more than one credulous strategy because several actions may yield the same maximal payoff for Robin in certain situations.

Taking another close look at the payoff structure in (6), we see that the scalar implicature arises because the difference between $v_S(w_{\exists\neg\forall}, a_{\exists\neg\forall})$ and $v_S(w_{\exists\neg\forall}, a_?)$ is smaller than the costs of sending $f_{\exists\neg\forall}$. Suppose the utilities would be as in (12), rather than as in (6). Then the pragmatically rationalizable outcome would be that Sally uses $f_{\exists\neg\forall}$ in $w_{\exists\neg\forall}$, while $f_\exists$ would never be used.

	$a_\forall$	$a_{\exists\neg\forall}$	$a_?$
$w_\forall$	10,10	0,0	6,6
$w_{\exists\neg\forall}$	0,0	10,10	6,6

(12)

At this point, we introduce another level of uncertainty concerning the payoff structure (in addition to the uncertainty of the player about the actual strategy of the other player). Robin might actually not know for sure what Sally's precise preferences are. If we call the utility matrix (6) *context* c_1, and the utilities in (12) context c_2, Robin might hold some probabilistic belief about whether Sally is in c_1 or in c_2. Likewise, Sally need not know for sure which context Robin is in. Now in each round of the iterative reasoning process, the players will ponder each strategy that is a potential best response not only to any probability distribution over strategies of the previous round as before, but also to any probability distribution over contexts. Sally will compute her first set of best responses S_0 by assuming a credulous Robin as follows: In $w_\forall$ I will definitely send $f_\forall$, no matter which context is the actual one. Now for $w_{\exists\neg\forall}$: If the actual context is c_1 it is better to send $f_\exists$ because the costs of sending the more explicit message $f_{\exists\neg\forall}$ exceed the potential benefits. But if it is c_2 and it is advisable to use $f_{\exists\neg\forall}$ nevertheless.

Robin, in turn, will reason as follows to compute his best responses R_1: If I hear $f_\forall$, we are definitely in $w_\forall$, and the best thing I can do is to perform $a_\forall$, no matter which context we are in. If I hear $f_{\exists\neg\forall}$ we are in $c_2/w_{\exists\neg\forall}$ and I will perform $a_{\exists\neg\forall}$. If I hear $f_\exists$ we are in $c_1/w_{\exists\neg\forall}$ and I will also play $a_{\exists\neg\forall}$.

So in S_1 Sally will infer: $f_\forall$ will induce $a_\forall$, and both $f_{\exists\neg\forall}$ and $f_\exists$ will induce $a_{\exists\neg\forall}$, no matter which context Robin is in. Since $f_\exists$ is less costly than $f_{\exists\neg\forall}$, I will hence always use $f_\forall$ in $w_\forall$ and $f_\exists$ in $w_{\exists\neg\forall}$, regardless of the context I am in.

Robin, in R_1, will thus conclude that his best response to $f_\forall$ is always $a_\forall$, and his best response to $f_\exists$ is $a_{\exists\neg\forall}$. Nothing will change in later iterations. So here, the scalar implicature from "*some*" to "*some but not all*" will arise in all contexts, even though context c_2 by itself would not license it.

The Formal Model

In this section we will present a formal model that captures the intuitive reasoning from the last section. A *semantic game* is a game between two players, the *sender* and the *receiver*. It is characterized by a finite set of contexts C, a finite set of worlds W, a finite set of signals (or forms) F, a finite set of actions A,

- a probability distribution $p^* \in \Delta^+(W)$ specifying the receiver's *a priori* probability for each world,
- an interpretation function $[\![\cdot]\!] : F \to \mathrm{Pow}(W)$,

- and utility functions

  $u_S \colon C \times W \times F \times A \to \mathbb{R}$ for the sender and

  $u_R \colon C \times W \times A \to \mathbb{R}$ for the receiver.

As in (7), we will give the sender's utility function by separating the context/outcome utilities v_S from the signalling costs $c \colon F \to \mathbb{R}$ in the following. The structure of the game is common knowledge between the players.

Definition 1. The space of *pure sender strategies* $\mathcal{S} = C \times W \to F$ is the set of functions from context/world pairs to signals. The space of *pure receiver strategies* $\mathcal{R} = C \times F \to A$ is the set of functions from context/signals pairs to actions. A *sender belief* is a pair of probability distributions $(\rho, p) \in \Delta(\mathcal{R}) \times \Delta(C)$ and a *receiver belief* is a pair of probability distributions $(\sigma, p) \in \Delta(\mathcal{S}) \times \Delta(C)$.

The central step in the iterative process described above is the computation of the set of strategies that maximize the expected payoff of a player against his belief about the strategies of the other player and the context. The notion of a *best response* captures this.

Definition 2. Let (σ, p) be a receiver belief and (ρ, p) a sender belief. The set $\mathrm{BR}_R(\sigma, p)$ of *best responses of the recevier to* (σ, p) and the set $\mathrm{BR}_S(\rho, p)$ of *best responses of the sender to* (ρ, p) are defined as follows:

$$\mathrm{BR}_R(\sigma, p) \doteq \left\{ r \in \mathcal{R} \;\middle|\; \forall c \in C : \right.$$
$$\left. r \in \operatorname*{argmax}_{r \in \mathcal{R}} \sum_{s \in \mathcal{S}} \sigma(s) \sum_{c' \in C} p(c') \sum_{w \in W} p^*(w)\, u_R(c, w, r(c, s(c', w))) \right\}$$

$$\mathrm{BR}_S(\rho, p) \doteq \left\{ s \in \mathcal{S} \;\middle|\; \forall c \in C\, \forall w \in W : \right.$$
$$\left. s \in \operatorname*{argmax}_{s \in \mathcal{S}} \sum_{r \in \mathcal{R}} \rho(r) \sum_{c' \in C} p(c')\, u_S(c, w, s(c, w), r(c', s(c, w))) \right\}$$

Based on this definition of best responses to a certain belief we may define the set of *potential best responses* against some set P of strategies of the opposing player as the set of strategies that are best responses to some belief state that assigns positive probability exactly to the elements of P.

Definition 3. Let $S \subseteq \mathcal{S}$ and $R \subseteq \mathcal{R}$ be a set of sender and receiver strategies, respectively. The set $\mathrm{PBR}(S)$ of *potential best responses of the receiver to S* and the set $\mathrm{PBR}(R)$ of *potential best responses (of the sender) to R* are defined as follows:

$$\mathrm{PBR}(S) \doteq \{\, r \in \mathrm{BR_R}(\sigma, p) \mid (\sigma, p) \text{ a receiver belief with } \sigma \in \Delta^+(S) \,\}$$

$$\mathrm{PBR}(R) \doteq \{\, s \in \mathrm{BR_S}(\rho, p) \mid (\rho, p) \text{ a sender belief with } \rho \in \Delta^+(R) \,\}$$

Suppose we know that Sally, being the sender, knows which context and world she is in, she believes for sure that Robin will play a strategy from R, and there is no more specific information that she believes to know for sure. We do not know which strategy from R Sally expects Robin to play with which likelihood, and which context Sally believes to be in. Under these conditions, all we can predict for sure is that Sally will play some strategy from $\mathrm{PBR}(R)$ if she is rational.

The same seems to hold if we only know that Robin, the receiver, expects Sally to play some strategy from S. Then we can infer that Robin, if he is rational, will certainly play a strategy from $\mathrm{PBR}(S)$. However, we may restrict his space of reasonable strategies even further. Suppose none of the strategies in S ever make use of the signal f (formally put, $f \in F - \bigcup_{s\in S} \mathrm{range}(s)$). We call such a signal *unexpected*. Then it does not make a difference how Robin would react to f, but he has to decide about how to react to f nevertheless because receiver strategies are *total* functions from context/form pairs to actions. It seems reasonable to demand (and it leads to reasonable predictions, as we will see below) that Robin should, in the absence of evidence to the contrary, still assume that f is true. For instance, if Sally speaks English to Robin, and she suddenly throws in a sentence in Latin that Robin happens to understand, Robin will probably assume that the Latin sentence is true, even if he did not expect her to use Latin.

If Robin encounters such an unexpected signal, he will have to revise his beliefs. Robin will have to figure out an explanation why Sally used f despite his expectations to the contrary, and this explanation can bias his prior beliefs in any conceivable way. We have to assume though that the result of this believe revision is a consistent belief state, and that Robin will act rationally according to his new beliefs. Formally speaking, he should only consider strategies that react to an unexpected signal f in a way that maximizes his expected utility, given that f is interpreted literally for some belief about W.

We can now proceed to define the iterative reasoning procedure that was informally described in the previous section, taking into account the treatment of unexpected signals detailed above (recall that p^* is the receiver's *a priori* probability distribution).

Definition 4.

$$
\begin{aligned}
R_0 &\doteq \left\{ r \in \mathcal{R} \,\middle|\, \forall c \in C \forall f \in F : r(c,f) \in \operatorname*{argmax}_{a\in A} \sum_{w\in[\![f]\!]} p^*(w) u_R(c,w,a) \right\} \\
S_n &\doteq \mathrm{PBR}(R_n) \\
R_{n+1} &\doteq \Bigg\{ r \in \mathrm{PBR}(S_n) \,\Bigg|\, \forall f \in F - \bigcup_{s\in S_n} \mathrm{range}(s) \forall c \in C \\
&\qquad \exists p \in \Delta^+(W) : r(c,f) \in \operatorname*{argmax}_{a\in A} \sum_{w\in[\![f]\!]} p(w) u_R(c,w,a) \Bigg\}
\end{aligned}
$$

R_0 is the set of credulous strategies of the receiver. It consists of those strategies r that yield, in each context c and for each signal f, some action $a \in A$ that is optimal for the receiver (i.e. that maximize his expected utility, cf. (2)), given that his *a priori* belief p^* is updated with the information that f is used literally. S_n is the set of potential best responses of the sender against R_n. Likewise, R_{n+1} is the set of potential best responses of the receiver if he assumes that the sender plays a strategy from S_n in which he always tries to make sense of unexpected messages under the assumption that they are literally true.

The sets of *pragmatically rationalizable strategies* are the set of sender strategies and receiver strategies that cannot be excluded for sure by the iterative reasoning process, no matter how deeply the reasoning goes.

Definition 5. $(\mathbf{S},\mathbf{R}) \in \mathrm{Pow}(\mathcal{S}) \times \mathrm{Pow}(\mathcal{R})$, the sets of *pragmatically rationalizable strategies*, are defined as follows:

$$\begin{aligned}\mathbf{S} &\doteq \{s \in \mathcal{S} \mid \forall n \in \mathbb{N} \exists m > n : s \in S_m\} \\ \mathbf{R} &\doteq \{r \in \mathcal{R} \mid \forall n \in \mathbb{N} \exists m > n : s \in R_m\}\end{aligned}$$

Note that there are only finitely many strategies in $\mathcal{S}$ and $\mathcal{R}$ (because we are only considering pure strategies over finite sets). Therefore there are only finitely many subsets thereof. The step from (S_n, R_n) to (S_{n+1}, R_{n+1}) is always deterministic. It follows that the iterative procedure will enter a cycle at some point. This ensures that $(\mathbf{S},\mathbf{R})$ is always defined.

3 Applying the IBR Model

In light of this formal definition, let us consider some of the previous examples again. For the ease of exposition we will specify signals as $f_{x_1 \ldots x_n}$ with the convention that $[\![f_{x_1 \ldots x_n}]\!] = \{w_{x_1}, \ldots, w_{x_n}\}$. Furthermore, if the utilities of the players are identical for each outcome, we will show only one number in the utility matrix. If the *a priori* probability p^* is not explicitly stated, we assume that it is the uniform distribution on W that assigns all worlds equal probability.

Completely aligned interests. We assume that all signals f are costless, i.e. $c(f) = 0$. There is only one context and v_S and u_R are given in table (1). Here is the sequence of iterated computation of potential best responses, starting with the set R_0 of credulous strategies.

$$\begin{aligned}\mathbf{R} = R_0 &= \left\{ \begin{bmatrix} f_1 & \rightarrow & a_{\mathrm{mild}} \\ f_2 & \rightarrow & a_{\mathrm{hot}} \\ f_{12} & \rightarrow & a_{\mathrm{mild}} \end{bmatrix}, \begin{bmatrix} f_1 & \rightarrow & a_{\mathrm{mild}} \\ f_2 & \rightarrow & a_{\mathrm{hot}} \\ f_{12} & \rightarrow & a_{\mathrm{hot}} \end{bmatrix} \right\} \\ \mathbf{S} = S_0 &= \left\{ \begin{bmatrix} w_1 & \rightarrow & f_1 \\ w_2 & \rightarrow & f_2 \end{bmatrix} \right\}\end{aligned}$$

In the following we will abbreviate the specifications of the strategy sets by dropping the set brackets and by conflating the strategies to one representation. The original set can be recovered by combination of all possible argument/value pairs.

Completely Opposing Interests. Again all messages are costless and there is only one context. The utilities are as in (5). Here the iterative procedure enters a never-ending cycle:

$$R_0 = \begin{bmatrix} f_1 & \to & a_{\text{hot}} \\ f_2 & \to & a_{\text{mild}} \\ f_{12} & \to & a_{\text{mild}}/a_{\text{hot}} \end{bmatrix} \qquad S_0 = \begin{bmatrix} w_1 & \to & f_2 \\ w_2 & \to & f_1 \end{bmatrix}$$

$$R_1 = \begin{bmatrix} f_1 & \to & a_{\text{mild}} \\ f_2 & \to & a_{\text{hot}} \\ f_{12} & \to & a_{\text{mild}}/a_{\text{hot}} \end{bmatrix} \qquad S_1 = \begin{bmatrix} w_1 & \to & f_1 \\ w_2 & \to & f_2 \end{bmatrix}$$

$$R_2 = R_0 \qquad S_2 = S_0$$

$$\mathbf{R} = \begin{bmatrix} f_1/f_2/f_{12} & \to & a_{\text{mild}}/a_{\text{hot}} \end{bmatrix} \qquad \mathbf{S} = \begin{bmatrix} w_1/w_2 & \to & f_1/f_2/f_{12} \end{bmatrix}$$

So if the interests of the players are completely opposed, *any* strategy is pragmatically rationalizable and no communication will ensue.

Scalar Implicatures and the Q-Heuristics. Next we will reconsider the example of the scalar implicature discussed above. There are two contexts c_1 and c_2 with utilities as in (6) and (12), respectively. The signals and their costs are also as above: $c(f_\forall) = c(f_\exists) = 0$ and $c(f_{\exists\neg\forall}) = 2$.

$$R_0 = \begin{bmatrix} (c_1, f_\forall)/(c_2, f_\forall) & \to & a_\forall \\ (c_1, f_{\exists\neg\forall})/(c_2, f_{\exists\neg\forall}) & \to & a_{\exists\neg\forall} \\ (c_1, f_\exists)/(c_2, f_\exists) & \to & a_? \end{bmatrix} \qquad S_0 = \begin{bmatrix} (c_1, w_\forall)/(c_2, w_\forall) & \to & f_\forall \\ (c_1, w_{\exists\neg\forall}) & \to & f_{\exists\neg\forall} \\ (c_2, w_{\exists\neg\forall}) & \to & f_\exists \end{bmatrix}$$

$$\mathbf{R} = R_1 = \begin{bmatrix} (c_1, f_\forall)/(c_2, f_\forall) & \to & a_\forall \\ (c_1, f_{\exists\neg\forall})/(c_2, f_{\exists\neg\forall})/(c_1, f_\exists)/(c_2, f_\exists) & \to & a_{\exists\neg\forall} \end{bmatrix}$$

$$\mathbf{S} = S_1 = \begin{bmatrix} (c_1, w_\forall)/(c_2, w_\forall) & \to & f_\forall \\ (c_1, w_{\exists\neg\forall})/(c_2, w_{\exists\neg\forall}) & \to & f_\exists \end{bmatrix}$$

The previous example illustrated how pragmatic rationalizability formalizes the intuition behind Levinson's (2000) *Q-heuristics* "What isn't said, isn't." This heuristics accounts, *inter alia* for scalar and clausal implicatures like the following:

(1) a. *Some boys came in.* $\rightsquigarrow$ *Not all boys came in.*
    b. *Three boys came in.* $\rightsquigarrow$ *Exactly three boys came in.*

(2) a. *If John comes, I will leave.* $\rightsquigarrow$ *It is open whether John comes.*
    b. *John tried to reach the summit.* $\rightsquigarrow$ *John did not reach the summit.*

The essential pattern here is as in the example above: There are two expressions A and B of comparable complexity such that the literal meaning of A entails the literal meaning of B. There is no simple expression for the concept "B but not A". In this scenario, a usage of "B" will implicate that A is false.

The I-Heuristics. Levinson assumes two further pragmatic principles that, together with the Q-heuristics, are supposed to replace Grice's maxims in the derivation of generalized conversational implicatures. The second heuristics, called *I-heuristics*, says: "What is simply described is stereotypically exemplified." It accounts for phenomena of pragmatic strengthening, as illustrated in the following examples:

(3) a. *John's book is good.* $\rightsquigarrow$ *The book that John is reading or that he has written is good.*

b. *a secretary* $\rightsquigarrow$ *a female secretary*

c. *road* $\rightsquigarrow$ *hard-surfaced road*

The notion of "stereotypically exemplification" is somewhat vague and difficult to translate into the language of game theory. We will assume that stereotypical propositions are those with a high prior probability and that simplicity of descriptions can be translated into low signaling costs. So the principle amounts to "Likely propositions are expressed by cheap forms".

Let us construct a schematic example of such a scenario. Suppose there are two possible worlds (which may also stand for objects, like a hard surfaced vs. soft-surfaced road) w_1 and w_2, such that w_1 is *a priori* much more likely than w_2, say $p^*(w_1) = 3/4$ and $p^*(w_2) = 1/4$. There are three possible actions for Robin: he may choose a_1 if he expects w_1 to be correct, a_2 if he expects w_2, and a_3 if he finds it too risky to choose.

There are again three signals, f_1, f_2 and f_{12}. This time the more general expression f_{12} (corresponding for instance to "*road*") is cheap, while the two specific expressions f_1 ("*hard-surfaced road*") and f_2 ("*soft-surfaced road*") are more expensive: $c(f_1) = c(f_2) = 5$, and $c(f_{12}) = 0$.

The interests of Sally and Robin are completely aligned, except for the signaling costs which only matter for Sally. There are three contexts (13). In c_1 and c_2, it is safest for Robin to choose a_3 if he decides on the basis of the prior probability. In c_3 it makes sense to choose a_1 if he only knows the prior probabilities because the payoff of a_3 is rather low (but still higher than making the wrong choice between a_1 and a_2). In c_1, but not in c_2 it would be rational for Sally to use a costly message if this is the only way to make Robin perform a_1 rather than a_3.

$$c_1: \begin{array}{|c|ccc|}\hline & a_1 & a_2 & a_3 \\ \hline w_1 & 28 & 0 & 22 \\ w_2 & 0 & 28 & 22 \\ \hline\end{array} \qquad c_2: \begin{array}{|c|ccc|}\hline & a_1 & a_2 & a_3 \\ \hline w_1 & 28 & 0 & 25 \\ w_2 & 0 & 28 & 25 \\ \hline\end{array} \qquad c_3: \begin{array}{|c|ccc|}\hline & a_1 & a_2 & a_3 \\ \hline w_1 & 28 & 0 & 10 \\ w_2 & 0 & 28 & 10 \\ \hline\end{array} \qquad (13)$$

$$R_0 = \left[\begin{array}{lll} (c_1,f_1)/(c_2,f_1)/(c_3,f_1)/(c_3,f_{12}) & \to & a_1 \\ (c_1,f_2)/(c_2,f_2)/(c_3,f_2) & \to & a_2 \\ (c_1,f_{12})/(c_2,f_{12}) & \to & a_3 \end{array}\right]$$

$$\mathbf{S} = S_0 = \left[\begin{array}{lll} (c_1,w_1)/(c_3,w_1) & \to & f_1/f_{12} \\ (c_1,w_2)/(c_3,w_2) & \to & f_2 \\ (c_2,w_1) & \to & f_{12} \\ (c_2,w_2) & \to & f_2/f_{12} \end{array}\right]$$

$$\mathbf{R} = R_1 = \left[\begin{array}{lll} (c_1,f_1)/(c_2,f_1)/(c_3,f_1)/(c_3,f_{12}) & \to & a_1 \\ (c_1,f_2)/(c_2,f_2)/(c_3,f_2) & \to & a_2 \\ (c_1,f_{12})/(c_2,f_{12}) & \to & a_1/a_3 \end{array}\right]$$

Here both f_1 and f_2 retain their literal meaning under pragmatic rationalizability. The unspecific f_{12} also retains its literal meaning in c_2. In c_1 and c_3, though, its meaning is pragmatically strengthened to $\{w_1\}$. Another way of putting is to say that f_{12} is *pragmatically ambiguous* here. Even though it has an unambiguous semantic meaning, its pragmatic interpretation varies between contexts. It is noteworthy here that f_{12} can never be strengthened to mean $\{w_2\}$. Applying it to the example, this means that a simple non-specific expression like "*road*" can either retain its unspecific meaning, or it can be pragmatically strengthened to its stereotypical instantiation (like "*hard-surfaced road*" here). It can never be strengthened to a non-stereotypical meaning though.

M-Heuristics. Levinson's third heuristics is the *M-heuristics*: "What is said in an abnormal way isn't normal." It is also known, after Horn (1984), as *division of pragmatic labor*. A typical example is the following:

(4) a. *John stopped the car.*

b. *John made the car stop.*

The two sentences are arguably semantically synonymous. Nevertheless they carry different pragmatic meanings if uttered in a neutral context. (4a) is preferably interpreted as *John stopped the car in a regular way, like using the foot brake.* This would be another example for the I-heuristics. (4b), however, is also pragmatically strengthened. It means something like *John stopped the car in an abnormal way, like driving it against a wall, making a sharp u-turn, driving up a steep road, etc.*

This can be modeled quite straightforwardly. Suppose there are again two worlds, w_1 and w_2, such that w_1 is likely and w_2 is unlikely (like using the foot brake versus driving against a wall). Let us say that $p^*(w_1) = 3/4$ and $p^*(w_2) = 1/4$ again. There are two actions, a_1 and a_2, which are best responses in w_1 and w_2 respectively. There is only one context. The utilities are given as follows:

	a_1	a_2
w_1	5	0
w_2	0	5

(14)

Unlike in the previous example, we assume that there are only two expressions, f and f', which are both unspecific: $[\![f]\!] = [\![f']\!] = \{w_1, w_2\}$. f' is slightly more expensive than f, say $c(f) = 0$ and $c(f') = 1$.

$$\begin{aligned} R_0 &= \left[\begin{array}{ccc} f/f' & \rightarrow & a_1 \end{array}\right] & S_0 &= \left[\begin{array}{ccc} w_1/w_2 & \rightarrow & f \end{array}\right] \\ R_1 &= \left[\begin{array}{ccc} f & \rightarrow & a_1 \\ f' & \rightarrow & a_1/a_2 \end{array}\right] & S_1 &= \left[\begin{array}{ccc} w_1 & \rightarrow & f \\ w_2 & \rightarrow & f/f' \end{array}\right] \\ \mathbf{R} = R_2 &= \left[\begin{array}{ccc} f & \rightarrow & a_1 \\ f' & \rightarrow & a_2 \end{array}\right] & \mathbf{S} = S_2 &= \left[\begin{array}{ccc} w_1 & \rightarrow & f \\ w_2 & \rightarrow & f' \end{array}\right] \end{aligned} \tag{15}$$

The crucial point here is that in S_0, the signal f' remains unused. Therefore any rationalizable interpretation of f' which is compatible with its literal meaning is licit in R_1, including the one where f' is associated with w_2 (which triggers the reaction a_2). Robin's reasoning at this stage can be paraphrased as: If Sally uses f, this could mean either w_1 or w_2. Since w_1 is *a priori* more likely, I will choose a_1. There is apparently no good reason for Sally to use f'. If she uses it nevertheless, she must have something in mind which I hadn't thought of. Perhaps she wants to convey that she is actually in w_2.

Sally in turn reasons: If I say f, Robin will take action a_1. If I use f', he may take either action. In w_1 I will thus use f. In w_2 I can play it safe and use f, but I can also take my chances and try f'.

Robin in turn will calculate in R_2: If I hear f, we are in w_1 with a confidence between 75% and 100%. In any event, I should use a_1. The only world where Sally would even consider using f' is w_2. So if I hear f' we are surely in w_2 and I can safely choose a_2. If Robin reasons this way, it is absolutely safe for Sally to use f' in w_2.

4 Conclusion

We proposed a game theoretic formalization of Gricean reasoning that both captures the intuitive reasoning patterns that are traditionally assumed in the computation of implicatures. The essential intuition behind the proposal is that the literal meaning of signals constitutes their default interpretation, and that rational communicators decide about their communicative strategies by iteratively calculating the best response to this default strategy.

Concerning related work, Franke (2008) proposes to calculate the pragmatically licit communication strategies by starting with a strategy based on the literal interpretation of signals and iteratively computing the best response strategy until a fixed point is reached. So this approach is very similar in spirit to the present one. The main differences are that Franke uses a particular honest sender strategy — rather than the set of all credulous receiver strategies — as the starting point of the iteration process, and that he uses deterministic best response calculation, rather than potential best responses, as update rule.

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The Interpretation of Questions in Dialogue

Alex Lascarides
School of Informatics
University of Edinburgh

alex@inf.ed.ac.uk

Nicholas Asher
IRIT
Université Paul Sabatier

asher@irit.fr

Abstract

We propose a dynamic semantics of questions in dialogue that tracks the public commitments of each dialogue agent, including commitments to issues raised by questions.

1 Introduction

A semantic framework for interpreting dialogue should provide an account of the content that is *mutually accepted* by its participants. The acceptance by one agent of another's contribution crucially involves the theory of what that contribution means; *A*'s acceptance of *B*'s contribution means that the content of *B*'s contribution must be integrated into *A*'s extant commitments.[1] For assertions, traditionally assumed to express a proposition formalised as a set of possible worlds, it was clear how the integration should go: acceptance meant intersecting the newly accepted proposition with the set of worlds representing the content of the agent's prior commitments. Dynamic semantics (e.g., Asher (1989)) refined this picture by replacing intersection with the operation of dynamic update. The way to treat the negative counterpart of acceptance—namely, rejection—is also clear in principle: $A's$ rejection of *B*'s assertion means that the negation of the content of *B*'s contribution should be integrated with the content of *A*'s prior commitments.

However, acceptance and rejection don't just happen with assertions. These speech acts can happen with questions as well. That is, an agent can choose to address the issues raised by the questioner; he can also choose to reject them. The explicit acceptance of a question can be conveyed by providing a direct answer or by an explicit admittance that one doesn't know an answer; explicit rejection by uttering *I won't answer*.

Agents can also signal acceptance or rejection of questions via implicature, just as they can indicate acceptance or rejection of assertions by implicature, as Lascarides

[1] Lascarides and Asher (2009), following (Hamblin, 1987, p.240), argue that public commitment is the appropriate mental attitude of a speaker towards his own dialogue moves and the moves that he accepts. We adopt this standpoint here as well.

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and Asher (2009) show. For instance, compare (1) (from dialogue r053c in the Verbmobil corpus (Wahlster, 2000)) with the excerpt (2) of a press conference given by Mr. Sheehan, the aide to Senator Coleman (see www.youtube.com/watch?v=VySnpLoaUrI).[2]

(1) a. A: Can you meet in the morning?
    b. B: How about eight thirty to ten?

(2) a. REPORTER: On a different subject is there a reason that the Senator won't say whether or not someone else bought some suits for him?
    b. SHEEHAN: Rachel, the Senator has reported every gift he has ever received.
    c. REPORTER: That wasn't my question, Cullen.
    d. SHEEHAN: The Senator has reported every gift he has ever received. We are not going to respond to unnamed sources on a blog.
    e. REPORTER: So Senator Coleman's friend has not bought these suits for him? Is that correct? [The dialogue continues with Sheehan repeating (2)b to every request for information from the reporters]

In (1), *B* responds to *A*'s question with a question; but *B*'s question, given its content, also implicates that he accepts the issues raised by *A*'s question (i.e., he is indicating his willingness to help answer (1)a). In (2), Sheehan's assertion (2)b is clearly not an answer to the question (2)a, and in (2)c the reporter (correctly) takes it as a refusal to answer. This refusal is not explicit—like uttering *I won't answer* would be—but implicit.

In this paper we propose an account of acceptance and rejection of questions. Standard theories of the semantics of questions (Kartunnen (1977), Groenendijk and Stokhof (1982) or Ginzburg (1995)) are difficult to integrate with an intuitive theory of acceptance and rejection. All of these theories take the content of a question to be its set of answers (they differ on what counts as an answer in context and on whether the set denoted by the question includes only true or both true and false answers). But how can we use such a set of answers to update the commitments of an agent who accepts or refuses a question?

Some theories model acceptance in terms of an agent's commitments to a set of propositions, but it is clear from the way these sets are conceived that the elements in the set are understood intersectively; i.e., the set representation is just another way of formulating the traditional approach to acceptance. This will not work with the semantics of questions in general, and it's easy to see why: the set of answers to a question are often inconsistent with each other. For instance, the semantics of a *yes/no* question like *Did you take the garbage out?* is given in terms of two propositions: You took the garbage out, and you did not take the garbage out. Taking the intersection of these two propositions yields an empty set. Conceivably, if a question denotes only answers that are true at the world of evaluation, one might avoid this absurd result. But it has equally bad consequences for acceptance: it would imply that agents who accept questions are always committed to its true answers; and thus one can't truthfully respond to a *yes/no* question with *I don't know but your question is an interesting one*, since the responding agent is already committed to the true answer (be it positive, or negative). Thus, tradi-

[2] Thanks to Chris Potts for bringing this example to our attention.

tional semantic analyses of questions appear to be incompatible with intuitive accounts of acceptance and rejection.

If the formal semantics of questions is to be made relevant to accounting for the basic phenomena of acceptance and rejection in dialogue, it has to change. That is what we propose to do in this paper. There is additional pressure on the traditional semantics of questions from data on embedded speech acts: Asher (2007) argues that it cannot adequately handle questions embedded within other operators like conditionals—as in *If I buy into this plan, what can I expect my returns to be?* Asher (2007) provides a dynamic, first order adaptation of Groenendijk's (2003) semantics for questions to recursively compute appropriate values for embedded speech acts; the general idea is to use a question's direct, exhaustive answers to form a partition over the input information state and then to lift the dynamic semantics of other operators and quantifiers so as to define them as transitions from an input partition to an output partition. In this paper, we demonstrate that this semantics is also the basis for a uniform account of the acceptance (and rejection) of questions and assertions in dialogue. It achieves this by making the input and output contexts for interpreting propositions and questions of the same type, and so an agent can be simultaneously committed to questions and propositions and also share those commitments with other agents.

We motivate and describe our model in Section 2, and in Section 3 we define the dynamic semantics for questions and show how it makes intuitively compelling predictions about acceptance and rejection.

2 Background

To our knowledge, there is currently no formally precise, adequate account of acceptance (and rejection) of both propositions and questions in dialogue. The Grounding Acts Model (GAM, Traum (1994), Poesio and Traum (1998)) addresses the effects of both questions and assertions on an information state. In Poesio and Traum's (1998) formalisation of GAM, agreement occurs when one agent accepts a prior assertion that's made by another agent. Questions, on the other hand, create an obligation on the interlocutor to respond, but GAM as it stands does not address the issue of predicting when the response conveys, indirectly, that the speaker is prepared to answer the question (as in (1)). So GAM needs to be supplemented to account for this data.

Asher and Lascarides' (2003) SDRT also addresses updates with questions and assertions. But its traditional semantics for questions makes it fall prey to the problem about acceptance that we described in Section 1. While Ginzburg (1995) provides very detailed predictions for when a question is resolved, his theory does not predict when an agent rejects the question; indeed he observes in Ginzburg (2009) that being a question under discussion is a necessary but not a sufficient condition for both acceptance and rejection of the issues raised by the question.

Lascarides and Asher (2009) argue that Poesio and Traum's (1998) rules for identifying speech acts undergenerate acceptance in many cases and that SDRT from Asher and Lascarides (2003) errs in the opposite direction to GAM by *overgenerating* acceptance. To correct these problems, Lascarides and Asher (2009) propose a logical

Turn	A's SDRS	B's SDRS
1	$\pi_{1.1} : K_{\pi_{1.1}}$	$\emptyset$
2	$\pi_{1.1} : K_{\pi_{1.1}}$	$\pi_{2B} : Correction(\pi_{1.1}, \pi_{2.1})$
3	$\pi_{3A} : Correction(\pi_{1.1}, \pi_{3.1}) \wedge Acceptance(\pi_{2.1}, \pi_{3.1})$	$\pi_{2B} : Correction(\pi_{1.1}, \pi_{2.1})$

Table 1: The logical form of dialogue (3).

form for dialogue that tracks each agent's public commitments. They argue that these include commitments to *rhetorical connections* (e.g., *Narration*) among utterances in the dialogue, on the grounds that recognising implicit acceptance and identifying the rhetorical connection that links an agent's utterance to the dialogue context are logically co-dependent. So they propose that each agent's commitments at any given stage in the dialogue be represented as a Segmented Discourse Representation Structure (SDRS): this is a set of *labels* that each represent a unit of discourse, and a function that associates each label with a formula representing the unit's interpretation. These formulae include rhetorical relations among labels.

To see how this framework handles both acceptance and rejection, consider (3), an example where A accepts a denial of his prior assertion:

(3) $\pi_{1.1}$. A: It's raining.
$\pi_{2.1}$. B: No it's not.
$\pi_{3.1}$. A: Oh, you're right (*uttered after looking out the window*).

The logical form of a dialogue turn (where a turn boundary occurs whenever the speaker changes) is a tuple of SDRSs: one for each agent, representing his public commitments. The logical form of dialogue—known as a Dialogue SDRS or DSDRS—is the logical form of each of its turns, yielding Table 1 as the logical form for dialogue (3). For reasons of space, the logical forms of the clauses are omitted from Table 1. We will often gloss the content of a label π as K_π, and use π_{nd} to label the dialogue segment of turn n with (unique) speaker d, and $\pi_{n.i}$ to label the i^{th} elementary discourse unit that is part of the turn π_{nd}. The glue-logic inference that $Correction(\pi_{1.1}, \pi_{3.1})$ is a part of A's commitments in turn 3 arises from the fact that $\pi_{3.1}$ is an *Acceptance* of the corrective move $\pi_{2.1}$ (see Lascarides and Asher (2009)). The SDRSs in a DSDRS share labels because a speaker can perform a relational speech act whose first argument is part of a prior turn (e.g., $\pi_{1.1}$ and $\pi_{2.1}$ are literals in A's SDRS for turn 3 in Table 1). As a special case, it captures the fact that an agent can reveal his commitments (or lack of them) to content that another agent conveyed, even if this is linguistically implicit.

To see how DSDRSs capture facts about acceptance and rejection, let's review how they're are interpreted. Asher and Lascarides (2003) define precisely the *context change potential* (CCP) of an individual SDRS. Since the logical form of a dialogue turn is now a tuple of SDRSs, its CCP is the *product* of the CCPs of the individual SDRSs. In other words, the context of evaluation C_d for interpreting a dialogue turn is a set of dynamic contexts for interpreting SDRSs—one for each agent $a \in D$, where D is the set of dialogue agents. Thus, where C^i_a and C^o_a are respectively an input and output context

Turn	A's SDRS	B's SDRS
1	$\pi_{1A} : K_{\pi_{1.1}}$	$\emptyset$
2	$\pi_{1A} : K_{\pi_{1.1}}$	$\pi_{2B} : \textit{Q-Elab}(\pi_{1.1}, \pi_{2.1})$

Table 2: The logical form of (1).

for evaluating an SDRS:

$$C_d = \{\langle C_a^i, C_a^o \rangle : a \in D\}$$

The semantics of a dialogue turn $T = \{S_a : a \in D\}$ is the product of the CCPs its SDRSs, as shown in (4) (m in $[\![.]\!]_m$ stands for monologue and d in $[\![.]\!]_d$ for dialogue):

(4) $C_d [\![T]\!]_d C'_d$ iff $C'_d = \{\langle C_a^i, C_a^o \rangle \circ [\![S_a]\!]_m : \langle C_a^i, C_a^o \rangle \in C_d, a \in D\}$

And given that a turn represents *all* of each agent's current commitments, the CCP of a DSDRS is that of its last turn. Dialogue entailment is then defined in terms of the entailment relation $\models_m$ afforded by $[\![.]\!]_m$ of SDRSs:

(5) $T \models_d \phi$ iff $\forall a \in D, S_a \models_m \phi$

Thus $\models_d$ defines shared public commitments, and we assume that ϕ is mutually accepted in turn T among D iff $T \models_d \phi$. Similar definitions hold for acceptance among a subgroup $D' \subset D$: i.e., for all $a \in D'$, $S_a \models_m \phi$.

Equation (6) defines the dynamic interpretation of veridical relations (e.g. *Narration*, *Explanation*, *Acceptance*), ensuring that a discourse unit consisting of veridical relations entails its smaller discourse units plus the relations' illocutionary effects $\varphi_{R(\alpha,\beta)}$:

(6) $C^i [\![R(\alpha, \beta)]\!]_m C^o$ iff $C^i [\![K_\alpha \wedge K_\beta \wedge \varphi_{R(\alpha,\beta)}]\!]_m C^o$

(7) $C^i [\![\textit{Correction}(\alpha, \beta)]\!]_m C^o$ iff $C^i [\![(\neg K_\alpha) \wedge K_\beta \wedge \varphi_{\textit{Corr}(\alpha,\beta)}]\!]_m C^o$

Meaning postulates then constrain the content $\varphi_{R(\alpha,\beta)}$: e.g., $\varphi_{\textit{Explanation}(\alpha,\beta)}$ entails K_β is an answer to *Why* K_α*?* Equation (7) is the interpretation of *Correction* and it entails the negation of the denied segment.

These definitions capture intuitions about acceptance and rejection for dialogue (3), given its logical form in Table 1. Assuming that $K_{\pi_{1.1}}$ to $K_{\pi_{2.1}}$ are expressed appropriately, turn 2 in Table 1 entails that A is committed in $K_{\pi_{1.1}}$ while B rejects it (for his commitments entail $\neg K_{\pi_{1.1}}$), a rejection that A then accepts in turn 3. The CCP of Table 1 thus reflects intuitions about changing commitments and agreement. At the end of turn 3 both agents agree that it's not raining, and A has dropped an earlier commitment in favour of an incompatible commitment. The DSDRS is consistent even though A's SDRS for turn 2 is inconsistent with his SDRS for turn 3, and the SDRSs for turn 2 are inconsistent with each other.

This formalism provides logical forms for dialogues involving questions as well, as shown in Tables 2 and 3, the proposed logical forms for dialogues (1) and (2) respectively. Consider Table 2 first. The relation $\textit{Q-Elab}(\pi_{1.1}, \pi_{2.1})$—which means that $\pi_{2.1}$ is a question all of whose possible answers elaborate a plan to achieve the goal of $\pi_{1.1}$,

Turn	R's SDRS	S's SDRS
1	$\pi_{1.1} : ?K_{\pi_{1.1}}$	$\emptyset$
2	$\pi_{1.1} : ?K_{\pi_{1.1}}$	$\pi_{2.1} : K_{\pi_{2.1}}$
3	$\pi_{3A} : \mathit{Commentary}^*(\pi_{2.1}, \pi_{1.1})$	$\pi_{2.1} : K_{\pi_{2.1}}$
4	$\pi_{3A} : \mathit{Commentary}^*(\pi_{2.1}, \pi_{1.1})$	$\pi_{4B} : \mathit{Explanation}^*(\pi_{4.1}, \pi_{4.2})$
5	$\pi_{5A} : \mathit{Result}^*(\pi_{4B}, \pi_{5.1}) \wedge$ $\mathit{Elaboration}(\pi_{5.1}, \pi_{5.2})$	$\pi_{4B} : \mathit{Explanation}^*(\pi_{4.1}, \pi_{4.2})$

Table 3: The logical form of dialogue (2)

which here is for A to know its answer—intuitively implicates a commitment by B to the question $\pi_{1.1}$ posed by A (we'll see later why this doesn't quite work in Asher and Lascarides' (2003) model theory though).

The DSDRS for (2) in Table 3 (R is the reporter and S is Sheehan) contains lots of implicit rejections. Again, we have omitted the logical forms of clauses because of space. The lack of a relation between S's utterance $\pi_{2.1}$ and R's question $\pi_{1.1}$ implicates a rejection by S of the question (although, as we've mentioned, to ensure that this intended interpretation is reflected in the model theory, we must revise the semantics of questions).[3] R's commitments in turn 3 are to $\mathit{Commentary}^*(\pi_{2.1}, \pi_{3.1})$—that is, his utterance is a commentary on the fact that S said $\pi_{2.1}$ (rather than a commentary on its content $K_{\pi_{2.1}}$). Thus the semantics of this relation does not entail $K_{\pi_{2.1}}$, indicating R's lack of commitment to it. $\mathit{Result}^*(\pi_{4B}, \pi_{5.1})$ in S's SDRS for turn 5 likewise entails that a particular *assertion* π_{4B} was made but not that assertion's content (in contrast to *Result*): it entails that S making the assertions he did leads to the question $\pi_{5.1}$ (which is in effect the earlier question that R asked). So R does not accept the content of S's assertions, just as S doesn't accept the issues raised by the question.

Note that acceptance and rejection in dialogue (2) are implicated but not part of semantic content. This is because anaphoric tests suggest that these acts, while implicated, are *not* a part of what the agents said: the reporter cannot coherently respond to (2)b with *Why?* (meaning "why are you refusing to answer the question?"). SDRT distinguishes what was said from its cognitive effects partly so as to account for these anaphoric effects: antecedents to surface anaphors must be chosen from SDRSs, while cognitive effects are validated within a separate cognitive logic not discussed here (but see Asher and Lascarides (2008)).

However, as we mentioned before, the dynamic interpretation Lascarides and Asher (2009) provide for DSDRSs has a serious defect in its semantics for questions, which undermines the generality of its model of acceptance. We will now remedy this defect.

[3]Readers familiar with SDRT may wonder why S's SDRS is not $\pi_{2S} : \mathit{Plan\text{-}Elab}(\pi_{1.1}, \pi_{2.1})$—this would implicate that S accepts R's question, because it entails that $\pi_{2.1}$ elaborates a plan to achieve the intention that prompted it; namely, for R to know an answer. While $K_{\pi_{2.1}}$ is compatible with the semantics of $\mathit{Plan\text{-}Elab}(\pi_{1.1}, \pi_{2.1})$, an inference to this relation is blocked by knowledge of S's mental state: namely, R and S mutually know that S, being an aide to the senator, knows the answer. By S not providing an answer when he knows it, R can infer that S does not adopt R's intention for R to know an answer, and thus an inference to the speech act *Plan-Elab* is not validated.

2.1 Questions

The semantics of SDRSs in Asher and Lascarides (2003), on which the model of dialogue in Lascarides and Asher (2009) is based, incorporates a traditional semantics of questions, according to which the meaning of a question is given by its set of (true) answers (in this it follows Groenendijk and Stokhof (1982) but agrees with Ginzburg (1995) that those answers need not be exhaustive). More formally, the context of evaluation in SDRT is a pair of elements (w, f), where w is a possible world and f is a partial variable assignment function. But the CCP of a question transforms an input state (w, f) into an output state of a different type: a set of dynamic propositions, each proposition being a true answer. In other words, the output state of a question is a set of pairs of world assignment pairs.

While this semantics of questions has a certain appeal when considered in isolation, it is problematic when questions are part of the content of an extended dialogue. This is because the output context of a question cannot be the input context for interpreting a subsequent discourse unit. Therefore, questions cannot be arguments to veridical rhetorical relations, given their CCP in (6). And yet intuitively, the second question in (2)e should be construed as *elaborating* the first question in (2)e (as we've shown in Table 3), since all true answers to one entail a true answer to the other. Asher and Lascarides (2003) provide many more examples where questions can enter into relations that are normally associated with assertions, like *Explanation* and *Narration*.

SDRT as described in Asher and Lascarides (2003) bypasses this problem by introducing a distinct relation $Elaboration_{qq}$ for connecting an 'elaborating' question to the question it elaborates. Semantically, the CCP of $Elaboration_{qq}(\pi_{1.1}, \pi_{2.1})$ makes it a *test* on the input context: in words, the input context (w, f) must be such that $K_{\pi_{1.1}}$ and $K_{\pi_{1.2}}$ are questions, and any true answer to $K_{\pi_{2.1}}$ in (w, f) entails a true answer to $K_{\pi_{1.2}}$ in (w, f). Similar additional relations are introduced for other veridical rhetorical relations—e.g., $Explanation_{qq}$ and $Narration_{pq}$.

But the problems go much deeper than this. The proliferation of non-veridical relations for handling questions is not just an inconvenience; it is a fatal flaw in our proposed model of acceptance. If *R*'s commitments in turn 5 are represented in terms of $Elaboration_{qq}$, then *R* is not committed even to his own questions, contrary to intuitions. Rather, he is simply committed to the two questions being in a certain semantic relationship. Similarly, consider the relation $Q\text{-}Elab(\pi_{1.1}, \pi_{2.1})$, which forms part of *B*'s SDRS for turn 2 of (1). As we said, this expresses the information that $K_{\pi_{2.1}}$ is a question and any of its possible answers elaborate a plan to achieve the communicative goal behind $K_{\pi_{1.1}}$ (that *A* know an answer to the question $K_{\pi_{1.1}}$). But out of technical necessity the CCP of *Q-Elab* from Asher and Lascarides (2003) is a test on the input context, and so *B*'s SDRS does not commit him to $K_{\pi_{2.1}}$ or $K_{\pi_{1.1}}$. This undergenerates what's accepted for (1): it makes *B* committed to the answers of $\pi_{2.1}$ bearing a certain semantic relationship with those of $\pi_{1.1}$, but it fails to commit *B* to *A*'s question, and therefore also fails to predict that *R*'s responses to *S*'s question in (2) are different in this respect from *B*'s responses to *A*'s in (1).

Ideally, we want a semantics for questions that is compatible with an agent being committed to it. This requires the input and output contexts for questions and for propositions to be of uniform type, allowing both of them to be arguments to veridical rhetorical relations. This would not only solve the problem with acceptance that we have just described, but it would also simplify the inventory of rhetorical relations: a question could be an argument to *Elaboration*, obviating the need for the distinct relation $Elaboration_{qq}$ that comes with similar implicatures to *Elaboration*; similarly for all other veridical relations. Groenendijk's (2003) semantics of questions assumes uniform input and output contexts for both propositions and questions. Asher (2007) generalises this semantics to provide a dynamic treatment of variables and quantifiers so as to preserve SDRT's predictions about anaphora (Groenendijk treats quantifiers statically). This is the semantics that we will adopt here. While the semantic type of the contexts C^i_a and C^o_a for SDRSs will change, the definitions (4) and (5) for interpreting DSDRSs will be unchanged.

3 Formal Syntax and Semantics

Before we refine the formal semantics of questions, we must define the language's syntax. We start with the syntax of so-called SDRS-formulae from which DSDRSs are built (Definition 1 is from Asher and Lascarides (2003)).

Definition 1 The Syntax of SDRS-Formulae

SDRS-formulae are constructed from the following vocabulary:

vocab-1. A classical first order vocabulary, augmented with the modal operator δ that turns formulae into action terms ($\delta\phi$ is the action of bringing it about that ϕ and this is used to represent imperatives); and the operator '?' and λ-terms for representing questions as $?\lambda x_1 \ldots \lambda x_n \phi$, each x_i corresponding to a *wh*-element.

vocab-2. labels: π, π_1, π_2, etc.

vocab-3. a set of symbols for rhetorical relations: R, R_1, R_2, etc.

The set $\mathcal{L}$ of well-formed SDRS-formulae is defined as follows:

1. Let $\mathcal{L}_{basic}$ be the set of well-formed formulae that are derived from vocab-1 using the usual syntax rules for first order languages with action terms and questions. Then $\mathcal{L}_{basic} \subseteq \mathcal{L}$.
2. If R is an n-ary discourse relation symbol and $\pi_1, \ldots, \pi_n$ are labels, then $R(\pi_1, \cdots, \pi_n) \in \mathcal{L}$.
3. For $\phi, \phi' \in \mathcal{L}, (\phi \wedge \phi'), \neg\phi \in \mathcal{L}$.

Definition 2 reflects the logical forms proposed in Lascarides and Asher (2009) and illustrated in Tables 1 to 3. It maps each dialogue turn and agent into an SDRS: that is, a rooted and well-founded partial order of labels, each one standing for a discourse unit and associated with a representation of its content. For simplicity, we have ignored Asher and Lascarides' (2003) notion of a *last* label in these definitions, since we won't be focussing on anaphora in this paper.

Definition 2 DSDRSs

Let D be a set of dialogue participants. Then a Dialogue SDRS (or DSDRS) is a tuple $\langle n, T, \Pi, \mathcal{F}\rangle$, where:

- $n \in \mathcal{N}$ is a natural number (intuitively, $j \leq n$ is the j^{th} turn in the dialogue);
- Π is a set of labels;
- $\mathcal{F}$ is a function from Π to the SDRS-formulae $\mathcal{L}$;
- T is a mapping from $[1,n]$ to a function from D to SDRSs drawn from Π and $\mathcal{F}$. That is, if $T(j)(a) = \langle \Pi^a_j, \mathcal{F}^a_j\rangle$ where $j \in [1,n]$ and $a \in D$, then $\Pi^a_j \subseteq \Pi$ and $\mathcal{F}^a_j =_{def} \mathcal{F} \restriction \Pi^a_j$ (that is, $\mathcal{F}^a_j$ is $\mathcal{F}$ restricted to Π^a_j). Furthermore, let $\pi \succ^a_j \pi'$ iff π' is a literal in $\mathcal{F}^a_j(\pi)$ or a literal in $F^a_j(\pi'')$ where $\pi \succ^a_j \pi''$. Then $\succ^a_j$ is a well-founded partial order with a unique root.

There are many notational variants for DSDRSs—Table 1 is a notational variant of the DSDRS (8) for example:

(8) $\langle 2, T, \{\pi_{2B}, \pi_{3A}, \pi_{1.1}, \pi_{1.2}, \pi_{2.1}, \pi_{3.1}\}, F\rangle$, where:

- $F(\pi_{1.1}) = K_{\pi_{1.1}}$, $F(\pi_{2.1}) = K_{\pi_{2.1}}$, $F(\pi_{3.1}) = K_{\pi_{3.1}}$
  $F(\pi_{2B}) = Correction(\pi_{1.1}, \pi_{2.1})$
  $F(\pi_{2K}) = Correction(\pi_{1.1}, \pi_{3.1}) \wedge Acceptance(\pi_{2.1}, \pi_{3.1})$
- $T(1) = \{(A, \langle\{\pi_{1.1}\}, F_1\rangle), (B, \emptyset)\}$, where $F_1 = F \restriction \{\pi_{1.1}\}$
- $T(2) = \{(A, \langle\{\pi_{1.1}\}, F_1\rangle), (B, \langle\{\pi_{2B}, \pi_{1.1}, \pi_{2.1}\}, F_2\rangle)\}$
  where $F_2 = F \restriction \{\pi_{2B}, \pi_{1.1}, \pi_{2.1}\}$
- $T(3) = \{(A, \langle\{\pi_{3A}, \pi_{1.1}, \pi_{2.1}, \pi_{3.1}\}, F_3\rangle), (B, \langle\{\pi_{2B}, \pi_{1.1}, \pi_{2.1}\}, F_2\rangle)\}$
  where $F_3 = F \restriction \{\pi_{3A}, \pi_{1.1}, \pi_{2.1}, \pi_{3.1}\}$

Definition 2 allows label sharing across speakers and turns but the content assigned to a label is unique: $\forall \pi \in \Pi^{a_1}_j \cap \Pi^{a_2}_k$, $j,k \in [1,n]$, $a_1, a_2 \in D$, $\mathcal{F}^{a_1}_j(\pi) = \mathcal{F}^{a_2}_k(\pi)$. A situation where a_1 and a_2 interpret π differently won't correspond to a situation where π is assigned distinct contents in distinct SDRSs within the *same* DSDRS. Rather, it corresponds to a situation where a_1 and a_2 each build different DSDRSs (although we won't explore misunderstandings further here).

With the syntax of the formal language in place, let's define its semantics. As we explained in Section 2.1, the semantics $[\![.]\!]_d$ of DSDRSs requires the input and output contexts for propositions, questions and requests to be the same. We now adapt the semantics from Asher and Lascarides (2003) to meet this criterion. We start with a few illustrative clauses of the distributive, non-eliminative CCP for $\mathcal{L}_{basic}$ from Asher and Lascarides (2003), which we refer to here as $[\![.]\!]_\delta$. Our new semantics $[\![.]\!]_m$ of SDRSs will be defined in terms of $[\![.]\!]_\delta$. Both $[\![.]\!]_\delta$ and $[\![.]\!]_m$ are defined with respect to a model $M = \langle \Delta, W, I\rangle$, where Δ is a set of individuals, W is a set of possible worlds and I is an interpretation function that maps n-place predicates into sets of n-tuples from Δ.

The CCP $[\![.]\!]_\delta$ from Asher and Lascarides (2003) treats all formulae save $\exists x$, conjunctions, imperatives and questions as tests on the input context. For instance: $(w,f)[\![P(x)]\!]_\delta(w',g)$ iff $(w,f)=(w',g)$ and $f(x)\in I(P)$; and $(w,f)[\![\neg\phi]\!]_\delta(w',g)$ iff $(w,f)=(w',g)$ and there is no (w'',k) such that $(w,f)[\![\phi]\!]_\delta(w'',k)$. Conjunction is interpreted as dynamic succession: $(w,f)[\![\phi\wedge\psi]\!]_\delta(w',g)$ iff $(w,f)[\![\phi]\!]_\delta\circ[\![\psi]\!]_\delta(w',g)$. Questions, as we have already stated, transform an input context (w,f) into a set of propositions that are its true (non-exhaustive) answers (see Asher and Lascarides (2003) for details). The formula $\exists x$ updates the input variable assignment function: $(w,f)[\![\exists x]\!]_\delta(w',g)$ iff $dom(g)=dom(f)\cup\{x\}$ and $f\subseteq g$ (i.e., $\forall y\in dom(f),\ f(y)=g(y)$). Note that $\exists x\phi$ is syntactic sugar for $\exists x\wedge\phi$. Action terms, on the other hand, update the world: $(w,f)[\![\delta\phi]\!]_\delta(w',g)$ iff $(w',f)[\![\phi]\!]_\delta(w',g)$.

Following Asher (2007), we will 'lift' the distributive semantics $[\![.]\!]_\delta$ to a collective semantics $[\![.]\!]_m$ so that it can incorporate the collective semantics to questions proposed in Groenendijk (2003). This strategy results in a uniform type of input and output context for all formulae. Asher demonstrates that this allows questions to be embedded in conditionals (e.g., *If you're serious, what's his name?*). Here, we demonstrate that it also properly accounts for their rhetorical role in dialogue, including their role in acceptance.

For Groenendijk, a question *partitions* the input information state, which in turn consists of all the world assignment pairs that have not been ruled out by prior assertions. Each equivalence class in the output partition represents a different possible answer to the question. Thus the input and output contexts C_m are always a subset of $(W\times F)^2$, where W is the set of possible worlds and F is the set of partial variable assignment functions, and $\langle(w,f),(w',g)\rangle\in C_m$ means that (w,f) and (w',g) are in the same equivalence class. One can intuitively interpret the equivalence class in terms of the agent's attitudes: if $\langle(w,f),(w',g)\rangle\in C_m$, then the agent 'doesn't care' about the different interpretations to formulae that these world-assignment pairs define. If, on the other hand, (w,f) and (w',g) are in different classes of C_m then the agent does care—he is committed to a question whose true answers are different in (w,f) vs. (w',g). Assertions that are subsequent to a question may then remove all but one equivalence class from the partition that's created by the question; if so, the question is answered.

Informally, then, our new dynamic semantics $[\![.]\!]_m$ for SDRS-formulae is as follows. For those formulae ϕ where $[\![.]\!]_\delta$ imposes a test on the input context—so ϕ is *not* of the form $\exists x$, $\psi\wedge\chi$, $\delta\psi$ or $?\psi$—$[\![\phi]\!]_m$ has an entirely eliminative and distributive semantics. In other words, any element $\langle(w,f),(w',g)\rangle$ from the input context C will survive as an element of the output context C' iff $(w,f)[\![\phi]\!]_\delta(w,f)$ and $(w',g)[\![\phi]\!]_\delta(w',g)$. $\exists x$, on the other hand, *changes* the input assignment functions f and g, by extending them to be defined for x. $\delta\phi$ changes the input worlds. Conjunction is dynamic succession, as before. And following Groenendijk (2003), questions will *refine* the input partition by eliminating pairs $\langle(w,f),(w',g)\rangle\in C$, according to whether (w,f) and (w',g) define different possible answers. Whether they do this or not is determined by whether the $[\![.]\!]_\delta$-semantics of the question transforms (w,f) and (w,g) into the same set of true answers, or not. These principles for defining $[\![.]\!]_m$ lead to Definition 3—we will see shortly how this semantics is extended to SDRS-formulae that feature rhetorical relations.

Definition 3 The Semantics $[\![.]\!]_m$ of $\mathcal{L}_{basic}$
Let $M = \langle D, W, , I\rangle$ be a model, and let $C, C' \subseteq (W \times F)^2$. Then:

(i) $C[\![P(x_1,\ldots,x_n)]\!]^M_m C'$ iff
$C' = \{\langle (w,f),(w',g)\rangle \in C :\ (w,f)[\![P(x_1,\ldots x_n)]\!]^M_\delta (w,f)$ and $(w',g)[\![P(x_1,\ldots,x_n)]\!]^M_\delta (w',g)\}$

(ii) $C[\![\exists x]\!]^M_m C'$ iff $C' = \{\langle (w,f'),(w',g')\rangle :\ \langle (w,f),(w',g)\rangle \in C,$ $(w,f)[\![\exists x]\!]^M_\delta (w,f')$ and $(w',g)[\![\exists x]\!]^M_\delta (w',g')\}$

(iii) $C[\![\phi \wedge \psi]\!]^M_m C'$ iff $C[\![\phi]\!]^M_m \circ [\![\psi]\!]^M_m C'$.

(iv) $C[\![\neg\phi]\!]^M_m C'$ iff $C' = \{\langle (w,f),(w',g)\rangle \in C :\ (w,f)[\![\neg\phi]\!]^M_\delta (w,f)$ and $(w',g)[\![\neg\phi]\!]^M_\delta (w',g)\}$

(v) $C[\![\delta\phi]\!]^M_m C'$ iff $C' = \{\langle (w^o,f'),(w'^o,g')\rangle :\ \langle (w,f),(w',g)\rangle \in C$ and $(w,f)[\![\delta\phi]\!]^M_\delta (w^o,f')$ and $(w',g)[\![\delta\phi]\!]^M_\delta (w'^o,g')\}$

(vi) $C[\![?\lambda x_1\ldots x_n\phi]\!]^M_m C'$ iff
$C' = \{\langle (w,f),(w',g)\rangle \in C :$
$\forall f'$ st $dom(f') = dom(f) \cup \{x_1,\ldots,x_n\}$ and $f \subseteq f'$,
$\exists g'$ st $dom(g') = dom(g) \cup \{x_1,\ldots x_n\}$ and $g \subseteq g'$, and
$f'(x_i) = g'(x_i), 1 \leq i \leq n$ and
$\exists (w'',k),(w''',l)$ st
$(w,f')[\![\phi]\!]^M_\delta (w'',k) \leftrightarrow (w',g')[\![\phi]\!]^M_\delta (w''',l)$
and conversely:
$\forall g'$ st $dom(g') = dom(g) \cup \{x_1,\ldots x_n\}$ and $g \subseteq g'$,
$\exists f'$ st $dom(f') = dom(f) \cup \{x_1,\ldots,x_n\}$ and $f \subseteq f'$, and
$f'(x_i) = g'(x_i), 1 \leq i \leq n$ and
$\exists (w'',k),(w''',l)$ st
$(w,f')[\![\phi]\!]^M_\delta (w'',k) \leftrightarrow (w',g')[\![\phi]\!]^M_\delta (w''',l)\}$

The CCPs (6) and (7) of rhetorical relations lift immediately to these new contexts of evaluation; so $C^i, C^o \subseteq (W \times F)^2$ in these definitions. But we can now take advantage of the uniform contexts of evaluation for propositions and questions. As promised in Section 2.1, rhetorical connections among questions can be simplified. Unlike the $[\![.]\!]_\delta$-semantics from Asher and Lascarides (2003), questions in the $[\![.]\!]_m$-semantics can be arguments to veridical relations such as *Elaboration*. So the SDRS representing the turn (2)e, as shown in Table 3, invokes an *Elaboration* on labels for questions. Thus the reporter is committed to the issues raised by both questions, and the second question can be paraphrased in this context as *So is it correct that Senator Coleman's friend has not bought these suits for him?*

Further examples of rhetorical relations involving questions from Asher and Lascarides (2003) are *QAP* (Question Answer Pair) and *Q-Elab* mentioned earlier. We start with the semantics of *QAP*. The semantics of questions in Definition 3, following Groenendijk's (2003), assumes that a direct answer to a question is an *exhaustive* answer. But in reality, the demands on answerhood are not so stringent during dialogue interpretation (Ginzburg, 1995): a question can be resolved to the questioner's satisfaction without the answer being exhaustive. We reflect this in our semantics of *QAP*—we make it match the constraints on specificity for answerhood that we assumed for this relation in our earlier work.

Technically, we achieve this by introducing a predicate symbol *Answer* between a question and a proposition. $Answer(q, p)$ is a test on the input context, but the test may be passed even if p is not an exhaustive answer (and so fails to exclude all but one class from the partition created by q). In essence, as in Asher and Lascarides (2003), p must identify *de re* values for q's *wh*-elements, or entail that no such elements exist. So it is a stronger constraint on answerhood than partial answerhood but not as strong a constraint as exhaustive answerhood. For instance, $Answer(q, p)$ will be true when q is *Who talked?* and p is *Mary talked*: this is not an exhaustive answer (people other than Mary may have talked) and accordingly fails to eliminate all but one class from the partition created by q. The formal definition of the predicate *Answer* is as follows:

- $C[\![Answer(?\lambda x_1, \ldots, x_n\phi, p)]\!]_m C'$ iff

  1 $C = C'$; and

  2 $\forall C''$ such that $C[\![?\lambda x_1, \ldots, x_n\phi]\!]_m C''$, there is a C''' such that $C''[\![p]\!]_m C'''$ and either

  – $\exists a_1, \ldots a_n \in \Delta$ such that for all $(w, f) \in \bigcup\bigcup C'''$, $\exists (w', g)$ st $(w, f\frac{a_1}{x_1} \ldots \frac{a_n}{x_n})[\![\phi]\!]_\delta (w', g)$ or

  – $\forall a_1, \ldots a_n \in \Delta$ and for all $(w, f) \in \bigcup\bigcup C'''$, $\neg\exists (w', g)$ st $(w, f\frac{a_1}{x_1} \ldots \frac{a_n}{x_n})[\![\phi]\!]_\delta (w', g)$

The semantics of *QAP* is then defined in terms of *Answer*, to reflect the intuition that non-exhaustive answers can play a rhetorical role in a dialogue of being a sufficiently specific answer:

$$C[\![QAP(\alpha, \beta)]\!]_m C' \text{ iff } C[\![K_\alpha \wedge Answer(K_\alpha, K_\beta) \wedge K_\beta]\!]_m C'$$

In words, $QAP(\alpha, \beta)$ partitions its input state C into one that distinguishes among the possible exhaustive answers to the question K_α, the resulting partition satisfies the test imposed by $Answer(K_\alpha, K_\beta)$—in other words, updating C with K_β would yield an output state that identifies *de re* values to K_α's *wh*-elements, or it identifies that there no such values exist—and finally the context is updated by K_β, and hence the output context C' has resolved (in the rhetorical sense, if not in the literal sense) the question K_α. The original definition of $QAP(\alpha, \beta)$ from Asher and Lascarides (2003) was not veridical on α; now it is, reflecting the fact that answering a question entails acceptance of the issues raised by the question. Similarly, whereas the original definition of *Q-Elab* from Asher and Lascarides (2003) was non-veridical our revised definition makes it veridical. In other words, its CCP is defined by (6), with meaning postulates on $\varphi_{Q\text{-}Elab(\alpha,\beta)}$ constraining K_β so that it helps achieve the intentions behind α (formal details are omitted here, but see Asher and Lascarides (2003)). We can similarly define a univocal semantics for *Result*, *Result**, *Elaboration*, *Commentary* and *Commentary**, regardless of whether their terms are questions or assertions.

We have now defined the $[\![.]\!]_m$-semantics for all SDRS-formulae. The semantics of an SDRS is the semantics of the content of its unique root label. In other words, for an SDRS S with root label π_0, $C[\![S]\!]_m C'$ iff $C[\![K_{\pi_0}]\!]_m C'$. The semantics $[\![.]\!]_d$ of a DSDRS is then defined in terms of $[\![.]\!]_m$ as described in Section 2: the CCP of a dialogue turn is given in (4); the entailment relation it engenders in (5); and the CCP of an entire DSDRS is that of its last turn.

The illocutionary contributions of speech acts are encoded in the semantics of DSDRSs, as a part of the agents' commitments. And thus our definition of acceptance as joint entailment on those commitments enables implicit acceptance. With our new semantics of SDRSs, we can now make the right predictions about acceptance and rejection of questions, as well as acceptance and rejection of assertions. For instance, with the logical form in Table 2 for dialogue (1), our revised semantics of *Q-Elab* as a veridical relation ensures that *B* accepts *A*'s question (1)a. In contrast, *S* does not accept *R*'s questions in dialogue (2), given its logical form in Table 3; nor does *R* accept *S*'s assertions.

4 Conclusion

This paper presents a dynamic model theory for questions that fully supports a theory of acceptance and rejection for questions and assertions. Following GAM (Traum, 1994), it models acceptance as shared public commitment. However, unlike any prior formally precise theory of dialogue of which we are aware, it is able to represent implicit acceptance, and it also analyses commitments to questions and mutual acceptance of the issues raised by questions.

A crucial ingredient in our account was the use of relational speech acts, and the logical relationships among their semantics. By 'lifting' the distributive dynamic semantics from Asher and Lascarides (2003) to a collective semantics in the style of Groenendijk (2003), we were able to maintain a uniform model of acceptance regardless of whether the speakers utter indicatives or interrogatives.

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Building Event-Based *Ad Hoc* Properties: On the Interpretation of Adjectival Passives

Claudia Maienborn
German Department
University of Tübingen

claudia.maienborn@uni-tuebingen.de

Abstract

The paper develops a new perspective on the semantics and pragmatics of adjectival passives that focuses on their characteristic context dependency. Adjectival passives are analyzed as a flexible grammatical means of creating a potentially new *ad hoc* property based on the verbal event by which the subject referent is categorized according to contextually salient goals. The post state vs. target state ambiguity of adjectival passives is accounted for by deriving the two readings from a semantically underspecified representation that requires the pragmatic machinery to infer a suitable contextual instantiation.

1 Introduction

The aim of this paper is to develop a new perspective on the semantics and pragmatics of adjectival passives that accounts properly for the impact the context has on their formation and interpretation. There are two ways in which the context comes into play when dealing with adjectival passives. First, context appears to greatly influence which verbs get to build adjectival passives. Typical cases of adjectival passives discussed in the literature are based on transitive resultative verbs like *to close* or *to submit*, i.e. verbs with a lexically specified result state; see e.g. the German sentences in (1).[1]

(1) a. Die Schublade war geschlossen.
The drawer was closed.

b. Das Manuskript ist eingereicht.
The manuscript is submitted.

[1] Note that (1) only has an adjectival passive reading; the verbal passive is built with the auxiliary *werden* in German; see below.

Kratzer (2000) briefly mentions the case of activity verbs like *streicheln* 'to pet'. These verbs do not have a designated result state and they seem to resist adjectival passive formation. A sentence like (2) sounds odd out of the blue.

(2) ? Die Katze ist gestreichelt.
The cat is petted.

Yet under certain contextual conditions adjectival passives may also be built with activity verbs. In particular, sentences like (2) are fine if the context supports what Kratzer (2000: 4) calls a "job is done" interpretation; see also Rapp (1998: 243f), Maienborn (2007a). A natural setting for such a "job is done" interpretation for (2) is given in (2').

(2') Anna hat ihre Nachbarspflichten erfüllt: Der Briefkasten ist geleert,
Anna has her neighbor-duties fulfilled: The mail-box is emptied

die Blumen sind gegossen und die Katze ist gestreichelt.
the flowers are watered, and the cat is petted.

'Anna has done her neighborly duties: the mailbox is emptied, the flowers are watered and the cat is petted.'

Judgments are also improved if the subject triggers a figurative use of the participle as in (2"); cf. Gese et al. (2009).

(2") Meine Seele ist gestreichelt.
My soul is petted.

'My soul is caressed.'

Thus, in light of perfectly natural variants like (2') and (2"), the adjectival passive formation of activity verbs such as *streicheln* 'to pet' should not be ruled out as ungrammatical. The same holds true for other seemingly ill-formed cases, such as stative verbs. According to Kratzer (2000: 5) stative verbs like *wissen* 'to know' are categorically excluded from the adjectival passive formation; sentence (3) is judged ungrammatical by Kratzer. Yet in a contrastive setting like the one in (4), where it is at issue whether an answer has been given on the basis of firm knowledge or by guessing, sentence (3) is perfectly fine and by no means deviant.

(3) Die Antwort ist gewusst.
The answer is known.

(4) Ist die Antwort gewusst oder geraten?
Is the answer known or guessed?

Thus the context plays an important role in the formation and admissibility of adjectival passives. Moreover – and this is the second way how context comes into play – adjectival passives have two readings, depending on their contextual environment: a "post state reading" as indicated by the continuation in (5a) and a "target state reading" illustrated in (5b).

(5) Das Manuskript ist eingereicht …
The manuscript is submitted …

a. … jetzt können wir uns an den Projektantrag machen — post state reading
… let's turn to the project proposal now

b. … aber nicht angenommen / veröffentlicht / … — target state reading
… but not accepted / published / …

Roughly speaking, the post state reading of sentence (5) means that the manuscript is classified as being in the post state of a submitting event, while the target state reading of (5) expresses that the manuscript belongs to the class of submitted papers, rather than being, e.g., accepted or published or rejected. A first indication for the existence of these two readings can be found in Brandt (1982: 31) and has been independently observed and elaborated by Kratzer (2000).[2] Kratzer's account will be presented in more detail below.

This provides a first overview of the kind of data that will be discussed in the present paper. In the following I will argue that adjectival passives are subject to a particular kind of contextual variance resulting from the interplay between grammar and pragmatics. More specifically, adjectival passives will be analyzed as a flexible grammatical means of creating a potentially new *ad hoc* property based on the verbal event by which the subject referent is categorized according to contextually salient goals. Under this view post state and target state readings of adjectival passives will turn out to be contextual specifications of a common, more abstract semantic representation.

The paper is organized as follows: Section 2 summarizes the relevant facts and assumptions concerning adjectival passives that constitute the background for the present analysis. Section 3 develops the idea of event-based *ad hoc* properties as the core notion behind adjectival passives. This leads to the formulation of an underspecified semantics for adjectival passives in section 4, which in turn provides the starting point for deriving post state and target state readings of adjectival passives by means of contextual enrichment in the final section 5.

2 Background

Let's start with some introductory remarks on adjectival passives. In the literature on passives it has widely been observed that many languages display two kinds of

[2] Kratzer (2000) uses the term "resultant state reading" instead of the term "post state reading", which I will use here. She also has a somewhat narrower understanding of the target state reading in mind, restricting it to only those target states that are reversible (as indicated by the admissibility of the modifier *immer noch* 'still').

passives: an eventive, or verbal, passive and a so-called “stative”, or “adjectival”, passive; see the overview in Emonds (2006). English does not mark this difference overtly – both verbal and adjectival passives are expressed by an *-en/-ed* participle in combination with a form of *to be*. Thus, a sentence like (6) is ambiguous between an eventive and a stative reading and can only be disambiguated by the linguistic or extralinguistic context; see (6a) vs. (6b). The manner adverbial *quietly* and the agent phrase *by the thief* in (6a) highlight the verbal passive’s eventive reading whereas the durative adverbial *for years* in (6b) selects for the adjectival passive’s stative reading.

(6) The drawer was closed. — adjectival or verbal passive

a. The drawer was quietly closed by the thief. — verbal passive

b. The drawer was closed for years. — adjectival passive

That is, the same form *to be* is used both in the verbal and in the adjectival passive. This makes it difficult to tease apart verbal and adjectival passives in English. In a language like German the situation is more transparent, because verbal and adjectival passives are expressed by different means. The verbal passive is built by combining an *-en/-t* participle with the passive auxiliary *werden* (‘become’); cf. (7).[3] The adjectival passive is formed by using *sein* (‘be’) instead; cf. (8).

(7) Die Schublade wurde geschlossen. — verbal passive
The drawer became closed
‘The drawer was closed.’

a. Die Schublade wurde leise von dem Dieb geschlossen.
The drawer became quietly by the thief closed
‘The drawer was quietly closed by the thief.’

b. *Die Schublade wurde jahrelang geschlossen.
The drawer became for years closed

(8) Die Schublade war geschlossen. — adjectival passive
The drawer was closed
‘The drawer was closed.’

a. *Die Schublade war leise von dem Dieb geschlossen.
The drawer was quietly by the thief closed

b. Die Schublade war jahrelang geschlossen.
The drawer was for years closed
‘The drawer was closed for years.’

---

[3] The ungrammatical sentence (7b) could only be rescued by an iterative reinterpretation of the verbal expression.

Thus, a sentence like (8) can only receive an adjectival passive analysis. Due to their formal difference there is no danger of mixing up adjectival and verbal passives in German. This makes German particularly suitable for studying adjectival passives.

It should be stressed that the adjectival passive formation is a very productive process, at least in German. Adjectival passives coexist with primary adjectives as in (9); forms such as *geleert sein* ('to be emptied'), *geöffnet sein* ('to be opened') are not blocked by the respective primary adjective but are completely regular.

(9)	a.	Die	Schublade	ist	geöffnet	/	offen
		The	drawer	is	opened	/	open
	b.	Die	Schublade	ist	geleert	/	leer
		The	drawer	is	emptied	/	empty

Further illustration of the productivity of the adjectival passive formation in German is given in (10). A manuscript may be submitted, accepted, cited, reviewed, rejected etc. as in (10a). One may also use a sentence like (10b) to express that a certain crisis is an artefact that was brought about by the actions of some protagonists (rather than being the result of a natural development).

(10)	a.	Das	Manuskript	ist	eingereicht	/ akzeptiert	/ zitiert	/ begutachtet ...
		The	manuscript	is	submitted	/ accepted	/ cited	/ reviewed …
	b.	Die	Krise	ist	gemacht.			
		The	crisis	is	made			

That is, with the exception of a very small set of verbs for which the adjectival passive formation is categorically ruled out (e.g. weather verbs, true reflexives, certain statives like *kosten* ('to cost')), almost any verb may form an adjectival passive in German; see Maienborn (2007a) for details and Gese et al. (2008) for a thorough discussion of the particularly interesting case of unaccusatives.

The last remark to be made here concerns the underlying structure of adjectival passives. Nowadays there is wide agreement among linguists that adjectival passives, are to be seen as combinations of the copula *sein / to be* with an adjectivized verbal participle (e.g., Kratzer 1994, 2000; Rapp 1997, 1998; von Stechow 1998; Maienborn 2007a; Gese et al. 2008) rather than some analytic verb form. Following Lieber (1980) the adjectival participle is derived from its verbal counterpart via zero-affixation:

(11)	Die	Schublade	ist	geschlossen	adjectival analysis
			COP	$[_{AP}\ [_{A}\ [_{V_{PART}}$ geschlossen$]\ ø\ ]]$	

(11) provides the structural basis for the following semantic analysis.[4]

[4] Stolterfoht et al. (2008) provide further psycholinguistic evidence for the structural analysis given in (11). In a self-paced reading study we found that participles in adjectival passives require more processing effort than those in verbal passives. These results support the assumption that adjectival passives rely on an additional conversion process of the verbal participle.

3 Event-based *ad hoc* properties

While the view that adjectival passives are in fact combinations of the copula *sein / to be* with an adjectivized participle has become widely accepted, the implications that such a view on the *structure* of adjectival passives has for their *interpretation* haven't been explored up to now. This is what I want to pursue here. If adjectival passives are to be seen as a special instance of the form 'copula plus adjectival predicate', we expect their meaning to follow the general pattern of copula expressions.

For our purposes it suffices to say that a copula sentence ascribes to the subject referent the property given by the predicate. For instance, sentence (12) expresses that the manuscript has the property of being new. That's fairly simple; see Maienborn (2003, 2005a, 2005b, 2007b) and the literature discussed therein for a more thorough consideration of the semantics of the copula.

(12) The manuscript is new.

So the question is whether we can view adjectival passives along these lines and analyze them as ascribing a certain property to their subject referent. What would be a plausible candidate for such a property? I propose that adjectival passives assign a pragmatically salient *ad hoc* property to the subject referent. This *ad hoc* property is conceived of as resulting from the event referred to by the verbal participle. That is, while a standard copula sentence with an adjectival base predicate assigns to the subject referent a lexically coded property, which has a fixed place in the subject referent's property space, adjectival passives are a grammatically supplied means of creating *ad hoc* potentially new, event-based properties, whose exact import, and therefore the place they occupy in the subject referent's property space, is more or less shaped by the context and by our contextually available world knowledge.

What do I mean by event-based *ad hoc* properties? Let's take (13) for an illustration.

(13) Das Manuskript ist eingereicht.
The manuscript is submitted

Sentence (13) does not just express that the manuscript is in some result state of having been submitted; it tells us more. In fact, we may interpret (13) as a statement about the quality of the manuscript. Our background knowledge as (linguistic) scientific community provides us with rich information about possible stages and gradings for scientific papers. We know that – at least when it comes to some assessment – a manuscript that is submitted is better than a manuscript that isn't finished yet or a manuscript that is published in some less prestigious place. But of course it would be better if our manuscript were accepted or even published in a high impact journal.

Adding an event-related modifier as in (14) makes the differentiation of potential properties for the subject referent even finer.[5]

(14)	a.	Das	Manuskript	ist	bei	*Nature*	eingereicht.
		The	manuscript	is	to	*Nature*	submitted
	b.	Das	Manuskript	ist	von	Chomsky	zitiert.
		The	manuscript	is	by	Chomsky	cited
	c.	Das	Manuskript	ist	in	einer Nacht	geschrieben.
		The	manuscript	is	in	one night	written

The modifiers in (14) activate bits of background knowledge which then trigger certain inferences about the kind of manuscript we are dealing with. For instance, from (14a) we may infer, given the reputation of the Journal *Nature*, that the manuscript is of very high quality – at least that is what the author believes. To be cited by Chomsky, as expressed in (14b), is kind of an accolade in generative linguistics. And a manuscript that is written in one night (14c) could be either ingenious or awfully sloppy.

As these examples already show the inferences drawn in a given context may vary considerably and depend largely on our particular background knowledge and attitudes. Providing a full account of this kind of contextual variance is not our job as linguists. However, what is crucial is that the adjectival passive *requires* us to draw some such inference by which we derive a certain property that is ascribed to the subject referent in the given context. This requirement is part of the semantics of adjectival passives.

The *ad hoc* nature of the property expressed by adjectival passives becomes particularly evident in adjectival compounds such as (15).

(15)	a.	Das	iPhone	ist	PIN-gesichert.			
		The	iPhone	is	PIN-secured			
	b.	Alle	Mitglieder	des	Berliner	Senats	sind	stasi-überprüft.
		All	members	of the	Berlin	senate	are	stasi-checked
	c.	Die	Realität	ist	heute	weitgehend	Diana-bereinigt.	
		The	reality	is	today	largely	Diana-purged	

(Spiegel-online 18.07.2007)[6]

[5] The ability of adjectival passives to combine with typical verbal modifiers like agent phrases, instrumentals and locatives plays a prominent role in the current discussion. Kratzer (1994, 2000) proposes to account for data such as (14) by assuming that the adjectival ø-affix may attach at the lexical level as well as at the phrasal level. In the latter case adjectivization applies to a whole VP including verbal modifiers. Kratzer's solution has been taken up and developed further by several authors; cf. e.g. (Rapp 1997, 1998), von Stechow (1998), Anagnostopoulou (2003), Embick (2004), Alexiadou & Anagnostopoulou (2007). I don't have place to discuss this issue here, but see Maienborn (2007a) for arguments against using phrasal adjectivization to account for the combination of adjectival passives with verbal modifiers and an alternative solution that assumes only lexical adjectivization of the verbal participle. In short, I propose to analyze the modifiers in (14) as being *integrated* into the verbal complex (in the sense of Jacobs 1993, 1999), thus building a complex predicate.

[6] From a report about the 10th anniversary of Princess Di's death.

d. Ich hatte Sorge wie der Japaner das Oktoberfest finden würde,
aber es stellte sich heraus,
dass er schwedentrainiert war. (overheard on 11/2007)
that he Sweden-trained was
'I was worried about what the Japanese guy would think about the Oktoberfest, but it turned out that he was Sweden-trained.'

Predicatively used compounds such as *PIN-gesichert* ('PIN-secured') or *stasi-überprüft* ('stasi-checked') are widespread. Besides more or less lexicalized forms such compounds are also readily built "online"; cf. the occasional compounds *Diana-bereinigt* (roughly: 'Diana-purged') or *schwedentrainiert* ('Sweden-trained') in (15c/d). E.g., the intended interpretation of *schwedentrainiert* in (15d) is that the Japanese referred to was "trained" in Sweden and thus got used to drinking (lots of) alcohol.

Both the modifier data in (14) and the compound data in (15) provide further support for the claim that adjectival passives are a means of creating more or less *ad hoc* a possibly complex adjectival predicate by which the subject referent is assigned a certain property that is shaped by contextually salient knowledge, attitudes and goals.

The view of adjectival passives as expressing *ad hoc* properties is inspired by Barsalou's (1983, 1991, 1992, 2005) notion of *ad hoc* categories such as 'things to take on a camping trip'. These are goal-derived categories that are created spontaneously for use in more or less specialized contexts. Under this perspective adjectival passives may be seen as a means to extend and contextualize a concept's property space with respect to contextually salient goals.

To sum up, there is more to the meaning of adjectival passives than some kind of aspectual shift between the verb's event referent and some result state. I propose that adjectival passives are, in fact, nothing but a special case of a copula sentence. By taking a (possibly complex) verbal predicate and converting it into an adjective which then is combined with the copula, the subject referent is assigned a certain property that is linked to the verb's event argument. The crucial point is that this link may be mediated more or less heavily by context and world knowledge. This accounts for the characteristic *ad hoc* nature of adjectival passives.

(16) a. Das Manuskript ist von Chomsky zitiert.
The manuscript is by Chomsky cited

b. Das Manuskript ist von Chomsky zitiert worden.
The manuscript has by Chomsky cited been

With an adjectival passive such as (16a) we classify the manuscript and assign it a certain place within the concept's property space, e.g. as being recommended reading for the generative linguistics community. The perfect tense verbal passive counterpart in (16b) expresses that there is a post state of an event of citing the manuscript by Chomsky, and nothing more. We may go on and draw some inferences here too, but there is no need to do so. Adjectival passives, on the other hand, force us to derive a suitable *ad hoc* property. A semantics for adjectival passives should take account of this subtle difference.

4 An underspecified semantics for adjectival passives

In the following I will sketch a proposal for a formal semantic account of adjectival passives that implements the analysis developed above. First I will briefly summarize the very influential proposal by Kratzer, which set the frame for a series of further developments and variants (e.g. von Stechow 1998, Anagnostopoulou 2003, Embick 2004, Alexiadou & Anagnostopoulou 2007).

Kratzer (2000) proposes to assume two zero-affixes by which the verbal participle (whose semantics is identical to that of the verbal stem) is converted into an adjective. These so-called "stativizers" are intended to account for the two readings of adjectival passives. The semantics of the post (or resultant) state zero-affix is given in (17a), its target state variant is given in (17b).

(17) a. Post state Ø-affix: $\lambda P\ \lambda t\ \exists e\ [P(e)\ \&\ \tau(e) < t]$ Kratzer (2000: 12)
b. Target state Ø-affix: $\lambda R\ \lambda s\ \exists e\ [R(s)(e)]$ Kratzer (2000: 8)

The examples in (18) and (19) illustrate the result of applying these affixes to a verbal form.[7]

(18) **Post state reading:** Kratzer (2000: 12)
a. Das Theorem ist bewiesen.
The theorem is proven
b. beweis-: $\lambda x\ \lambda e\ [prove\ (x)(e)]$
c. [$_{IP}$ das Theorem bewiesen sei]: $\lambda t\ \exists e\ [prove\ (the\ theorem)(e)\ \&\ \tau(e) < t]$

(19) **Target state reading:** Kratzer (2000: 8)
a. Der Reifen ist aufgepumpt.
The tire is pumped-up
b. aufpump-: $\lambda x\ \lambda s\ \lambda e\ [pump\ (e)\ \&\ inflated\ (x)(s)\ \&\ cause\ (s)(e)]$
c. [$_{IP}$ der Reifen aufgepumpt sei]: $\lambda s\ \exists e\ [pump\ (e)\ \&\ inflated\ (the\ tire)(s)\ \&\ cause(s)(e)]$

Assuming the zero-affix in (17a) yields a semantic analysis of the post state reading according to which an adjectival passive expresses a resultant state (given over times t) that starts with the culmination of the verb's event and holds forever after; see Parsons (1990: 234) for this view on resultant states. Kratzer's target state affix in (17b) may only apply to a subgroup of resultative verbs, more specifically those verbs that specify a characteristic (and in principle reversible) target state that is compositionally accessible via the verb's argument structure; see e.g. the lexical entry for the verb

[7] For the time being I neglect further complications in connection with Kratzer's suggestion that these affixes may apply both at the lexical and the phrasal level (see footnote 5).

aufpumpen ('to pump up') in (19b).[8] According to this analysis the target state reading of an adjectival passive expresses a lexically specified target state that is caused by the verb's event.[9]

These are the aspects of Kratzer's proposal that are relevant for our present purposes in a nutshell. Under the perspective on adjectival passives developed above this analysis has three shortcomings. First, Kratzer analyzes the adjectival passive ambiguity as a case of lexical homonymy. Her post state stativizer in (17a) and the target state stativizer in (17b) have nothing in common (apart from the existential binding of the verb's event argument). This does not seem to me a particularly attractive feature of Kratzer's account given the apparent relatedness of the two readings. Second, the application of the stativizers is determined exclusively by the verb's argument structure. The target state reading is only available for the lexical subgroup of target state verbs. This is in conflict with the characteristic contextual flexibility of adjectival passives observed above. The previous discussion of the data has shown that the target state reading of adjectival passives is much more broadly available than Kratzer's lexical account predicts. In fact, with a little contextual help both readings are available for nearly any verb. And third, Kratzer's account reduces the semantic contribution of the adjectival zero-affixes to a merely aspectual shift from the verbal event to some subsequent state (either post or target state). This ignores the subtle but crucial difference between adjectival passives and perfect tense; see the discussion of (16).

In sum, all the ingredients of Kratzer's account of the meaning of adjectival passives are to be found either in the lexicon or in the grammar. There is no particular place for a systematic contextual import. This does not fit very well with the empirical evidence presented above.

What would a more balanced division of labor between grammar and pragmatics look like? As for the grammar, I want to propose that the meaning of adjectival passives should be accounted for by assuming a unique adjectival zero-affix. This affix is semantically underspecified in two respects. First, it does not fully determine what kind of property is assigned to the subject referent. And, secondly, it is underspecified with respect to the post state / target state ambiguity of adjectival passives A respective semantic representation for a zero-affix that turns a verbal into an adjectival participle is given in (20).

(20) Adjectival Ø-affix: $\lambda P\ \lambda x\ \lambda s\ \exists e\ [s: Q(x)\ \&\ \text{result}\ (e, s)\ \&\ P(e)]$

According to (20) the adjectival affix introduces a free variable Q for the property that holds for the subject referent x in a state s. Q is further restricted as resulting from the verbal event e. The grammar does not suppy any more information than that about the actual kind of property. An illustration is given in (22). For comparison see the representation of a standard copula sentence with an adjectival base predicate in (21).

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[8] Recall that Kratzer's conception of the target state reading is more narrow than the one I advocate here (see footnote 2)

[9] Sentence (19a) may have an additional post state reading besides that.

(21) Das Manuskript ist neu.
The manuscript is new
$\exists$s [s: new (the manuscript)]

(22) Das Manuskript ist eingereicht.
The manuscript is submitted
$\exists$s [s: Q (the manuscript) & result (e, s) & submit (e)]

As for the semantics of the copula, I have argued in Maienborn (2005a, 2007b) that copula constructions and other stative verbs differ fundamentally from Davidsonian event and state expressions. In order to account for this difference I introduced a new ontological sort of so-called "Kimian states" (or K-states) that supplements the ontological sort of Davidsonian eventualities (which also include Davidsonian states). K-states are to be understood as reifications for the exemplification of a property Q at a holder x and a time t. From this it follows that K-states are ontologically poorer and more abstract than Davidsonian eventualities; see Maienborn (2005a, 2007b) for details. I'll come back to this issue below.

Turning back to our adjectival passives, a comparison of the semantic structures given in (21) and (22) shows that the semantics of the adjectival zero-affix laid out in (20) leads to an analysis of adjectival passives that follows the pattern of regular copula sentences. Adjectival passives only differ from adjectival base predicates in that they express an internally more complex and semantically underspecified property. For the adjectival passive to be interpretable, the free variable Q must be given a suitable value by the context.

5 Deriving post state and target state readings

The semantic analysis advocated in the previous section takes adjectival passives to express a semantically underspecified, event-based *ad hoc* property. The task of pragmatics is to legitimate this *ad hoc* property in a given context. More specifically, pragmatics must provide a contextually suitable value for the free variable Q, and it must justify the choice of an *ad hoc* formation instead of a pre-established, lexically coded property. This will lead to the post state / target state differentiation.

I will not present a formal account for the pragmatics in this paper but will only point towards the basic idea. In searching for a value for the free variable Q, the best/most economic instantiation for it is the one that gets by with the fewest contextually not licensed additional assumptions. If the conceptual knowledge associated with the verb's event referent happens to already specify a resulting property, this will of course be the best choice for Q. In this case, there is no need to draw further inferences and derive more remote *ad hoc* property candidates – unless the context explicitly forces us to.

This explains why virtually no pragmatic effort is needed for interpreting adjectival passives in the case of resultative verbs. These verbs already specify a result state within their lexical entry. Thus Q may simply be identified with the property introduced at the lexical level. Non-resultative verbs will need more contextual support to derive a suitable value for Q and to localize Q within the category's property space. That is, while the pragmatic effort needed to derive a contextually suitable value for Q may vary considerably, sometimes being completely predictable from the verb's lexical semantics and sometimes relying heavily on context and world knowledge, the basic mechanism is the same.

A pragmatic justification for favoring an *ad hoc* formation over a lexically coded property follows from independent pragmatic economy principles (e.g. Blutner 1998, 2000; Levinson 2000; see also Ackerman & Goldberg 1996). Using an *ad hoc* property will only be pragmatically licensed if the context supports a salient alternative. That is, for an adjectival passive to be interpretable, the context must provide a contrasting alternative K-state s'.

As I indicated above, K-states are ontologically sparse entities and therefore offer few possibilities for establishing suitable alternatives. There are basically two options. This gives us the two readings of adjectival passives. A contextually salient contrasting state s' may differ from s with respect to either the temporal or the qualitative dimension. In the first case the context provides a salient alternative state s' that preceeds s and in which x does not have the property Q. This corresponds to the adjectival passive's post state reading; see (23a). In the second case, s' exemplifies a contextually salient property Q' that is distinct from Q; see (23b).

(23) Das Manuskript ist eingereicht.
$\exists s$ [s: Q (the manuscript) & result (e, s) & submit (e)]

a. **Post state reading:**
… & contrast (s, s') & s': $\neg$ Q(x) & s' < s

b. **Target state reading:**
… & contrast (s, s') & s': Q'(x)

Whether the contrasting state s' is construed along the temporal or the qualitative dimension affects the truth conditions of the adjectival passive. This is shown by the fact that we can simultaneously affirm and deny a particular state of affairs; see Zwicky & Sadock (1975), Kennedy (2009). In a context where an author finally succeeded in finishing a manuscript and submitted it to a journal but already received the sad note that the paper was rejected, he could answer (24) when asked about the manuscript.

(24) Das Manuskript ist zwar eingereicht, aber es ist nicht eingereicht,
The manuscript is though submitted but it is not submitted

sondern abgelehnt.
but rejected

The present proposal accounts for this post state / target state ambiguity by letting s be contextually determined relative to a salient contrasting alternative s'.

Finally, Kratzer's "job is done" reading by which the adjectival passive of, e.g., an activity verb like *streicheln* ('to pet') can be "rescued" (cf. (2') repeated in (25) below) turns out to be a specific instance of the post state reading.

(25) Anna hat ihre Nachbarspflichten erfüllt: Der Briefkasten ist geleert,
Anna has her neighbor-duties fulfilled: The mail-box is emptied

die Blumen sind gegossen und die Katze ist gestreichelt.
the flowers are watered, and the cat is petted.

'Anna has done her neighborly duties: the mailbox is emptied, the flowers are watered and the cat is petted.'

The particular context given in (25) supports an *ad hoc* categorization of cats into two contrasting sets, cats that still need to be petted and cats that have already been petted. With the adjectival passive sentence *The cat is petted* the subject referent is assigned the property of belonging to the second class.

The semantic and pragmatic analysis achieves the goals laid out in the beginning: First, it takes seriously the structural insights into the nature of adjectival passives and exploits them for their interpretation in taking adjectival passives to be a special instance of copula sentences. And, secondly, it accounts for the characteristic context dependency and *ad hoc* feel of adjectival passives by introducing a free variable at the semantic level that requires the pragmatic machinery to infer a suitable contextual instantiation. All in all this yields a more balanced division of labor between grammar and pragmatics in accordance with the empirical facts.

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On *Wh*-Islands

Márta Abrusán
Institut Jean Nicod
ENS, EHESS, CNRS

marta.abrusan@gmail.com

Abstract

This paper argues that *wh*-islands are unacceptable because they cannot be given a complete (exhaustive) answer. In the case of degree questions, the complete answer expresses a contradiction given the assumption that degree questions range over intervals. In the case of manner questions the problem arose from the fact that a complete answer to these questions is equivalent to a sentence with an embedded declarative, which is either a violation of the principle of Maximize Presupposition!, as in the case of question embedding predicates such as *know,* or simply incompatible with the meaning of the question embedding predicate, which is argued to be the case with predicates such as *wonder*.

1 Introduction

An interrogative complement clause creates an environment of which *wh*-words ranging over individuals can move out[1], but not *wh*-words ranging over degree or manners:

(1) a. ?Which problem do you wonder how to solve?
b. *How do you know which problem to solve?
c. *How high do you wonder who to lift?

(2) a. ?Which problem do you know whether to solve?
b. *How do you wonder whether to solve the problem?
c. *How tall do you know whether to be?

[1] There is significant crosslinguistic variation with respect to these facts: E.g. in English and Hungarian extraction of *wh*-words over individuals is indeed markedly better from their degree and manner counterparts, French e.g. however prohibits the extraction of wh-words ranging over individuals as well. I will not address this cross-linguistic difference.

The contrasts exemplified above represent some of the core cases of so called *weak-island* violations and have been a major topic in the *syntactic* literature in the last 20 years or so (cf. Rizzi 1990, Cinque 1990 and subsequent literature). Other examples of paradigmatic *weak-island* violations include negative islands, factive islands, islands created by certain quantifiers, to name but a few. Interestingly enough, the existing *semantic* accounts of weak islands, such as Szabolcsi and Zwarts (1993, 1997), Honcoop (1996), Rullmann (1995), Fox and Hackl (2007) concentrate their attention on one or more of these latter types of islands, offering at best a promissory note about the cases of the type of island violations exemplified above. The exception is Cresti (1995), who offers a syntactico-semantic account for *wh*-islands that arise with degree extraction. This paper presents a new, purely semantic/pragmatic account to *wh*-islands.

Dayal (1996) has argued that a question presupposes that there is a single most informative true proposition in the Karttunen denotation of the question, i.e. a proposition that entails all the other true answers to the question. This principle has been shown to explain the unacceptability of negative degree islands in Fox and Hackl (2007) and Abrusán and Spector (2008), and also to explain a number of other types of weak islands in Abrusán (2007). In this paper I argue that in the case of *wh*-islands that are formed by an extraction of a *degree-wh* phrase, Dayal's (1996) presupposition can also never be met. As a consequence, any complete answer to these questions will amount to the statement of a contradiction. The reason is that for any proposition p in the question domain, there will be at least two alternatives to p that cannot be denied at the same time. I argue that this maximization failure is predicted if we assume an interval-based semantics of degree constructions (cf. Schwarzschild and Wilkinson 2002, Heim 2006). In the case of manner questions the situation will be slightly different: Although these do have a most informative true answer, however, this answer will always be contextually equivalent to its counterpart with an embedded declarative. Since the answer with the embedded interrogative comes with a vacuous presupposition, while the answer with the embedded declarative has a contentful presupposition, any answer to a question such as the b-examples above will be a violation of the principle of Maximize Presupposition (cf. Heim (1991), Sauerland (2003), Percus (2006), Schlenker (2008)). Thus according to this proposal the compositional semantics and pragmatics of questions supplies everything we need for the explanation of *wh*-islands in questions, without invoking any further special rules.

A disclaimer is in order at this point: one aspect that I will not discuss in this paper is the role of tense, in other words why is it that the presence of overt tense marking turns these islands into strong islands in many languages[2]. I will assume that this is a consequence of an independent factor that creates strong-islands. Therefore the only thing that I will be concerned with here is the difference that I predict between questions about individuals on the one hand, and questions about manners and degrees on the other hand, independently of the contribution of tense.

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[2] The data on tensed constituent *wh*-complements seems to show a lot of cross-linguistic and cross-speaker variation. E.g. Szabolcsi (2006) reports sentences such as (i) below to be acceptable in Hungarian, but not in English or Dutch for most speakers.

(i) ???Which men did John ask whether Bill invited?

2 Embedded Questions and Exhaustivity

While Groenendijk and Stokhof (1982, 1984) have famously proposed that embedded questions in general should be understood as strongly exhaustive, Heim (1994) and following her Beck and Rullmann (1999), Guerzoni and Sharvit (2004) have argued for a theory that has more flexibility, namely allows for at least some embedded questions to be understood as weakly exhaustive. In this respect, a three-way classification is sometimes assumed (cf. e.g. Guerzoni and Sharvit 2004, Sharvit 1997) according to which predicates such as *wonder* are always strongly exhaustive[3], predicates belonging to the *know*-class can be understood as both strongly and weakly exhaustive, while predicates such as *be surprised* or *predict* only allow weakly exhaustive readings. At the same time, the weakly exhaustive reading of the verbs belonging to the know-class is rather controversial (cf. Sharvit 1997 for an overview) and therefore in the following discussion I will only use their strongly exhaustive readings.

Which types of question embedding predicates create *wh*-islands? It seems that *wh*-islands arise with both the *wonder*- and the *know*-type of question embedding predicates.

(3) *Wonder class* predicates (e.g. *Wonder, ask, want to know, inquire…)*
a. ?Who does Mary wonder whether to invite?
b. *How is Mary wondering whether to behave?
c. *How tall is the magician wondering whether to be?

d. ?Which problem do you wonder how to solve?
e. *How do you wonder which problem to solve?
f. *How high do you wonder who to lift?

(4) *Know*-class predicates (*Know, find out, remember, be certain…)*
a. ?Who does Mary know whether to invite?[4]
b. *How does Mary know whether to behave?
c. *How tall does Mary know whether to be?

d. ?Which problem do you know how to solve?
e. *How do you know which problem to solve?
f. *How high do you know who to lift?

How about predicates belonging to the *surprise* class, i.e. the class of weakly exhaustive predicates? Unfortunately, these examples do not offer a good testing ground for *wh*-islands, because the meaning of these seems to be incompatible with an

[3] But note that this claim is not uncontroversial, cf. discussion e.g. in Sharvit (1997).
[4] The acceptability of this example shows speaker variation, and also variation across languages. Its French counterpart I am told seems to be consistently unacceptable, while its Hungarian counterpart is acceptable.

embedded infinitival clause. However, since tense in the embedded complement turns weak islands into strong islands, we cannot find weak-islands created by such weakly exhaustive predicates. Therefore, all the examples that we find with *wh*-islands are in fact cases where the question embedding verb requires a strongly exhaustive reading.

3 Wh-Islands that Arise with Degree Questions

This section looks at *wh*-islands that arise with degree questions. The first part is concerned with embedded *whether* questions, discussing examples with the question embedding predicates *know* and *wonder.* It is assumed that the explanation given for these two verbs will carry over to all the other question embedding predicates in their class. In the second half of the section I discuss the case of embedded constituent questions and show that the problem they pose can in fact be reduced to the same problem that made embedded *whether* questions unacceptable in the first place.

3.1 Embedded Whether Questions

***Know*-class predicates** I follow Heim (1994) and Beck and Rullmann (1999) in assuming that the exhaustivity of embedded complements is encoded in the lexical meaning of the question embedding verb[5]. Given this, let's represent the lexical semantics of the strongly exhaustive question embedding verb *know* as follows, using a Hintikka-style semantics for attitude verbs. ($Q_H(w)$ stands for the Hamblin-denotation of an interrogative).

(5) **know** (w) (x, $Q_H(w)$) is true iff $\forall p \in Q_H(w)$, x knows whether p is true in w
where, 'x *knows whether p is true in w* ' is true in w iff for $\forall w' \in Dox_x(w)$,
if p(w)=1, p in w' and if p(w)=0, $\neg$p in w'
,*where* $Dox_x(w) = \{w' \in W$: x's beliefs in w are satisfied in w'$\}$

Embedded whether questions with *know*-predicates about individuals Let's look at an example of movement out of a *whether*-clause, and its Hamblin denotation:

(6) a. Who does Mary know whether she should invite?
b. $\lambda q.\exists x$ [person(x)$\wedge$ q=λw. knows (Mary, λp.[p=λw'. she_m should invite x in w' $\vee$ p=λw'. she_m should not invite x in w']) in w

Assuming that the domain of individuals in the discourse is {Bill, John, Fred}, the set of propositions that (6)b describes is {that Mary knows whether to invite Bill, that

[5] But note that this assumption is not in fact crucial for our analysis.

Mary knows whether to invite John, that Mary knows whether to invite Fred}[6]. More precisely we might represent this set of propositions as:

(7) $\{\forall w' \in Dox_M(w)$, (if *invB* in w, *invB in w')* $\wedge$ (if $\neg$*invB in w*, $\neg$*invB in w')*,
$\forall w' \in Dox_M(w)$, (if *invJ* in w, *invJ in w')* $\wedge$ (if $\neg$*invJ in w*, $\neg$*invJ* in w'),
$\forall w' \in Dox_M(w)$, (if *invF in w*, *invF in w')* $\wedge$ (if $\neg$*invF* in w, $\neg$*invF in w')}*
,where *invX* in w is a notational shorthand for *Mary should invite X in w*

A complete answer to a question Q is the assertion of some proposition in Q together with the negation of all the remaining alternatives in Q. For (6), the meaning we would get if we negated one of the propositions in its denotation is shown below:

(8) Mary does not know whether to invite John

$\neg[\forall w' \in Dox_M(w)$, (if *invJ* in w, *invJ in w')* $\wedge$ (if $\neg$*invJ in w*, $\neg$*invJ* in w')]

= $\exists w' \in Dox_M(w)$, (*invJ* in w $\wedge$ $\neg$*invJ in w')* $\vee$ ($\neg$*invJ* in w $\wedge$ *invJ* in w')

Suppose that we assert *Mary knows whether she should invite Bill* as an answer to the question in (6). The statement that this answer is the complete answer means that we in fact assert that the rest of the alternative propositions in Q are false: i.e. we assert that Mary knows whether she should invite Bill and that she does not know whether she should invite John and that she does not know whether she should invite Fred:

(9) *Mary knows whether she should invite Bill*
$\forall w' \in Dox_M(w)$, if *invB in w*, *invB in w'* $\wedge$ if $\neg$*invB* in w, $\neg$*invB in w'*
and $\exists w' \in Dox_M(w)$, (*invJ* in w $\wedge$ $\neg$*invJ in w')* $\vee$ ($\neg$*invJ* in w $\wedge$ *invJ* in w'),
and $\exists w' \in Dox_M(w)$,(*invF in w* $\wedge$ $\neg$*invF in w')* $\vee$ ($\neg$*invF in w* $\wedge$ *invF in w')*

In the case of questions about individuals thus no problem arises with complete answers: the meaning expressed above is coherent. This is because the alternatives in the question denotation are independent from each other: whether or not Bill is invited in the actual world is independent from whether or not Fred is invited etc.

Embedded *whether* questions with *know* about degrees Following the analyses of Schwarzschild and Wilkinson (2002), Heim (2006) and Abrusán and Spector (2008), I will assume that degree adjectives establish a relation between individuals and intervals:

(10) a. ▪ $\text{tall}\rrbracket = \lambda I_{<d,t>}.\ \lambda x_e.$ x's height $\in I$
b ▪ John is I-tall$\rrbracket = 1$ iff John's height $\in I$; *where I is an interval:*

---

[6] I restrict my attention to singular alternatives in the discussion. The reader can verify that adding plural alternatives would not change the facts.

c. A set of degrees D is an <u>interval</u> iff
For all d, d’, d’’: if $d \in D$ & $d'' \in D$ & $d \leq d' \leq d''$, then $d' \in D$

In the case of a positive degree question the alternative propositions in the question denotation range over different intervals that could be the argument of the adjective:

(11) ▪ How tall is John?□^{w} = $\lambda p.\exists I\, [I \in D_I \wedge p = \lambda w'.$ John’s height $\in I$ in $w']$
‘For what interval I, John’s height is in that interval?’

Given this, the Hamblin denotation of a question with movement of the degree expression out of the embedded question will be as shown below:

(12) a. *How tall does Mary know whether to be?
b. $\lambda q.\exists I\, [I \in D_I \wedge\ q = \lambda w.$ knows (Mary, $\lambda p.[p = \lambda w'.$ her_m height be in I in w’ $\vee$ $p = \lambda w'.\ \neg$ her_m height be in I in w’]) in w

We might represent this set informally, as {that Mary knows whether her height be in I_1, that Mary knows whether her height be in I_2, that Mary knows whether her height be in I_3 …etc, for all intervals in D_I }, or more precisely as follows: (Notice that if one knows that her height is not in an interval I equals knowing that her height is in the complement of interval I in a given domain of degrees, which I represent as $\neg$I.)

(13) {$\forall w' \in Dox_M(w)$, [if $I_1(w)=1$, $I_1(w')=1$] $\wedge$ [if $\neg I_1(w)=1$, $\neg I_1(w')=1$]
$\forall w' \in Dox_M(w)$, [if $I_2(w)=1$, $I_2(w')=1$] $\wedge$ [if $\neg I_2(w)=1$, $\neg I_2(w')=1$]
$\forall w' \in Dox_M(w)$, [if $I_3(w)=1$, $I_3(w')=1$] $\wedge$ [if $\neg I_3(w)=1$, $\neg I_3(w')=1$] }
,where I_n (w) is a notational shorthand for *Mary’s height should be in* I_n *in w*.

Imagine now that we were to state *Mary knows whether her height should be in* I_1 as a complete answer. A complete answer equals to the assertion of the most informative true answer together with the negation of all the alternatives that are not entailed by the most informative true answer. Now let’s take 3 intervals: interval 1, interval 2 which is fully contained in 1 and interval 3 which is fully contained in the complement of 1:

(14)
```
|__1_________________|_____¬1____________________|
|_____2_____|__¬2________________________________|
|______¬3________________________|_____3__________|
```

The propositions that Mary knows whether her height is in I_1 and that Mary knows whether her height is in I_2 and that Mary knows whether her height is in I_3 do not entail each other. Thus, asserting that *Mary knows whether her height be in* I_1 as a complete answer would amount to asserting the conjunction that she knows whether her height should be in I_1 and that she does not know whether her height should be in I_2 or I_3:

(15) $\underline{\forall w' \in \text{Dox } M(w),\ [\text{if } I_1(w)=1, I_1 (w')=1]} \wedge [\text{ if} \neg I_1(w)=1, \neg I_1 (w')=1]$
and $\exists w' \in \text{Dox}_M(w), (I_2 (w)=1 \wedge \neg I_2 (w')=1) \vee (\neg I_2 (w)=1 \wedge I_2 (w')=1)$
and $\exists w' \in \text{Dox}_M(w), (I_3 (w)=1 \wedge \neg I_3 (w')=1) \vee \underline{(\neg I_3 (w)=1 \wedge I_3 (w')=1)}$

However, the problem is that the meaning expressed by this tentative complete answer above is not coherent. Suppose first that Mary's height is in I_1. The complete answer states that Mary does not know that her height is in $\neg I_3$, i.e. in the complement of interval I_3. From this it follows that for any interval contained in $\neg I_3$, Mary does not know that her height is in it. Interval I_1 is contained in interval $\neg I_3$. But now we have derived that the complete answer states a contradiction: this is because it states that Mary knows that her height is in I_1 **and** that she does not know that her height is in $\neg I_3$, which is a contradiction. We might illustrate the contradiction that arises with the following:

(16) #Mary knows whether her height is btw 0 and 5 or between 5 and 10
but She does not know whether her height is btw 0 and 3 or between 3 and 10
and She does not know whether her height is btw 0 and 7 or between 7 and 10

It is easy to see that if Mary's height had to be in the complement of interval I_1 the same problem is recreated, but this time with interval I_2.

Embedded whether questions with *wonder*–type predicates about degrees As a first pass, let's assume (cf. e.g. Lahiri (2002), Guerzoni and Sharvit (2004)), that the lexical semantics of *wonder* is the following:

(17) **wonder** (w) (x, Q_H(w)) is defined iff $\neg\forall p \in Q_H(w)$, x believe p
if defined, **wonder** (w) (x, Q_H(w)) is true iff
$\forall p \in Q_H(w)$, x wants-to-know whether p in w

Let's spell out what it means if *x wants to know whether p*. Using a Hintikka-style semantics for attitude verbs such a meaning could be expressed as follows:

(18) 'x ***wants-to-know*** whether p in w ' is **true** in w iff
for $\forall w' \in \text{Bul}_x (w)$, if p(w)=1, x knows p in w'
and if p(w)=0, x knows $\neg$p in w'
,where $\text{Bul}_x (w) = \{w' \in W$: x's desires in w are satisfied in w'$\}$
'in every world in which x's desires are satisfied, if p, x knows that p
and if not p, x knows that not p'

Given this meaning, the meaning of question where a degree phrase moves out from the complement of *wonder* will be as follows:

(19) a. *How tall does Mary wonder whether to be?

b. $\lambda q.\exists I\ [I \in D_I \wedge\ q=\lambda w.$ wonders (Mary, $\lambda p.[p=\lambda w'.$ her$_m$ height be in I in w' $\vee$ $p=\lambda w'.\ \neg$ her$_m$ height be in I in w']) in w

Informally, we might represent the set described above as {that Mary wonders whether her height should be in I_1, that Mary wonders whether her height should be in I_2, that Mary wonders whether her height should be in I_3, etc, for all intervals in D_I}. Somewhat more precisely we might represent it as below: (Notice that if one wonders whether her height is not in an interval I equals her wondering about her height being in the complement of that interval in a given domain, which I represent as $\neg$I.)

(20) {$\forall$w'$\in$ Bul$_M$(w), if I_{1w}, M knows I_1 *in w'* $\wedge$ if $\neg\ I_{1w}$, M knows $\neg\ I_1$ *in w',*
$\forall$w'$\in$ Bul$_M$(w), if I_{2w}, M knows I_2 *in w'* $\wedge$ if $\neg\ I_{2w}$, M knows $\neg\ I_2$ *in w',*
$\forall$w'$\in$ Bul$_M$(w), if I_{3w}, M knows I_3 *in w'* $\wedge$ if $\neg\ I_{3w}$, M knows $\neg\ I_3$ *in w',*
etc. for all intervals in D_I}
,where I_{nw} is a notational shorthand for *Mary's height should be in I_n in w*.

Imagine now that we were to state *Mary wonders whether her height should be in I_1* as a complete answer. Now let's again take 3 intervals as follows: interval 1, interval 2 which is fully contained in 1 and interval 3 which is fully contained in the complement of interval 1:

(21)
```
|__1_________________|____¬1____________________|
|_____2_____|__¬2_________________________________|
|______¬3________________________|_____3__________|
```

Asserting that *Mary wonders whether her height should be in I_1* as a complete answer would amount to asserting the conjunction that she wonders whether her height should be in I_1 and that she does not wonder whether her height should be in I_2 or I_3:

(22) $\forall$w'$\in$ Bul$_M$(w), if I_{1w}, M knows I_1 *in w'* $\wedge$ if $\neg\ I_{1w}$, M knows $\neg\ I_1$ *in w',*
and $\exists$w'$\in$ Bul$_M$(w), (I_{2w} $\wedge$ M $\neg$know I_2 *in w')* $\vee$ *(*$\neg\ I_{2w}$ $\wedge$ M $\neg$know $\neg\ I_2$ *in w')*
and $\exists$w'$\in$ Bul$_M$(w), (I_{3w} $\wedge$ M $\neg$know I_3 *in w')* $\vee$ *(*$\neg\ I_{3w}$ $\wedge$ M $\neg$know $\neg\ I_3$ *in w')*

However, again the meaning expressed by the tentative complete answer above is not coherent. Suppose first that Mary's height has to be in I_1. Then the complete answer states that in her desire worlds, Mary does not know that her height is in $\neg I_3$, i.e. the complement of interval I_3. From this it follows, that for any interval contained in $\neg I_3$, Mary does not know that her height is in it. Interval I_1 is contained in interval $\neg I_3$. But now we have derived that the complete answer states a contradiction: this is because it states that in her desire worlds, Mary knows that her height is in I_1 **and** that she does not know that her height is in $\neg I_3$, which is a contradiction. Finally, it is easy to see that if Mary's height had to be in the complement of interval I_1, the same problem would be recreated, but this time with interval I_2. We might again illustrate the contradiction that arises with the following:

(23) #Mary wants to know whether her height is btw 0 and 5 or between 5 and 10
but She doesn't want to know whether her height is btw 0 and 3 or btw 3 and 10
and She doesn't want to know whether her height is btw 0 and 7 or btw 7 and 10

Interestingly, for both false alternatives, it would have been consistent with the meaning of p to exclude them, but trying to exclude them both at the same time leads to contradiction. Notice that this property connects in a straightforward way to the generalization made in Fox (2007) about non-exhaustifiable sets of alternatives.

3.2 Embedded Constituent Questions

Not only embedded whether-constituents, but also embedded constituent questions are *wh*-islands, as the examples below show:

(24) a. ?Which problem does Mary know how to solve?
b. *How tall does Mary know who should be?

The unacceptability of (24)b and similar questions can be reduced to the problem that lead to the unacceptability of embedded *whether* questions in the previous section. First, observe that the Hamblin-denotation of (24)b is as below:

(25) $\lambda q.\exists I\ [I \in D_I\ \wedge q = \lambda w.$ knows (Mary, $\lambda p.\exists x\ [p = \lambda w'.$ x's height should be in I in w']) in w

Informally, the meaning above might be schematized as below:

(26) {that Mary knows about Q_1, that Mary knows about Q_2}

Imagine that there are 3 individuals in the domain A, B and C, and 3 intervals: interval 1, interval 2 which is fully contained in 1 and interval 3 which is fully contained in the complement of 1, exactly as was assumed in (21) above. Then the informal representation of the denotation of the question above could be as follows:

(27) {that Mary knows (for which $x \in \{A,B,C\}$, x's height is in I_1)
that Mary knows (for which $x \in \{A,B,C\}$, x's height is in I_2)
that Mary knows (for which $x \in \{A,B,C\}$, x's height is in I_3) }

Recall that the strongly exhaustive meaning for the question embedding predicate *know* places a constraint on the true as well as the false alternatives. Given this, our question denotation equals the following set of propositions:

(28) {that M.knows{whetherA's height $\in I_1$;
whether B's height $\in I_1$;
whether C's height $\in I_1$ },
that M.knows {whether A's height $\in I_2$;
whether B's height $\in I_2$;
whether C's height $\in I_2$ },
that M.knows {whether A's height $\in I_3$;
whether B's height $\in I_3$;
whether C's height$\in I_3$}}

Before we proceed, let me insert here a note about negation: It has been already observed that the negation of a strongly exhaustive predicate is stronger than expected: e.g. *John does not know who came* seems to suggest that for no individual does John know whether they came. This is surprising because by simple negation we would only expect a much weaker meaning, according to which John does not know for everyone whether they came. In other words, the question below in (29)a seems to have the stonger meaning shown in (29)b instead of the predicted weaker (29)c:

(29) a. John does not know who came
b. $\forall p \in Q_H(w)$, John does not know whether p
c. $\neg \forall p \in Q_H(w)$, John knows whether p

In the discussion that follows I will take this fact at face value, without providing an explanation. Given this, the complete answer conjoins the most informative true answer with the strengthened negation of the false alternatives. Now, a complete answer *Mary knows who should be I_1-tall* will state:

(30) **that M. knows whether A's height $\in \mathbf{I_1}$**
& that M knows whether B's height $\in I_1$
& that M knows C's height $\in I_1$,
& **that M. $\neg$know whether A's height $\in \mathbf{I_2}$**
& that M $\neg$ know whether B's height $\in I_2$
& that M $\neg$ know whether C's height $\in I_2$,
& **that M $\neg$know whether A's height $\in \mathbf{I_3}$**
& that M $\neg$know whether B's height $\in I_3$
& that M $\neg$ know whether C's height $\in I_3$

Looking more closely at the set of propositions above, we can observe that exactly the same problem that arose with the embedded *whether* questions is recreated, but multiply! Observe that each boxed part below corresponds to an embedded contradictory *whether* question:

(31)

that M knows if A's height $\in I_1$ & that M$\neg$know if A's height$\in I_2$ & that M$\neg$know if A's height$\in I_3$	& & &	that M knows if B's height $\in I_1$ that M $\neg$know if B's height $\in I_2$ that M $\neg$know if B's height $\in I_3$	& & &	*that M knows if C's height $\in I_1$ that M $\neg$know if C's height $\in I_2$ that M$\neg$ know if C's height$\in I_3$*

Thus the problem of embedded constituent questions simply reduces to the problem of embedded *whether* questions, which have been argued to always lead to a contradiction in the previous section.

4 Questions about Manners

I will assume following Abrusán (2007) that the domain of manners contains *contraries* as described below:

(32) Manners denote functions from events to truth values. The set of manners (D_M) in a context C is a subset of $[\{f \mid E \rightarrow \{1,0\}\} = \wp(E)]$ such that for each predicate of manners $P \in D_M$, there is at least one contrary predicate of manners $P' \in D_M$, such that P and P' do not overlap: $P \cap P' = \emptyset$.

Second, although the context might implicitly restrict the domain of manners, just as the domain of individuals, but for any manner predicate P, its contrary predicates will be alternatives to it in any context, e.g. *wisely, unwisely*. Finally, we might observe that the law of excluded middle does not hold for manners: for each pair (P, P'), where P is a manner predicate and P'is a contrary of P, and $P \in D_M$ and $P' \in D_M$, there is a set of events $P^M \in D_M$, such that for every event e in $P^M \in D_M$ $[e \notin P \in D_M \ \& \ e \notin P' \in D_M]$.

Let's first observe that unfortunately the account proposed for degree questions above does not go through in a straightforward way for manner questions. In analogy with the intervals that we have used for degrees, we might think of contrary manner predicates as exclusive sets of events. Suppose now that the domain of manners contains three exclusive sets of events, i.e. three contrary predicates, e.g. the *politely, impolitely,* and *neither politely and impolitely,* which I represent as *med-politely* below. Now, the sets of events that are *politely*-events, the sets of events that are *impolitely*-events and the sets of events that are *med-politely*-events and the events that are in the complement set of these can be represented as follows:

(33)
$\neg$*med.politely*	*med.pol*	$\neg$*med.politely*
politely	$\neg$ *politely*
$\neg$*impolitely*	*impolitely*

Take now an example of a *wh*-island that arises if we attempt to move the manner-expression out of the embedded interrogative:

(34) a. *How does Mary know whether to behave?

b. $\lambda q.\exists\alpha$ [manner(α)$\wedge$ q=λw. knows (Mary, λp.[p=λw'. she$_m$ behave in α in w' $\vee$ p=λw'. she$_m$ not behave in α in w']) in w

Assuming that our domain of manners is {*politely, impolitely med-politely*}, we might informally represent the Hamblin denotation of this question as {that Mary knows whether to behave *politely*, that Mary knows whether to behave *impolitely*, that Mary knows whether to behave *med-politely* , …}. A word of caution is in order. Notice that given this small domain, the set of alternatives is **not** the singular set {that Mary knows whether to (behave *politely,* behave *impolitely*, behave *med-politely)*}. This is because given the regular meaning of *whether*, this is simply not what we get compositionally. Given some proposition p, *whether p*, as defined in the previous section, gives us the set consisting of p and its complement proposition ¬p: i.e. {p,¬p}. *Whether p* cannot denote the set of propositions that we would get by replacing a manner predicate m that p contains by all the contraries to m in the domain, which is what the second option would amount to in this case. Of course, the set we derive seems a little bit strange, but that is part of the point being made here. By the rules of semantic composition we only get this strange set.

Suppose we tried to assert *Mary knows whether to behave politely* as a complete answer. If Mary has to behave politely, than her behavior will also be not impolite and not medium polite, therefore in her belief worlds if the event was a politely-event Mary will know that it was not an impolitely-event and not a med-politely event, in other words it would be inconsistent for Mary to know that the event was polite, but not to know that it was also not-impolite and not-medium polite. As a consequence, it is not consistent with the complete answer that the event be polite. However, if the event in question is not a polite one, this is still consistent with it not being impolite (as it might be medium polite) and with it not being medium polite (as it might be impolite). Therefore, it will be coherent for Mary to know that the event was not polite, but not to know whether it was impolite or medium polite. Therefore, unlike what we have seen above in connection with manner questions, the complete answer above does not state a contradiction. However, we still might observe something unusual. While this complete answer is not contradictory, it is nevertheless contextually equivalent to its counterpart with an embedded declarative:

(35) Mary knows that she should not behave impolitely.

This is because, as we have seen above, polite behavior would have resulted in an inconsistent state of beliefs, but impolite behavior would not have. It is easy to see, that given our earlier assumptions about the domain of contraries this observation generalizes to any complete answer to the question. However, now we might say that the problem with the question is that all of its complete answers are contextually equivalent to sentences which have a stronger presupposition, and therefore the question itself will be ruled out as violation of the principle of Maximize

Presupposition![7]. Notice that a complete answer such as (36)a stands with a vacuous presupposition, but its counterpart with an embedded declarative in (36)b stands with a contentful presupposition:

(36) a. Mary knows whether to behave politely. (vacuous presupp.: $p \vee \neg p$)
b. Mary knows that she should not behave politely (presupposition: $\neg p$)

Roughly speaking, the principle of Maximize Presupposition! requires that if we have two alternatives which are contextually equivalent, but one of them comes with a stronger presupposition, we are required to use the one with the stronger presupposition. (But cf. Heim (1991), Sauerland (2003), Percus (2006), Schlenker (2008) for a number of different ways of spelling out this principle in a more precise fashion.) Given this principle, any complete answer to our question will be ruled out in a systematic way as a violation of the principle of Maximize Presupposition. Finally, for any question, if we are in a position to know in advance that every complete answer to it will be ruled out then the question is infelicitous.

In the case of question embedding predicates such as *wonder*, the situation is again a bit different. This is because question embedding predicates such as *wonder* cannot in fact embed a declarative clause, as it is shown in the example below:

(37) *How do you wonder whether to solve the problem?
a. I wonder whether you should solve this problem fast
b. #I wonder that you should solve this problem fast

Therefore, although the meaning of the complete answer is still predicted to be contextually equivalent to a sentence with an embedded declarative, the embedded declarative is independently unacceptable and the explanation for the unacceptability of the question in (37) cannot rely on the principle of Maximize Presupposition. However, I would like to suggest that now the problem with the complete answer is in fact the same that makes it impossible for question-embedding predicates such as *wonder* to take declarative complements: Since it is the essential part of the lexical meaning of *wonder*-type verbs that they express a mental questioning act, a declarative complement (or a complement that is contextually equivalent to declarative one) is simply incompatible with the lexical meaning of *wonder*. It is for this reason then, that that both the embedded declarative, as well any complete answer to (37) above is unacceptable.

5 Conclusion

In this paper I have argued that *wh*-islands are unacceptable because they cannot have a complete (exhaustive) answer. In the case of degree questions, the complete answer was shown to express a contradiction, given the assumption that degree questions

[7] I am indebted to E. Chemla (pc) for this suggestion.

range over intervals. In the case of manner questions the problem arose from the fact that a complete answer to these questions was predicted to be equivalent to a sentence with an embedded declarative, which was either a violation of the principle of Maximize Presupposition!, as in the case of question embedding predicates such as *know,* or simply incompatible with the meaning of the question embedding predicate, which was argued to be the case with predicates such as *wonder*.

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'Only' and Monotonicity in Conditionals

Matthew Berends
Dept. of Linguistics
Northwestern University

Stefan Kaufmann
Dept. of Linguistics
Northwestern University

matthewberends@gmail.com
kaufmann@northwestern.edu

Abstract

This paper proposes an account of the interpretation of *'only'* in the antecedents of indicative conditionals. Our concern lies with the implication from a conditional of the form *if (only* ϕ*),* ψ to its *'only'*-less counterpart *if* ϕ*,* ψ: when and why it is warranted. We argue that the pragmatic relationship of *scalar upward monotonicity* determines its availability. Two factors serve as license. First, it may arise by virtue of a language user's pre-existing world knowledge. Second, it may manifest when it constitutes the most informative reading of the conditional available. We discuss one case in point; namely, its appearance when the consequent is desirable.

1 Introduction

Some, but not all conditionals with *'only'* in the antecedent license the inference to their *'only'*-less counterparts. Thus (1) implies that doing his homework will ensure that Chris passes the class. By contrast, (2) does not convey that Chris's doing his homework will ensure that he fails the class.[1]

(1) a. If Chris only [does his homework]$_F$, he will pass the class.
b. $\rightsquigarrow$ If Chris does his homework, he will pass the class.

(2) a. If Chris only [does his homework]$_F$, he will fail the class.
b. $\not\rightsquigarrow$ If Chris does his homework, he will fail the class.

The goal of this paper is to explain when and why the implication from *'if only* ϕ, ψ*'* to *'if* ϕ, ψ*'* holds. Our analysis relies on three main ingredients. The first is the *scalarity* of *'only'* in cases in which the inference is licensed. Intuitively, both the availability of the inference in (1) and its absence in (2) rely on a construal of the situation in which doing his homework and nothing else is at the "low end," in terms of effort or cost, of the list of things Chris might do to secure his success in the class. Formally, we argue that the inference, where available, relies in part on an ordering relation between the alternatives invoked by *'only'*. The second ingredient is a relation between this order

[1] The bracketing indicates the location of focus; see Section 4 below for details.

on the one hand, and the truth of the consequent of the conditional, on the other. Simply put, the question is whether, assuming that the alternative antecedents are ranked in terms of effort, the consequent becomes more likely by moving up or down the scale. In the above examples, it is reasonable to assume that expending more effort will make the consequent more likely in (1) but not in (2).[2] We refer to this relationship as *scalar (upward or downward) monotonicity*. It is distinct from the familiar up/downward monotonicity in terms of entailment: Although we assume that *'Chris only does his homework'* entails *'Chris does his homework'* (see Section 4), we will whos in the next section that the effects of scalar monotonicity are not limited to such cases.

It is evident from the above remarks that both of the first two ingredients – the scalarity of *'only'* and the scalar monotonicity between the alternative antecedents and the consequent – crucially depend on the content of the conditional's constituents. Thus not surprisingly, background world knowledge plays an important role in explaining when and why the inference goes through. The third ingredient of our account goes beyond the immediate goal of explaining the inference in cases in which these relations are common knowledge. Here we show that one can run the account "backwards," so to speak, and infer from the fact that the speaker chose to use the conditional with *'only'* in the antecedent, rather than its *'only'*-less counterpart, that the requisite scalar relations hold. This reasoning crucially relies on two elements: the assumption that the speaker is being helpful, and common knowledge as to whether the consequent is desirable or not.

We discuss the data in some more detail in Section 2. Following that, we prepare the ground for our account by laying out our assumption about the semantics of the main ingredients: conditionals (Section 3) and *'only'* (Section 4). We then spell out the main ingredients, specifically scalar monotonicity, in Section 5. Section 6 is devoted to the role of the desirability of the consequent. We conclude with Section 7.

2 Data

We first point out that the conditionals we are dealing with here are ones in which *'only'* is embedded inside the antecedent. This is the case for (1) and (2) above, as well as for the examples below. Our analysis does not apply to conditionals with *'only'* in other positions, such as (3).

(3) Only if Chris does his homework will he pass the class.

The analysis does apply to sentences like (4), however. We realize that an utterance of (4), in addition to making an assertion about Chris's situation, carries an "evaluative" connotation on the part of the speaker to the effect that Chris's success is important to him or her. Our analysis does not explain this connotation, but we believe that crucial parts of our analysis are prerequisites for an understanding of it.

(4) If only Chris does his homework, he will pass the class.

[2] In fact, is seems plausible that more effort makes the consequent *less* likely in (2).

As we mentioned above, one main ingredient of our account is what we call *scalar monotonicity*. We first take a look at its upward version – scalar upward monotonicity, or 'SUM' – in more detail, previewing the main ideas of our analysis along the way. We construe the SUM relationship as resting on two components: a scale consisting of a set of alternative antecedents and an ordering on this set; and an upward monotonic relationship between the values on the scale and the consequent. Given these components, SUM holds if and only if: if the consequent is true for some element of the scale, then it is also true for all higher-ranked elements. The case of scalar downward monotonicity is similar.

'Only' facilitates the inference by making a scale salient, but is not itself essential. A scale may also arise implicitly from the context. Thus the inferences in (5) and (6) go through despite the absence of *'only'*.

(5) a. If Chris passes the final, he will pass the class.
b. $\rightsquigarrow$ If Chris gets a "B+" on the final, he will pass the class.

(6) a. If Chris gets a "B+" on the final, he will fail the class.
b. $\rightsquigarrow$ If Chris fails the final, he will fail the class.

On occasion, particular lexical items used in the conditionals in question draw attention to a scale. Thus in (7) and (8), it is the cardinals and gradable adjectives, respectively, that invoke the scale in virtue of their lexical semantics.

(7) a. If you have five dollars, you can buy a medium coffee.
b. $\rightsquigarrow$ If you have more than five dollars, you can buy a medium coffee.

(8) a. If you are a lazy student, you will pass the class.
b. $\rightsquigarrow$ If you are a hard-working student, you will pass the class.

That the availability of the inference indeed depends on the content of the conditional rather than its logical form is indicated by the reversal of the pattern in (1-a) when the antecedent belongs to a scale of activities which cumulatively lead to failing rather than passing the class.

(9) a. If Chris only [skips the exam]$_F$, he will pass the class.
b. $\not\rightsquigarrow$ If Chris skips the exam, he will pass the class.

(10) a. If Chris only [skips the exam]$_F$, he will fail the class.
b. $\rightsquigarrow$ If Chris skips the exam, he will fail the class.

As mentioned above, we identify two general reasons that scalar monotonicity might manifest. One may know that the relationship holds by virtue of one's pre-existing knowledge of how the world works. Alternatively, an attempt to derive as informative an interpretation of the conditional as possible may lead one to infer that it holds even in the absence of any supporting world knowledge. The role of informativeness is made plain by its interaction with the desirability consequent. It is possible to infer from the mere fact that the speaker chose to assert *'if (only ϕ), ψ'* that a SUM relationship holds, hence *'if ϕ, ψ'* can be inferred, without knowing so in advance. We observe this with the following conditionals, which fail to provide, at first glance, either a notion of the relevant alternatives to *'florp'*, nor a dimension along which to rank those alternatives, nor a sense of how the resulting scale relates to the consequent. However, the reader may verify for herself that the second-person subject greatly facilitates the availability of these judgments.

(11) a. If you only [florp]$_F$, you will win a hundred dollars.
b. $\rightsquigarrow$ If you florps, you will win a hundred dollars.

(12) a. If you only [florp]$_F$, you will lose a hundred dollars.
b. $\not\rightsquigarrow$ If you florp, you will lose a hundred dollars.

3 Conditionals and Modality

We follow Lewis (1975) and Kratzer (1981) in treating conditionals of the form *if* ϕ, ψ as modal expressions. Our assumptions for this paper are very simple: Syntactically, a conditional is composed of a matrix clause and an adverbial headed by *'if'*. We refer to the adverbial clause as the *antecedent* and to the matrix clause as the *consequent*. Semantically, *'if'* introduces a modal operator, restricted by the antecedent, that scopes over the consequent.[3]

The semantic analysis of modal expressions that we adopt is that of Kratzer (1981, 1991; see also Kaufmann, 2005b; Kaufmann et al, 2006; Portner, 2009). Modal operators are interpreted relative to two parameters, a *modal base* and an *ordering source*. Both are *conversational backgrounds* – formally, functions from possible worlds to sets of propositions (i.e., sets of sets of possible worlds.) The modal base provides the domain of modal quantification and determines the kind of modality (e.g., epistemic, doxastic, deontic etc.), analogously to the *accessibility relations* familiar from modal logic. More specifically, from the perspective of a world w of evaluation and a modal base f, the worlds in the intersection $\bigcap f(w)$ play the same role as those accessible from w via the corresponding accessibility relation. However, within this set of accessible worlds, some may be more salient, likely, or otherwise relevant to the truth of the conditional than others. This is incorporated by ranking worlds according to their "goodness" with respect to the propositions provided by the ordering source.

Definition 1 (Frame) A *frame* is a structure $\langle W, f, g\rangle$ where W is a non-empty set of worlds and f and g are *conversational backgrounds*, i.e., functions from worlds to sets of propositions.

Definition 2 (Accessibility relation) Given a frame $\langle W, f, g\rangle$, the *accessibility relation* R_f determined by f defined as follows: For all $w, w' \in W$, $wR_f w'$ iff $w' \in \bigcap f(w)$.

Definition 3 (Relative likelihood) Given a frame $\langle W, f, g\rangle$, the *relative likelihood* order determined by g is a three-place relation $\leq$ on W defined as follows: For all $w, w', w'' \in W$,

$$w' \leq_{g(w)} w'' \text{ iff } \{p | w'' \in p \wedge p \in g(w)\} \subseteq \{p | w' \in p \wedge p \in g(w)\}$$

[3] This treatment is too simplistic to account for certain facts. For instance, there is good evidence that the modal operator is not introduced by *'if'*, but by tense. For this and related ideas, see Kaufmann (2005a).

It is easy to show that $\leq_{g(w)}$ is transitive and reflexive.

For simplicity, we illustrate with a language $\mathcal{L}_{\mathcal{A}}$, which for now is simply the language of standard propositional logic built on a set $\mathcal{A}$ of propositional variables. We extend it with a modal operator below.

Definition 4 (Model) A *model* for a language $\mathcal{L}_{\mathcal{A}}$ is a structure $\langle W, f, g, [\![]\!] \rangle$ such that $\langle W, f, g \rangle$ is a frame and $[\![\cdot]\!] : \mathcal{L}_{\mathcal{A}} \mapsto (W \mapsto \{0,1\})$ is a valuation function mapping propositional variables and their Boolean compounds to (characteristic functions of) subsets of W.

As mentioned above, we treat conditionals as modal expressions and assume, following Kratzer, that their interpretation depends not only on the modal base, but also on the ordering source. The main role of the ordering source here is to provide the formal basis for a weaker notion of necessity (and a stronger notion of possibility) than that afforded by standard necessity and possibility operators. Kratzer refers to these modal forces as *human necessity* and *human possibility*, respectively. The idea is to make certain worlds in the modal base irrelevant to the interpretation of modal expressions. The worlds made irrelevant are those that are strictly "outranked" by others with respect to some contexually salient criterion (plausibility, likelihood, normalcy). The relevant ranking is given by the ordering source, formally represented as a world-dependent preorder on the set of possible worlds, defined in Definition 3 above. Human necessity is defined with reference to this order as in Definition 5. Human possibility is its dual.

Definition 5 (Human necessity) The notion $\boxdot$ of *human necessity* is defined as follows: For all $w \in W$ and $\phi, \psi \in \mathcal{L}_{\mathcal{A}}$: $[\![\boxdot(\phi)(\psi)]\!]^{M,w} = 1$ iff for all w' in $\bigcap f(w)$ such that $[\![\phi]\!]^{M,w'} = 1$, there is some w'' in $\bigcap f(w)$ such that $[\![\phi]\!]^{M,w''} = 1$ and $w'' \leq_{g(w)} w'$ and for all w''' in $\bigcap f(w)$ such that $[\![\phi]\!]^{M,w'''} = 1$ and $w''' \leq_{g(w)} w''$), $[\![\psi]\!]^{M,w'''} = 1$.

Notice that the syntactic form employed in Definition 5 assumes that $\boxdot$ is a binary operator. We follow a convention common in linguistics and refer to its two arguments ϕ and ψ as its *restrictor* and its *scope*, respectively. Typically, for simple sentences involving human necessity modals, the restrictor is semantically inert, and the relevant set of worlds is simply $\bigcap f(w)$. We may account for this by assuming that in the absence of any overt information about the restrictor, the constant function $\lambda w.1$ is inserted by default.

In the case of conditionals, we follow Kratzer's assumption that a covert human-necessity modal is present by default (although that modal force can be overridden by overt modal expressions). Here, the *'if'*-clause does contribute explicit information about the restrictor, while the consequent serves as the scope. The relevant domain of modal quantification, then, consists of those worlds in the modal base where the antecedent holds. Thus we interpret a conditional *'if* ϕ, ψ*'* as $\boxdot(\phi)(\psi)$.

(13) $\quad \mathbf{if}' = \lambda\phi\lambda\psi \boxdot (\phi)(\psi)$

The reason why we use human necessity in the semantics of *'if'* rather than strict necessity is that human necessity better captures our intuitions about the inferences available with conditionals. In particular, we avoid licensing strengthening of the antecedent.

With strict necessity, we would incorrectly predict that *if* ϕ, ψ entails *if* $(\phi \wedge \gamma)$, ψ, for any γ. Human necessity avoids this problem because the ideal $(\phi \wedge \gamma)$-worlds relevant for the latter need not be a subset of the ϕ-worlds relevant for the former. Accordingly, the latter may ψ-worlds while the former are not.

Most relevant for our purposes is that human necessity blocks the entailment from *if* ϕ, ψ to *if (only* ϕ*),* ψ. The intuitive notion is that the "stereotypical" ways of doing ϕ may make propositions true that are denied by *only* ϕ. For instance, an utterer of (1-b) might take for granted that typically, students who complete their homework also attend class. However, a speaker of (1-a) may have in mind that doing one's homework is sufficient for passing without any further effort. Clearly (1-b) does not entail (1-a) under these conditions. Nevertheless, a classical account of indicative conditional meaning would predict the entailment from *if* ϕ, ψ to *if (only* ϕ*),* ψ under the assumption (which we make – see below) that (only ϕ) entails ϕ. Using human necessity as the modal operator correctly allows the implication to fail.

4 Focus and *'Only'*

With a semantics for conditionals and modality in hand, we can now discuss *'only'*. We begin with a bare-bones and intuitive account of *'only'*, and proceed to refine this by appeal to notions of information structure and then finally scalarity.

'Only' is commonly analyzed as bearing two distinct semantic components, its *positive* and its *negative* contribution. The *prejacent* of a sentence containing *'only'* is what remains after removing *'only'*. Thus in (14), the prejacent is (14-a). The positive contribution is the proposition denoted by the prejacent. The negative contribution is the negation of a number of alternative propositions derived in a certain systematic way which relies on a bipartition of the prejacent into two parts, typically referred to as *focus* and *background*.

(14) Only Bill slept.
  a. Bill slept.
  b. {Mary slept, Sue slept, Bill and Mary slept, ...}

Simply put, the alternatives are derived by substituting alternative values for the focus (subject to pragmatic factors such as domain restriction) while holding the background constant. In (14), the focus is *'Bill'* and the background is *'slept'*. Thus the alternatives are propositions which assert of various individual(s) that it/they slept. It is usually assumed that the prejacent is itself one of the alternatives (Rooth, 1992). The negative contribution is the denial of all alternatives other than the prejacent (Horn, 1996).

It is generally agreed that the negative contribution is an entailment, but there is some debate over whether the positive contribution is implicated, presupposed, or entailed. Without committing ourselves irrevocably to either of these positions, we see good reasons for taking the latter route and assuming that the positive contribution, like the negative one, is an entailment. If it were an implicature, then *'only p'* would literally mean that among the alternatives, *at most p* is true, but it would be consistent with the falsehood of p. This would result in the wrong predictions about the conditionals we are concerned with: *'Chris only does his homework'* would be equivalent to *'Chris does at most his homework'*, leading to truth conditions for (1-a) and (2-a) that are too strong.[4] On the other hand, if the positive contribution were a presupposition, we would expect it to project out of the antecedent, but we see no evidence for that. Thus we assume, at least for the purposes of this paper, that both the positive and the negative contribution are entailed.

We note in passing that while the focus is generally marked by accent placement, the relationship between prosodic accent and semantic focus is not one-to-one and mediated in the standard theoretical approach by an abstract syntactic feature 'F'. Thus for instance, while the focus marking in (15) would be unambiguously expressed by placing the nuclear pitch accent on *'walked'* and *'dog'*, respectively, an accent placement on *'dog'* would be compatible with all three focus markings in (16).

(15) a. John only [walked]$_F$ his dog
b. John only walked [his]$_F$ dog

(16) a. John only [walked his dog]$_F$
b. John only walked [his dog]$_F$
c. John only walked his [dog]$_F$

The relationship between accent placement and F-marking is the object of a long-standing line of investigation and continues to be debated (Schwarzschild, 1999; Selkirk, 2001; German et al, 2006, among others). An exploration of this topic would lead us too far afield. Instead, for the purposes of this paper, we simply assume that the F-marking in the antecedents in question is given. F-marked constituents are treated as the focus, while the remainder of the clause constitutes the background.

The interpretation of *'only'* sketched above can be made precise within a *Structured Meanings* representation (Krifka, 1991, 1995). We assume that *'only'* syntactically takes sentential scope and applies to an entire structured meaning. Formally, we may represent it as in (17).[5]

(17) (Preliminary version)
$$\mathbf{only}' = \lambda\langle F,B,A\rangle[B(F)\wedge\forall X[(X\in A\wedge B(X))\rightarrow X=F]]$$

To illustrate, the sentence in (18-a), with F-marking as indicated, is interpreted as (18-b), which given the denotation in (17) simplifies to (18-c).

[4] One way to avoid this undesirable result while maintaining that the prejacent is an implicature would be to claim that this implicature is compiled into the literal meaning as part of the interpretation of the antecedent. Such a view would not be without precedent (Chierchia, 2004), but we will not explore it any futher here.

[5] Notice that while we assume that *'only'* composes with a structured meaning, the result is not a structured meaning again. Thus the dentotation in (17) does not allow other focus-sensitive expressions "higher up" to associate with a focus in the same clause. See Krifka (1991) for a solution to this problem, which we sidestep here because it is orthogonal to our concerns.

(18) a. John only [did his homework]$_F$

b. $$\textbf{only}'\left(\left\langle \lambda x.\text{do-hw}(x), \lambda P.P(j), \left\{\begin{matrix}\lambda x.\text{attend}(x),\\ \lambda x.\text{pass-final}(x),\\ \lambda x.\text{do-hw}(x),\ldots\end{matrix}\right\}\right\rangle\right)$$

c. $$\text{do-hw}(j) \wedge \forall X\left[\left(\begin{matrix}X \in \left\{\begin{matrix}\lambda x.\text{attend}(x),\\ \lambda x.\text{pass-final}(x),\\ \lambda x.\text{do-hw}(x),\ldots\end{matrix}\right\}\\ \wedge X(j)\end{matrix}\right) \rightarrow X = \lambda x.\text{do-hw}(x)\right]$$

The above denotation for *'only'* denies that alternatives other than the focus truthfully combine with the background. However, not all sentences with *'only'* seem to make so strong a claim. On occasion, the background may truthfully apply to other alternatives. This happens when *'only'* bears a scalar tinge: In this case, the alternatives whose truth is not denied are "lesser" in some sense than the focus. For illustration, imagine a selection of lunch choices ordered by size, as in (19-c). A truthful utterance of (19-a) assuredly conveys that John did not eat a hamburger, but need not deny that he had a handful of raisins. There are two distinct readings: on the first, John ate nothing *other* than an apple; on the second, John ate nothing *more* than an apple. The data is clearer if we imagine (19-a) as a response to either *'Did John eat any items from the refridgerator for lunch?'* or *'Why does John look so famished?'*.

(19) a. John only ate [an apple]$_F$ for lunch
b. Focus alternatives to *'apple'*: {apple, raisins, pear, cheeseburger}
c. $\langle$raisins $\preceq$ {pear, apple} $\preceq$ cheeseburger$\rangle$

Debate lingers over the nature of this scalar reading. One possible approach is to explain it as a restriction on the set of alternatives, stipulating that *raisins* fails to count as an alternative. However, this misses the fact that even among potential alternatives that are excluded for pragmatic reasons, there is an asymmetry between higher-ranked ones and lower-ranked ones: The former are still denied (counterfactually, as it were) in a way the latter are not. For instance, one does not typically think of *steak* as a luncheon choice, but (19-c) certainly seems to deny that John ate steak for lunch. Alternatively, the optionality of the scalar reading might suggest that *'only'* is ambiguous. This approach gains traction from the presence of similar accounts for *'even'*. However, although there may be good reasons for taking this approach in the case of *'even'*, parsimony demands that we consider this a last resort. In the case of *'only'*, several authors (e.g., Bonomi and Casalegno, 1992; Beaver, 2004; van Rooij, 2002) have demonstrated that a uniform scalar denotation for *'only'* is sufficient. On such an implementation, *'only'* conveys that the combination of the background and higher-ranked alternatives is false, but crucially makes no claims about the combination of the background with lower-ranked alternatives. The appropriate scale is determined by a contextually given dimension for ranking the alternatives. In the default case, the relevant scale is the semi-lattice of the alternatives with conjunction, thus the relevant "scale" in that case is that of entailment.

Under this approach, we can always assume that a scale ranked by a pre-order $\preceq$ is available. This allows for a unified account of *'only'* along the lines of (20).

(20) $\mathbf{only}' = \lambda\langle F,B,A\rangle[B(F) \wedge \forall X[(X \in A \wedge B(X)) \rightarrow B(X) \preceq B(F)]]$

Notice that here we compare $B(X)$ and $B(F)$, rather than just X and F as in (17) above. The reason for this is that we assume that the scale in question is uniformly one of propositions. In (17), the difference did not matter since if $X = F$, then $B(X) = B(F)$. However, since B may itself contribute to the scalar ordering (e.g., the scale gets reversed if B contains a negation), from $X \prec F$ it does not follow that $B(X) \prec B(F)$, and it is the latter that counts for the truth of the sentence.

4.1 *'Only'* in conditional antecedents

The composition of *'only'* within the antecedent of a conditional offers no surprises. Intuitively, the result is an interpretation of *'if only* ϕ, ψ*'* as *'if* ϕ *and no more than* ϕ, ψ*'*. Importantly, ψ is not ruled out if *'more than* ϕ*'* is true. This means that, borrowing from (1), Chris may do other things and still pass the class.

(21) $\mathbf{if}'(\text{only } \langle F,B,A\rangle)(\psi) = \boxdot(\mathbf{only}'\langle F,B,A\rangle)(\psi)$
$= \boxdot(B(F) \wedge \forall X[(X \in A \wedge B(X)) \rightarrow B(X) \preceq B(F)])(\psi)$

5 Scalar Monotonicity and *'Only'*

The implication from *if (only* ϕ*),* ψ to *if* ϕ*,* ψ prompted our excursion into the interpretation of *'only'* conditional antecedents. The implication is present for some conditionals, but absent for others. Our paper explores why the particular asymmetry exists and what might explain it. The answer we arrive at is that the implication is governed by a pragmatically-determined scalar relationship between the antecedent and the consequent of a conditional. Before we go into nature of this relationship, we briefly mention why we discard entailment and ambiguity in *'only'* as possible explanations. Then, in the remainder of the paper we discuss the role of scalar monotonicity. There are four parts to our discussion. First, we offer a description of what it is to be SUM. Second, we discuss how scalar monotoniciy accounts for the implication arising in (1). Third, we supply an explanation of the conditions under which the SUM relationship arises. Lastly, we discuss how the SUM reading may be informative.

5.1 Against ambiguity and entailment as explanations

Here we consider two possible alternative explanations before proferring our SUM explanation. These are first that *'only'* is ambiguous between a reading that permits the implication and one that does not, and second that the relationship is adequately characterized by entailment.

The most straightforward-seeming hypothesis regarding the asymmetry is that it arises from an ambiguity in the meaning of *'only'* itself. However, we can account for our data with a single denotation for *'only'*, as we argue below. Parsimony, then, demands that we explain the asymmetry as arising from facts about conditionals rather than an ambiguity with regard to *'only'* itself.

As for entailment, we find that it offers an inadequate description of the relationship between the sentences in (1). Given that the implication in (1) is from a stronger antecedent to one that it is weaker, it is an instance of an upward monotonic inference that has never been claimed valid for conditionals.

5.2 Scalar monotonicity characterized

The above observations are made concrete in the examples below. If *'if Chris only does his homework, he will pass the class'* is true, then so is the conditional *'if* ϕ*, Chris will pass the class'*, for all alternatives ϕ that are higher than than *'Chris only does his homework'* on the scale, such as the antecedents in (22-b) and (22-c):

(22) a. If Chris only does his homework, he will pass the class.
b. $\rightsquigarrow$ If Chris does his homework, he will pass the class.
c. $\rightsquigarrow$ If Chris does his homework and attends class, he will pass the class.
d. $\not\rightsquigarrow$ If Chris does his homework and gets caught cheating, he will pass the class.

Working out a formal implementation of this idea is not trivial. Suppose the scale in question is $\langle \Phi, \preceq \rangle$, and the proposition is ψ. Intuitively, what one would want is a condition on the distribution of ψ-worlds in the various propositions in Φ, stating in effect that if ψ is a human necessity relative to some $\phi \in \Phi$, then it is also a human necessity relative to all ϕ' such that $\phi \preceq \phi'$.

To see why this is not trivial, notice first that in order for ψ to be a human necessity relative to both ϕ and ϕ', it is not required that ψ be true at all worlds in either ϕ or ϕ'. For as we saw above, it is the very point of human necessity that some worlds in the restrictor are made irrelevant to the truth of the modal expression. Without this ability, we would predict that (22-b) entails (22-d) and (22-c), since both instantiate strengthenings of the antecedent. We also saw that this ability is important for our purposes because otherwise we could not account for the fact that even though *'only p'* entails p, the conditional *'if p, q'* does not entail *'if only p, q'*.

So we need a more restricted statement roughly to the effect that if we inevitably and inescapably end up in ψ-territory by inspecting less and less far-fetched worlds in ϕ, then the same is bound to happen when we inspect ϕ'-worlds in the same manner. Somewhat more simplified, assuming that there is a set of "best" worlds (technically, local minima) under $\leq_{g(w)}$ within each $\phi \in \Phi$, if all the "best" worlds in ϕ are ψ-worlds, then all the "best" worlds in ϕ' are ψ-worlds, too. Stating it in this way is easy enough, but we would like to go deeper than that by capturing the conditions under which this outcome is guaranteed in terms of the worlds in ϕ, ϕ', and ψ.

The intuition now is that even though the worlds in ϕ and ϕ' may be distinct, there is nevertheless a "correspondence" of sorts which determines, for a given world v in ϕ, which worlds in ϕ' are "at least as good" as v with respect to the ordering source. This seems straightforward enough, but we cannot be sure that any two worlds in ϕ and ϕ' are even comparable under $\leq_{g(w)}$. For instance, if $g(w)$ contains ϕ and ϕ', then no two worlds are comparable in terms of "goodness" across the two propositions.[6] As an easy way to avoid this problem, we simply stipulate that for all worlds w, $g(w)$ consists entirely of propositions that have non-empty intersections with *all* propositions in the alternative set Φ.[7] It is important to keep this in mind in reading the following definition:

Definition 6 (Scalar Upward Monotonicity) Let $M = \langle W, f, g \rangle$ be a model and $\langle \Phi, \preceq \rangle$ a scale of propositions such that for all $w \in W$ and $\phi \in \Phi$, all propositions in $g(w)$ have a non-empty intersection with ϕ. A proposition ψ is *scalar upward monotone* at a world $w \in W$ relative to $\langle \Phi, \preceq \rangle$ if and only if for all $\phi, \phi' \in \Phi$ such that $\phi \preceq \phi'$ and all worlds $v \in \phi, v' \in \phi'$ such that $v' \leq_{g(w)} v$, if $z \in \psi$ for all $z \leq_{g(w)} v$, then $z' \in \psi$ for all $z' \leq_{g(w)} v'$.

6 Scalar monotonicity and desirability

One factor affecting the availability of the inference concerns the interplay between scalar monotonicity and the interlocutors' goals. The relevant examples are repeated here. The failure of the inference from (2-a) to (2-b), as well as from (9-a) to (9-b) tends to get strengthened to the conclusion that the (b)-conditional is false.

(1) a. If Chris only [does his homework]$_F$, he will pass the class.
b. $\rightsquigarrow$ If Chris does his homework, he will pass the class.

(2) a. If Chris only [does his homework]$_F$, he will fail the class.
b. $\not\rightsquigarrow$ If Chris does his homework, he will fail the class.

(9) a. If Chris only [skips the exam]$_F$, he will pass the class.
b. $\not\rightsquigarrow$ If Chris skips the exam, he will pass the class.

(10) a. If Chris only [skips the exam]$_F$, he will fail the class.
b. $\rightsquigarrow$ If Chris skips the exam, he will fail the class.

Assuming competence on the part of the speaker, this follows from two assumptions: First, it is common knowledge that listeners strive to make choices which lead to desirable outcomes, and to avoid negative ones, both with minimal effort; and second, speakers try to impart information that will help listeners in doing so.

For given a scale $\langle \Phi, \leq \rangle$ of alternative antecedents and a consequent q, let $A = \{p \in \Phi | \textit{If } p, q \text{ is true}\}$. Then cooperative speakers will choose '*If* $\min(A)$, q' if q is scalar increasing in A, as in (1-a) and (10-a), and '*If* $\max(A)$, q' if q is scalar monotone decreasing in A, as in (2-a) and (9-a) (choosing at random if $\min(A)/\max(A)$ is not unique).

Together with the fact that q is desirable in (1-a) and (9-a), the listener expects the speaker to choose an antecedent that is *minimal* on its respective scale among those alternatives for which the conditional is true – for knowing the least costly way to guarantee the truth of the consequent is useful both in securing and in preventing the latter.

[6] Problems arise under weaker conditions as well. For instance, if $g(w)$ contains non-empty subsets of ϕ and ϕ', then there are two worlds $v \in \phi, v' \in \phi'$ such that neither $v \leq_{g(w)} v'$ nor $v' \leq_{g(w)} v$. We do not attempt a complete characterization of the problematic cases in this paper.

[7] Ultimately the most elegant solution might be to manipulate g "online" in the course of the interpretation, filtering our propositions from the ordering source that imposes a ranking among the alternatives.

Antecedents higher on the scale than the minimal ensure the truth of the conditional, too. Likewise, since q is undesirable in (2-a) and (10-a), the listener expects the speaker to choose an antecedent that is *maximal* on its scale among those alternatives that ensure the truth of the conditional – the listener's interests are the same way as before, but since the consequent is decreasing in A, knowing the most costly way to ensure its truth is more useful to him. Antecedents higher than the maximal one do not ensure the truth of the conditional. The preceding argument rests on the assumption that *only* is scalar, such that for each of the two scales, *only* $p \leq p$.

7 Conclusions and Future Directions

We investigated the implication from *if (only* ϕ*),* ψ to *if* ϕ, ψ, arguing that its presence hinges on the availability of a scalar relationship between antecedent and consequent. The pragmatic relationship of Scalar Upward Monotonicity that governs the implication is characterized by three components. SUM first requires a set of alternatives; second, a ranking of the alternatives; and third a relationship between the ranking and the consequent. SUM holds if the consequent remains true when higher-valued propositions are substitued into the antecedent.

Two factors appear to license SUM. First, language users may know of it simply by virtue of their world knowledge. Second, pragmatic considerations may lead them to conclude that it motivates the speaker's choice of asserting *'if only* ϕ, ψ*'* rather than just *'if* ϕ, ψ*'*. Future work will explore this link between desirability and scalar monotonicity in greater detail.

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Three-Dimensional Semantics

Gregory Bochner
Laboratoire de Linguistique Textuelle et de Pragmatique Cognitive
Université Libre de Bruxelles (FNRS)
&
Institut Jean Nicod (CNRS-EHESS-ENS, Paris)

gbochner@ulb.ac.be

Abstract

How can identity sentences involving distinct names be informative? Any theory of names facing the *problem of informativity* will need to appeal to descriptions. The crucial question is: *at which level* do descriptions play a role? Kripke showed that descriptions neither constitute nor fix the semantic contents of names. At the same time, his Millian views imply the problematic existence of *modal illusions*: some necessary truths are knowable only aposteriori *even though* there is no possible world in which they don't hold. I sketch a new, metasemantic strategy that purports to avoid modal illusions within a referentialist framework: the relevant descriptions describe not extensions (descriptivism), not intensions (two-dimensionalism), but names themselves (three-dimensionalism).

1 Introduction

The primary, Millian intuition about names is that they refer to their bearer directly, without the mediation of descriptive conditions. But, as Frege highlighted, if this intuition is taken seriously, it seems we cannot explain the potential informativity of identity sentences involving distinct names: how can a competent speaker fail to know the truth (or falsity) of a sentence like "Hesperus is Phosphorus"?

Frege had initially proposed, in his *Begriffschrift*, that what such sentences convey is a piece of metalinguistic information about the names themselves. But later, in *Sinn Und Bedeutung*, he retracted from his early view, deeming that, after all, what people learnt when they discovered that Hesperus is Phosphorus was a substantive fact of astronomy, and not a metalinguistic fact about the arbitrary signs used to describe that substantive fact. And he introduced senses and *descriptivism:*

<u>Descriptivism</u>: Descriptions (senses) *constitute* the semantic content of names.

Kripke, however, refuted descriptivism and rehabilitated referentialism, the view that a name contributes only an individual to truth-conditions. But his Millian views provide no solution to the problem of informativity. This problem, taken within a framework that combines referentialism with a possible worlds semantics, becomes the problem of *modal illusions*: some necessary truths are knowable only a posteriori *even though* there is no possible world in which they don't hold. So that the next challenge is this: offer a referentialist theory of names that avoids modal illusions. This is what advocates of *two-dimensionalism* (henceforth, *2-D*) have been aiming to do:

<u>Two-dimensionalism</u>: Descriptions *fix* the semantic content of names.

However, as Byrne and Pryor (2006) emphasize, this strategy too is incompatible with Kripke's insights. Kripke showed not only descriptions do not constitute the contents of names, but also that they do not fix the contents of names. His central message is that no descriptive conditions, *whatever their role*, are *linguistically* associated with names. So that both descriptivist and two-dimensionalist approaches fail.

I want to suggest a third route, one that grants Kripke's Millianism and puts the descriptions responsible for cognitive significance into the *metasemantics* and *epistemology of language* stories. Whereas both descriptivists and two-dimensionalists suppose that descriptions describe extralinguisic *objects*, I will argue that descriptions describe *words*:

<u>Three-dimensionalism</u>: Descriptions *fix* public words (in individual minds).

On this view, which I call *three-dimensionalism* (henceforth, *3-D*), the (variable) function that explains informativity is a *third function* that comes over and above Kaplanian character (or any such reference-fixing function) and content: I call it *metacharacter*. Metacharacters are functions from possible worlds considered as actual into words. Unlike character and content, which both belong to the *semantic* story, metacharacter is meant to capture something highly metasemantic, internalistic and often private: the descriptive means through which individual speakers *mentally* individuate *public* words. I am aware that the claim that speakers describe public words in a mental language may appear highly controversial. But my hope is to show that this claim may well solve our problem. Some authors have already suggested that questions surrounding the individuation of words may provide the key to solving the problem of informativity. Among them, Kaplan, in *Words*:[1]

"Could it be that the elusive cognitive difference between believing that Hesperus is Hesperus and believing that Hesperus is Phosphorus rests on nothing more than syntax? [...] My speculations led me to conclude that I had to go back to basics and rethink not just the semantics of names, but their very syntax, the metaphysics of words: How should words be individuated?" (Kaplan, 1990: 93-4)

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1 See also Kaplan (1989b: 598-599) for very similar suggestions.

3-D elaborates upon this suggestion, and the resulting view is close in spirit to Frege's in his *Begriffschrift*: the discovery that an identity sentence expresses a necessary truth is, for a crucial part, a *metalinguistic* discovery about *words* themselves. What Frege failed to appreciate, however, and what 3-D claims is the key to the problem of informativity, is that the *epistemic* individuation of names involves *substantive* knowledge of how the *actual* world is.

2 Some background

Before I present 3-D in more detail, I wish to state some assumptions that underlie it, and then highlight its continuity with the two-dimensionalist project.

2.1 Six assumptions

(a) Names are directly referential.

Kripke showed that names are rigid designators *de iure*. This means that their semantic content is (linguistically meant to be) a *constant* function, yielding the same individual (or set of individuals or substance, in the case of natural kind terms) for all possible worlds of evaluation. Descriptivism, in contrast, is the view that the semantic content of a name is (usually) a variable function, whose value depends on which individual happens to satisfy the corresponding descriptive condition in some possible world of evaluation. So we have:

<u>Referentialism</u> (direct reference, rigidity *de iure*): The intension of a name is constant.
<u>Descriptivism</u>: The intension of a name is variable.

I will grant referentialism, and this means that I accept Kripke's claim to the effect that some necessary truths can be discovered aposteriori. I also agree with him and with Kaplan that whereas necessity and contingency have to do with metaphysics, apriority and aposteriority have to do with epistemology. I think, however, that Kant and Frege were essentially right that anything which is necessary is *ipso facto* apriori. Also, I will, for that matter, line up with two-dimensionalists, who distinguish the bearers of necessity and contingency from those of apriority and aposteriority, although I will eventually disagree with them as to the nature and semantic role of the bearers of apriority and aposteriority. My major concern here is precisely to reconsider *how* necessity and apriority must be disentangled.

(b) Names are context-insensitive.

This is a thesis about the character of names. The rival views, here, are:

<u>Minimalism</u>: The character of a name is constant.

Contextualism: The character of a name is variable.

I will, following Kripke and Kaplan, grant minimalism. So I endorse the Millian view that linguistic conventions associate a name directly with its unique bearer; they do not specify descriptive conditions that would have to be satisfied by an individual in order to *gain* bearerhood. Linguistic conventions settle the bearer from the start. Names are *absolute*: their character is a constant function from contexts to contents. It follows that the cognitive value of names cannot be explained in terms of their character. Your ignorance of the fact that the sentence "Hesperus is Phosphorus" expresses a truth has nothing to do with your ignorance of facts concerning the *context* in which the sentence was used. On this view, names are massively ambiguous, and the role of context is not semantic (it is not to determine the reference of a particular name), but merely presemantic (it is to disambiguate which name was used). The view that names are *both* rigid and absolute—that is, the view that neither the content nor the character of a name are descriptive—I call *Millianism*.

(c) Semantics is not epistemology of language.

I grant, following Wettstein (1986), that it is not the job of a semantic theory to account for all differences in cognitive value. This is primarily the job of epistemology of language. Strictly speaking, my semantics is not three-dimensional; my semantics is two-dimensional in the benign sense that linguistic rules associate expressions with characters, and characters are functions defined on particular contexts of use.

(d) Some version of social externalism is true.

I follow the main lines of Burge's (1979) social externalism: which name I use and which content that name has does not ultimately depend on my beliefs, but on social facts. Words are objects in the outer world, about which, importantly, speakers can have imprecise or false beliefs.

(e) Names are individuated by their form and bearer.

Pace Devitt (1981) or Evans (1982), I will assume that a name has its causal source essentially. Here I side with Justice (2001), who defends *essentialism* about names:

"A name could have another referent only if it could have another bearer, but a name with any other bearer would be another name with its own origin in the naming of that other bearer. Having the bearer it has is an essential property of a name." (Justice 2001: 362)

So, *metaphysically speaking*, the name 'John' for John Lennon is individuated by its phonological form 'John' and John Lennon himself; the name 'John' for John Perry is *another* name, one which happens to share the phonological shape of the name 'John' for John Lennon, but not its bearer. Differences in bearers are *ipso facto* differences in names. This actually follows from Millianism: linguistic conventions link a name directly with its unique bearer. So, on this metaphysics of names, it is not an essential property of John Lennon's that he be called 'John', but it is an essential property of that name 'John' that it is a name for John Lennon *only*.[2]

(f) There is only one modal space.

This means that conceivability entails possibility: whatever I can conceive of is metaphysically possible, an assumption commonly found in the literature[3], and that I will not discuss further here. Its relevance to the present discussion is that it implies that if something is conceivable then there must *ipso facto* be some metaphysically possible world in which it holds. We can *conceive* that the sentence "Hesperus is Phosphorus" is false, and the central aim of our enquiry is to locate and describe the sort of the falsifying possible world that our intuition detects (and which, of course, often explains the progresses of science).

2.2 Two-dimensionalism

3-D borrows some tools from two-dimensionalists. Inspired by Stalnaker's work on assertion and informativity (1978) and by Kaplan's (1989a) distinction between the character and the content of indexical expressions, two-dimensionalists have sought to extend the idea of a two-fold meaning to the semantics of names. In the case of indexicals, Kaplan's view seemed to allow that a competent hearer can grasp apriori, in virtue of her knowledge of character alone, something from my utterance of "I am hungry" even when she doesn't know precisely who uttered it and hence lacks full knowledge of the context: *that the producer of this utterance, whoever she is, is hungry*. Two-dimensionalists argue that things are similar with names. Despite Kripke's arguments to the contrary, they maintain that names are *linguistically* associated (perhaps implicitly) with reference-fixing descriptions. Also, they think, a hearer can understand something from an utterance of (1)

(1) Hesperus appears in the evening sky.

even when she doesn't know precisely which world is actual, and in particular doesn't know which star satisfies the reference-fixing condition *being the evening star* linguistically associated with the name 'Hesperus': *that the actual evening star, whatever it is, appears in the evening sky*.

The basic idea of 2-D is that there are two ways in which the semantic values of sentences depend on the facts. First, facts play an *interpretation role* when they determine what is said by a sentence on an occasion of use (this role is similar to that

2 The claim here is that both the form and the bearer are *essential* to the individuation of a name; I do not mean that they are *sufficient*. In order to get sufficient identity conditions for names additional aspects of the causal chains relating the form of names with their bearers would have to be integrated.

3 But see Soames (2006) for a proposal based on the denial of that assumption.

of contexts in Kaplan's framework). Second, facts play an *evaluation role* when they determine whether what was said by that sentence is true or false (this role is similar to that of circumstances in Kaplan's framework). Two-dimensionalists argue that, corresponding to these two forms of dependency to facts, there are two sorts of propositions that are associated with a sentence, which, following Chalmers's (2006) terminology, may be called, respectively, its *primary* and its *secondary* intensions. *Secondary intensions* just correspond to the traditional functions from possible worlds of evaluation to extensions. For instance, when I utter sentence (1) in the actual world of interpretation *i*, what I say is true with respect to *i* taken as a world of evaluation, because in the actual world it is Venus that appears in the evening sky, but false with respect to a counterfactual world of evaluation *j* in which it would be Mars and not Venus that appears in the evening sky, as shown in matrix *A*:[4]

$$\begin{array}{c|c|c|} & i & j \\ \cline{2-3} i & \mathrm{T} & \mathrm{F} \\ \cline{2-3} \end{array}$$

A

Now, two-dimensionalists argue that each sentence is associated with a *two-dimensional* matrix, one that captures, in addition to the dependency of truth-values on worlds taken in their evaluation role, the dependency of contents on worlds taken in their interpretation role. Which content a use of a sentence has depends on which world of interpretation turns out to be actual. Speakers have only imperfect knowledge of how the actual world is, so that a lot of possible worlds could, as far as they know, be the actual world. This imperfect knowledge, two-dimensionalists think, is relevant to semantics, for which world is *considered to be the actual world of interpretation* determines which secondary proposition gets actually expressed by a sentence. Had the actual world of interpretation been *j* and not *i*, then sentence (1) would have received a different content, one which is true in all worlds of evaluation in which it is Mars which is the star that appears in the evening sky, as shown in matrix *B*:[5]

$$\begin{array}{c|c|c|} & i & j \\ \cline{2-3} i & \mathrm{T} & \mathrm{F} \\ \cline{2-3} j & \mathrm{F} & \mathrm{T} \\ \cline{2-3} \end{array}$$

B

Stalnaker calls a two-dimensional matrix like *B* a *propositional concept*: this is a function from possible worlds of interpretation into propositions. The worlds in the vertical rows are worlds taken in their interpretation role (contexts), and the worlds in the horizontal row are worlds taken in their evaluation role (circumstances). Each horizontal line thus represents a distinct proposition. Now, two-dimensionalists claim,

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4 From García-Carpintero and Macià (2006: 4).

5 *Ibid*.

there is another important proposition which can be recovered from *B*: this is the *primary intension* they are after. Stalnaker calls it the *diagonal proposition*, because it corresponds to "the function from possible worlds into truth-values whose values are read along the diagonal of the matrix from upper left to lower right" (1978: 81). This is the proposition which is true for any world of evaluation *w* when *w* is also taken to be the world of interpretation, or, equivalently, it is the set of worlds of interpretation (contexts, if you like) in which the sentence is true. Importantly, the primary intension is also the proposition that the competent speaker knows apriori to be true, regardless of how the actual world of interpretation happens to be.

2-D comes in many versions; these differ in how they construe the worlds of interpretation and the primary intensions. As Chalmers (2006: 64) summarizes, the common denominator of all versions of 2-D is to relate the cognitive significance of a sentence with its primary intension:

<u>Core thesis of 2-D</u>: A sentence S is metaphysically necessary iff its secondary intension is necessary; S is epistemically necessary (a priori) iff its primary intension is necessary.

Correspondingly, a sentence S is *necessary aposteriori* iff its primary intension is contingent and its secondary intension is necessary; and S is *contingent apriori* iff its primary intension is necessary and its secondary intension is contingent.

3 Three-dimensionalism

My rejection of 2-D here simply follows from my assumption that Millianism is correct: both the character and the content of a name are constant functions. But then, given Millianism, the only way to solve the problem of informativity is to go *metalinguistic*. Indeed, it follows from Millianism that there is no possible world of *evaluation* in which Hesperus is not Phosphorus (names are rigid) and no possible world of *interpretation* in which the names 'Hesperus' and 'Phosphorus' have distinct contents (names are absolute). So if it is conceivable at all for a competent speaker that the sentence "Hesperus is Phosphorus" express a falsehood, this must be because that speaker, *although competent*, lacks some piece of metalinguistic knowledge about the *words* themselves. Donnellan once remarked:

"If we distinguish a sentence from the proposition it expresses, then the terms 'truth' and 'necessity' apply to the proposition expressed by a sentence, while the terms 'a priori' and 'a posteriori' are sentence relative. Given that it is true that Cicero is Tully [...], 'Cicero is Cicero' and 'Cicero is Tully' express the same proposition. And the *proposition* is necessarily true. But looking at the proposition through the lens of the *sentence* 'Cicero is Cicero', the proposition can be seen a priori to be true, but through 'Cicero is Tully' one may need an a posteriori investigation." (Donnellan, 1983: 88)

In the same spirit, Tichy (1983: 231) draws a distinction between the proposition expressed by a sentence S in a language L (what S says in L) and the proposition associated with S ("the proposition to the effect that S is true in L"), and notes:

"Kripke must think that the net result of the scientists' efforts was a *semantic* discovery. What they established is that the term 'heat' names molecular motion and that accordingly sentence (2) ["Heat is molecular motion"] states the truism that molecular motion is self-identical. In other words, they discovered the truth of the proposition associated with (2); it is that proposition which is only knowable *a posteriori*, through hard experimental slog." (Tichy, 1983: 234-5)

Drawing on Donnellan's and Tichy's suggestions, Wong (1996; 2006) has recently argued that the bearers of apriority and aposteriority are not propositions *simpliciter* (that would be the absolute view of apriority) but propositions *relative to* sentences (the relative view). Here's the core thesis of the relative view of apriority:

"A proposition *p* is a priori relative to a sentence S that expresses it if and only if S is a priori; *p* is a posteriori relative to a sentence S' that expresses it if and only if S' is a posteriori. [...] Some may want to replace 'a sentence S' by something like 'a way of taking *p*' or 'a mode of access to *p*'. Indeed, a major task in elaborating the relative view is to answer the question, 'What is it that a proposition can be said to be a priori relative to?'" (Wong, 1996: 67)

3-D's answer is: relative to the *epistemic* individuation of words. The descriptions through which a speaker individuates the words 'Hesperus' and 'Phosphorus' are the *lenses*, mentioned by Donnellan, through which this speaker fails to see that the sentence "Hesperus is Phosphorus" expresses a necessary truth. The problem is not semantic, but metasemantic: it has to do with how our speaker individuates the public names in her mind, and more specifically with what she wrongly believes or fails to know about these names.

3.1 The meaning-constitution problem

Before I go further, I wish to introduce a potential problem that threatens to undermine any metasemantic account like 3-D. García-Carpintero (2006) calls it the "meaning-constitution problem." Stalnaker (2006) contrasts between two interpretations, semantic and metasemantic, of the two-dimensionalist framework. On the semantic interpretation, primary intensions are *semantic* values that sentences have in virtue of *linguistic* conventions. Stalnaker claims that, granting Millianism, this interpretation gets automatically excluded: names are not *linguistically* associated with reference-fixing descriptions. Stalnaker (2001: 150, 152; 2006: 301) therefore urges that only the metasemantic interpretation of the framework could make sense, and I agree with him on that point. But, Stalnaker (1999: Introduction; 2001; 2006) goes on to argue, the metasemantic construal has the consequence that the meanings of names can vary freely across worlds of interpretations, hence it appears to imply that no diagonal proposition will ever be necessary, and therefore that the metasemantic interpretation makes any account of apriori knowledge impossible:

"Since the metasemantic two-dimensional intension represents all the ways in which the reference or content of an expression depend on the facts, it will not provide any non-vacuous account of a priori truth. To say that a primary proposition associated with a sentence was necessary would be to say that the sentence would express a truth <u>whatever it meant</u>, and that notion, of course, will have no application." (Stalnaker, 2001: 155; my underlining)

Thus, the reasoning underlying Stalnaker's skepticism is this: given Millianism, a *metasemantic* interpretation must assume that words that are carried across worlds of interpretation are individuated by their *phonological form alone if their meaning is allowed to vary at all*, so that words end up having *any arbitrary* meaning relative to all possible worlds considered as actual. In other words, the primary proposition would, on the metasemantic interpretation, reflect all the possible meanings that names could have in *all possible languages*. This, then, is the meaning-constitution problem.

Interestingly, the worries expressed by Stalnaker resemble the reasons which led Frege to abandon the early metalinguistic view of his *Begriffschrift*. And here I disagree. I think that Stalnaker's point shows *not* that no Carnapian connection holds between apriori knowledge and linguistic conventions, but only that *the relevant diagonal*, the one that accounts for apriori knowledge, is of another sort, and must be construed differently. On my account, the key to overcome the meaning-constitution problem is to contrast between two types of metasemantic facts: *metaphysical metasemantic facts* (facts relevant to the *metaphysical individuation* of words) and *epistemic metasemantic facts* (facts relevant to the *epistemic individuation* of words). My view is then that something *epistemic* about the word can vary from world to world even though the *metaphysical* word itself remains, as Millianism requires, fixed.

3.2 Metaphysical *vs* epistemic individuation of words

I have assumed that, *metaphysically* speaking, its bearer is essential to a name. As a consequence, sentences (2) and (3) must express necessary truths about *our* language:

(2) 'Hesperus' designates Hesperus.
(3) 'Hesperus' designates Phosphorus.

But then, how can a competent speaker discover that those metalinguistic truths only aposteriori? After all, if I am linguistically competent, then I should know that the propositions expressed by those sentences are true, since I do have a reliable grasp on what these names designate. The key is that, somehow, my *epistemic* situation is such that, for all I *know*, the actual language might be one in which these two names are *not* coreferential, even though, *metaphysically* speaking, there is *no* possibility that *our* actual language be such that the two names would not corefer. Importantly, this can only be because my cognitive access to public *words* themselves is mediated by some *inner description of words*. Also, *epistemically* speaking, a name is individuated by its form and a *description* of its bearer. My descriptions of the words ‘Hesperus’ and ‘Phosphorus’—the *lenses* through which I see them—are somehow too vague and too general to exclude the possibility that they don’t corefer. The *epistemic* individuation of a public name thus involves a description of its bearer, which is used within a *(mental) reference-fixing description of the name* itself.

3.3 Linguistic competence

One point of claiming that the informativity of the sentence “Hesperus is Phosphorus” is a *metasemantic* matter is to maintain that even a *linguistically competent* speaker can fail to see that this sentence is true. Here is how I define linguistic competence:

> <u>Linguistic competence</u>: In order to be linguistically competent with respect to a name N, a speaker must have the capacity to reidentify the bearer of N as the bearer of N through a *substantive* description that uniquely picks out the individual which is the bearer of N in the *actual* world.

So, for instance, in order to be competent with respect to the name ‘Aristotle’, all you need to know is the form of the name and *one* description that uniquely picks out Aristotle in the *actual* world, like *the tutor to Alexander the Great* or any other description identifying only Aristotle in the actual world. With this knowledge at hand, you will be able to correctly identify, in the actual world, the *name* ‘Aristotle’ itself: you will know of this name (i) that it has the phonological form ‘Aristotle’, and (ii) that its bearer was the tutor of Alexander the Great. But on that definition of linguistic competence, and because that definition requires only to have a *contingent* description of the bearer (one satisfied by the bearer in the *actual* world), there are lots of things you can still discover about a name with respect to which you are, nonetheless, already perfectly competent. This definition of linguistic competence paves the way for a definition of metacharacters.

3.4 Metacharacters

Metacharacters can be defined in either of two equivalent ways. They can be seen either as functions from possible worlds considered as actual to words, or as functions from possible languages considered as actual to words. Both understandings are fine here, because on my view possible languages cannot vary independently of possible worlds, and each possible language is determined by exactly one possible world. It must, however, be borne in mind that a central idea of 3-D is that what we discover when empirical investigation reveals a necessary truth is *also* something about the *language*. Consequently, what we want as a result of my discovery is that I exclude some *languages* from the set of languages compatible with my metalinguistic beliefs, and not only that I exclude some worlds from the set of worlds compatible with my beliefs.

Consider John, who is a linguistically competent speaker of English. He knows that the following sentences express truths about English:

(4) 'Hesperus' is a name for the actual evening star.
(5) 'Phosphorus' is a name for the actual morning star.

John is *linguistically* competent, on the standards just defined, because both of those contingent substantive descriptions uniquely identify a certain star in the *actual* world, and because *that* star is indeed an essential ingredient of what metaphysically individuates both of the words 'Hesperus' and 'Phosphorus'. (In order to count as linguistically competent with respect to the sentence "Hesperus is Phosphorus", the minimal information that John has to recover from it is the proposition *that the actual evening star is the actual morning star*. Although general, this proposition is rigid *de facto*—because of 'the actual'—so that its secondary intension is equivalent to the singular proposition *semantically* expressed, viz. *that Venus is Venus*. So the general proposition corresponding to linguistic *competence* and the singular proposition which is *semantically* expressed by the sentence share the same truth-value in all possible worlds of evaluation.) However, as far as John's *metalinguistic* knowledge is concerned, the actual public word 'Hesperus' could still be a lot of words. This is because John doesn't know precisely which *world*, among, say, w_1, w_2, and w_3, is the actual one, and especially he doesn't know exactly which entity, among Venus, Mars, and Uranus, is the actual evening star:

w_1 → Venus
w_2 → Mars
w_3 → Uranus

It follows that his metalinguistic knowledge of the word 'Hesperus' is imperfect because, as far as he knows, three words could still equally plausibly be the actual word 'Hesperus', depending on which entity turns out to be the actual evening star:

Venus-word: The word 'Hesperus' picks out Venus in the actual public language, because the actual evening star is Venus;

Mars-word: The word 'Hesperus' picks out Mars in the actual public language, because the actual evening star is Mars;

Uranus-word: The word 'Hesperus' picks out Uranus in the actual public language, because the actual evening star is Uranus.

As far as John is aware, the actual word 'Hesperus' might be either of these three words, *depending* on which world (hence, language) turns out to be the actual one.

This dependency is precisely what the *metacharacter function* is meant to capture. John's linguistic competence is fine, but his metalinguistic competence is imperfect because his knowledge of the actual world (hence, of the actual language) is imperfect.

2-D picture: 'Hesperus' (The associated description describes an *object*.)

	Venus-world	Mars-world	Uranus-world
Venus-world	Venus	Venus	Venus
Mars-world	Mars	Mars	Mars
Uranus-world	Uranus	Uranus	Uranus

3-D picture: 'Hesperus' (The associated description describes a *word*.)

	Venus-world	Mars-world	Uranus-world
Venus-world	Venus-word	Venus-word	Venus-word
Mars-world	Mars-word	Mars-word	Mars-word
Uranus-world	Uranus-word	Uranus-word	Uranus-word

The constancy in each *horizontal* row of both matrices reflects John's knowledge that, respectively, names in general are rigid because they have their bearer essentially. In the three-dimensional analysis, if the actual world is the Venus-world, then it will be an *essential* property of the name 'Hesperus' that it picks out Venus as its referent, and if the actual world turns is Mars-world, then it will be an essential property of the name 'Hesperus' that it picks out Mars as its referent, etc. The metacharacter that John associates with the word 'Hesperus' is given by the *diagonal* of this matrix. This diagonal reflects John's knowledge *that whichever world (language) turns out to be actual, the public word 'Hesperus' is such that it is a word essentially for whatever is the evening star in that world*. That piece of knowledge is sufficient for *linguistic* competence, but it is not sufficient to grasp the *metalinguistic* proposition *that 'Hesperus' and 'Phosphorus' corefer*, because it doesn't entail anything about whether or not the actual evening star is the actual morning star. The effect of an assertion of "Hesperus is Phosphorus" on John is double: (i) eliminate all the possible *worlds* in which the evening star is not the morning star from the set of worlds compatible with his knowledge of the actual world; (ii) eliminate all the possible *languages* in which the two names do not corefer from the set of languages compatible with his knowledge of the actual language, that is, modify his *metalinguistic* competence. (His linguistic competence remains unchanged.)

3.5 The solution to the meaning-constitution problem

We are now in a position to overcome the meaning-constitution problem and disavow Stalnaker's skepticism about a metasemantic account of apriori knowledge. It follows from my definition of linguistic competence with respect to a name that each competent speaker must possess at least a *substantive contingent description which is uniquely satisfied by the bearer in the actual world*. That description stops the regression Stalnaker worries about, because it restricts the (infinite) set of *arbitrary* meanings that a phonological shape could have to the (finite) set of words that an actual word might be *as far as a competent speaker's knowledge of the word is concerned*. So it is the descriptions used to *epistemically* individuate the names that are kept constant across worlds (languages) considered as actual, and, importantly, these descriptions can, *even for a linguistically competent speaker*, still pick out different names at different worlds (languages). To say that John is *linguistically* competent with respect to the name ‘Hesperus’ is to say that he knows *enough* of the actual world to know that not everything could plausibly be the actual evening star *and hence that he knows enough of the actual world to know that not everything* could plausibly be the word ‘Hesperus’. Since he knows the truth of the metalinguistic sentence (6),

(6) ‘Hesperus’ is a word for the actual evening star.

John knows **apriori**, *in virtue of his metacharacter alone*, that the object-language sentence (7)

(7) Hesperus is the evening star.

will express a truth in the actual world (language), *whatever the actual world (language) turns out to be*. And this is the result we were after. Only, metacharacters are often private, and apriori knowledge in general will need to be relativized to *individual* speakers (at particular times). But the account will hold regardless of the particular descriptions that individual speakers use to mentally individuate a public word, so long as these descriptions are substantive descriptions which are uniquely satisfied by the bearer in the actual world. This, then, is the sense in which linguistic conventions and apriori knowledge are connected. Carnap vindicated!

4 Conclusion

The sentence “Hesperus is Phosphorus” can be informative even to a linguistically competent speaker because, although she must know at least a (rigidified) general proposition (hence, one *cointensive* with the singular proposition *semantically expressed* by the sentence), she is not required to know the metalinguistic proposition *that the words ‘Hesperus’ and ‘Phosphorus’ corefer*. This metalinguistic proposition is necessary, because, metaphysically speaking, names have their bearers essentially. But our speaker, although competent, ignores it, because she epistemically individuates the names through descriptions that are only *contingently* true of the bearer in the actual world, and is not aware that the description she uses for the bearer of ‘Hesperus’ and the description she uses for the bearer ‘Phosphorus’ pick out the same individual in the actual world (language). Metacharacters capture the connection between linguistic conventions and apriori knowledge, and do so by reflecting what a competent speaker must know of the *names* regardless of precisely which world and language happen to be actual.

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Modifying Event Nominals: Syntactic Surface Meets Semantic Transparency

Sebastian Bücking
Deutsches Seminar
University of Tuebingen

sebastian.buecking@uni-tuebingen.de

Abstract

The paper starts out with the observation that modifiers to eventive *ung*-nominals can both target at the denoted event as a whole and modify it from inside. The internal reading will be shown to challenge iconic mapping between surface-oriented c-command and semantic scope. By using Egg (2006)'s flexible syntax-semantic interface the given ambiguity is analyzed as landing site underspecification allowing for a compositional make-up in both cases: based on a bipartite eventive structure for *ung*-nominals, the internal reading is argued to result from applying the modifier to an event concept fed by the verbal lexical base whereas the external reading emerges if the modifier targets at a concept-correlate introduced by the nominal affix.

1 Introduction

In event semantics, ample evidence has been put forward in favor of correlating syntactic position and interpretation of German adverbial modifiers, cf. e.g. Maienborn (2003), Pittner (2004) and related work. (1) and (2) are indicative:[1]

(1) a. Paul hat die Daten *schnell* verarbeitet.
Paul has the data fast processed.
b. Paul hat *schnell* die Daten verarbeitet.
Paul has fast the data processed.

(2) a. Der Koch hat das Huhn *in einer Pfeffersauce* zubereitet
the cook has the chicken in a pepper-sauce prepared
b. Der Koch hat *in der Küche* das Huhn zubereitet
the cook has in the kitchen the chicken prepared

[1] A close relation between syntax and semantics of adverbials is also suggested by Principle-C-effects, quantifier scope, remnant topicalization, focus projection. I will not discuss these.

The adverbials are interpreted event-internally if projected in V-adjacent position as in (1-a) and (2-a). The AP thus specifies the manner of the processing as fast, the PP localizes an integral constituent of the cooking event, i.e. the chicken, in the pepper-sauce.[2] On the contrary, if adverbials are in a higher position next to the VP as in (1-b) and (2-b), they are interpreted event-externally, i.e. they relate holistically to the event. In this case, the AP specifies the time span of the whole processing event or the time span between its initiation and some reference point as short. The PP situates the preparing event in the kitchen.

These findings can straightforwardly be accounted for by mapping syntactic c-command on semantic scope. The according intuition behind a compositional make-up is that adverbials c-command the semantic entity they relate to. Haider (2002, 61) and related work implement this idea by proposing the interface criterion and isomorphic relation given in (3). (4) illustrates the point:

(3) a. Interface criterion: Syntactic c-command domains are mapped monotonically on incrementally structured semantic type-domains.
b. Isomorphic relation:
(i) semantics: Proposition ⊂ Event ⊂ Process/State
(ii) structure: [‘p-related’ [‘e-related’ [‘l-related’]]][3]

(4) Paul hat [$_{p-related}$vermutlich [$_{e-related}$am Montag [seine Wohnung
Paul has $_{p-related}$presumably $_{e-related}$on monday his appartement
[$_{l-related}$sorgfältig [aufgeräumt]]]]]
$_{l-related}$carefully cleaned

The sentence adverbial being bound to the proposition is projected higher than the temporal one taking scope over the event; the manner specification being related to the lexical verbal base is embedded most deeply.

The challenge to be addressed in the present paper is the following: event nominals with the affix *-ung* that correspond to the examples in (1) and (2) do not show the same structural effect thus casting doubt on a straightforward mapping between syntactic surface and semantic scope. In case of a prenominal modifying adjective, both l-related internal and e-related external reading are conveyed by the same surface structure, cf. (5) and (6) with their respective readings:

(5) die schnelle *Verarbeit*ung der Daten durch Paul
the fast processing the data$_{GEN}$ by Paul
a. ‘the processing activity itself is fast’ (internal reading)
b. ‘the time span of the whole event or that between its initiation and some reference point is short’ (external reading)

---

[2]Maienborn considers internal locatives semantically underspecified, cf. section 3 for details.

[3]Haider uses the term ‘l-related’ because he assumes that the verbal lexical base determines the denotation as a process/state.

(6) die dumme *Anbieder*ung
the stupid fawning-on
a. 'event of stupidly fawning on sb.' (internal reading)
b. 'event of fawning on sb. is evaluated as stupid' (external reading)

The holistic external readings are expected by syntax in that the AP c-commands the whole following nominal structure. In their internal reading, however, the modifiers relate to the verbal lexical base italized in the examples above, that is, they apply to just one part of the expression modified syntactically. These thus challenge strict compositionality in the nominal domain.

This mismatch is corroborated by postnominal modifying PP: in case of specifying the l-related manner reading by a postnominal prepositional phrase, the structure differs from the VP in ruling out head-adjacency of the modifier, cf. (7). The same holds for locatives: even if interpreted internally, they do not surface in head-adjacent position but in distance, cf. (8).

(7) a. die *Verarbeit*ung der Daten auf schnelle Weise
the processing the data$_{GEN}$ in fast manner
b. *die *Verarbeit*ung auf schnelle Weise der Daten
the processing in fast manner the data$_{GEN}$

(8) a. die *Zubereit*ung des Huhns in einer Pfeffersauce
the preparation the chicken$_{GEN}$ in a pepper-sauce
b. *die *Zubereit*ung in einer Pfeffersauce des Huhns
the preparation in a pepper-sauce the chicken$_{GEN}$

One might argue that the reason for this is syntactic: German adnominal genitive can only be checked in N-adjacent position, cf. e.g. Sternefeld (2006, 587-589).[4] Note though that this explanation alone does not properly explain the availability of internal postnominal PP-modifiers. First, if one proceeds from surface structure, the interaction of syntactic constraint and mapping hypothesis should simply rule out any internal readings in case of a theme projection in between. But this prediction is obviously wrong. Second, one might weaken the claim of straightforward mapping between surface syntax and semantics by allowing for movement and thus invisible syntactic structure, i.e. the PP could be ascribed an N-adjacent base position. However, even then the PP still

[4]This is not quite the whole story. If the genitive is substituted by a PP with *von* ('of'), the theme argument cannot be projected in distance either, cf.:

(i) *?die Zubereitung in einer Pfeffersauce von Hühnern
the preparation in a pepper-sauce of chickens

One could argue that in such cases *von* functions as a case-like feature since it substitutes for the bare genitive which is ungrammatical here. Or one might account for the distribution by some hierarchy constraint. However, if one relies on a hierarchy, it seems even more urgent to explain why internal modifiers cannot project before the theme's projection as attested in the VP.

c-commands the nominal, but not merely the verbal lexical base it in fact contributes to in its internal reading.[5]

Finally, note that the locative in (8-a) could also be read externally if its pragmatic nonsense is neglected; cf. (9) for a clearly conceivable example:

(9) die *Zubereit*ung des Hühnchens in der Küche
the preparation the chicken$_{GEN}$ in the kitchen

To sum up: the data on modifiers to event nominals are at odds with compositional semantics based on surface structure. In their internal reading, i.e. in their being related to the lexical verbal base, adnominal modifiers apply to just one part of the expression modified syntactically. The present paper aims at compositionally deriving external vs. internal reading via a flexible syntax-semantic interface built upon underspecification. I will first present Egg (2006)'s analysis of well-known bracketing paradoxes as *good dancer* similarly involving internal modification not expected by simple c-command and apply it to the adnominal AP modifiers from above (section 2). Second, I will extend the proposal to PP modifiers by comprising Maienborn (2003)'s free variable approach to internal locatives (section 3).

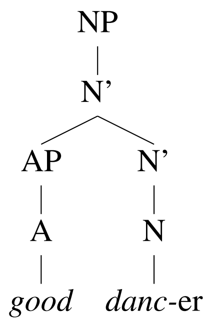
2 Scopally underspecified AP modifiers

2.1 Scope underspecification in Egg (2006)

Examples as *good dancer* are well-known for being ambiguous between reading (10-a) und (10-b).[6] A plausible structure is given in (11).

(10) a. $\lambda x.\mathbf{good}'(x) \wedge GEN[e,y](y \ \mathbf{in} \ e \wedge y = x, \mathbf{dance}'(y)(e))$
b. $\lambda x.GEN[e,y](y \ \mathbf{in} \ e \wedge y = x, \mathbf{good}'(e) \wedge \mathbf{dance}'(y)(e))$

(11)



In reading (10-a), the modifier has scope over the complex nominal. This is expected by the c-command relations in surface structure (11). Reading (10-b) though is in conflict with an iconic mapping between c-command and semantic scope because the

[5] A movement analysis also has to capture the data on prenominal AP; I do not know how to reasonably argue that they are base-generated in N-adjacent position. Such base position implies the bracketing [A+N] and subsequent movement of this complex constituent.

[6] I took Egg (2006)'s representation. *GEN* codes habituality; see Egg (2006, 6) for details.

modifier applies only to a part of the modifie, more specifically, it relates to the word-internal lexical verbal base italized in structure (11). The information carried by the affix thus has wide scope, what is unexpected.

Egg (2006) reconciles surface syntax and scope by using the following ingredients of the underspecification formalism CLLS (= Constraint Language for Lambda Structures) as developed in Egg et al. (1998) and Egg et al. (2001).[7] First, it is assumed that the semantics of constituents C contains a *main* and a *secondary* fragment. Second, built upon surface structure, complex C are construed by syntax-semantic and morpho-semantic interface rules (= SSI and MSI) which can address both fragments. Third, these SSI- and MSI-rules result in dominance diamonds that possibly have different solutions. These different solutions then correspond to the final readings available for the structure computed.

Applying this procedure to *good dancer* leads to the following diamond, cf. Egg (2006) for details:

(12)

$$\Box$$

$$\lambda x.\mathrm{GEN}[e,y](y\ \mathbf{in}\ e \wedge y = x, \Box\ (e)) \qquad \lambda z.\ \Box(z) \wedge \mathbf{good}'(z)$$

$$\mathbf{dance}'(y)$$

The diamond consists of λ-terms representing the semantic fragments involved. 'Holes' (symbolized by □) indicate their unknown, hence underspecified parts. Dominance relations (symbolized by dotted lines) attach fragments and holes to each other and thereby model scope. (12) can be read as follows: the final structure is not fixed; this motivates the hole at the top. The left fragment represents the meaning contribution of the affix *-er*, the fragment on the right side adds the meaning of the modifier *good*. While their scope interaction is not determined (i.e. neither fragment dominates the other), the lexical verbal base has necessarily narrow scope and is thus located at the bottom.

The possible solutions are calculated by monotonically identifying fragments and holes. By first identifying the right-hand hole with the top, the modifier takes scope over the full NP, cf. repeated from above (13-a). Starting from the left, i.e. identifying first the hole in the left fragment with the topmost hole, derives the critical internal reading with wide scope of the affix, cf. (13-b):

(13) a. $\lambda x.\mathbf{good}'(x) \wedge GEN[e,y](y\ \mathbf{in}\ e \wedge y = x, \mathbf{dance}'(y)(e))$
b. $\lambda x.GEN[e,y](y\ \mathbf{in}\ e \wedge y = x, \mathbf{good}'(e) \wedge \mathbf{dance}'(y)(e))$

The suggested formalism can hence systematically derive both readings on the basis of a uniform surface-oriented syntax and common assumptions on the meaning of the involved lexical items.[8] In the next section, the given analysis will be transferred to the modification of event nominals.

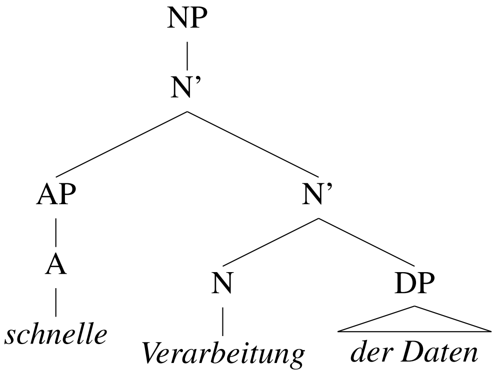
[7]Here, CLLS's underspecified representations will be used in a simplified form.

[8]Taking advantage of a powerful semantic construction, Egg's proposal can do without the assumption of underlying syntactic structure different from surface. This constrasts with e.g. Larson (1998) who ensures iconic mapping at the syntax-semantic interface by postulating an elaborate invisible syntax being the input for semantics, cf. Egg (2006, 7-9) for some discussion.

2.2 Underspecified AP modifiers to event nominals

Recall the task: how can one compositionally derive internal vs. external reading of *schnelle Verarbeitung der Daten* ('fast processing of the data') on the basis of surface structure (14) and standard semantics for the involved lexical units in (15):

(14)



(15) a. $[\![\text{schnell}]\!] = \lambda x.\mathbf{fast}'(x)$
b. $[\![\text{verarbeit}]\!] = \mathbf{process}'$
c. $[\![\text{Daten}]\!] = \lambda x.\mathbf{data}'(x)$
d. $[\![\text{die}]\!] = \lambda Q\lambda P\exists!x.[Q(x)] \wedge P(x)$[9]

The anti-iconic effect in case of internal modification strikes as being very similar to the paradox with agentive nouns discussed by Egg. In order to make his proposal work here, the semantics of the eventive affix *-ung* has to be appropriately defined. Most importantly, its semantics must assure two different landing sites the modifier can pertain to. In case of *-er*, these landing sites, i.e. agent and event, were easy to detect due to their obvious ontological difference. The situation with eventive affixes is more intricate since *-ung* does not pick up a thematic argument but relates to the underlying verbal event itself. What I propose is the following:

(16) a. main fragment: $\lambda P\lambda e.e \approx \lambda E.P(E)$
b. secondary fragment: $\lambda P\lambda x\lambda e.\mathbf{theme}'(e,x) \wedge P(e)$

According to the given proposal, the semantic contribution of *-ung* is split into a main and a secondary fragment. The main fragment entails a bipartite eventive structure. Small e represents the nominal event argument which is associated with a big E variable that stands for an event concept described by the verbal stem. This move presumes a specific perspective on the relation between verbal predicates and their eventive nominalizations. There are two conceivable positions: according to the first, nominalized predicates contribute the identical predicate to logical form as the underlying verbal predicate does, cf. e.g. Parsons (1990). Semantically, *-ung* would merely uncover the silent verbal event argument. The second position instead assumes that nominalized predicates contribute an individual term which is merely correlated with the underlying

[9]This abbreviates Montague's denotation for the definite determiner $\lambda Q\lambda P[\exists x[\forall y[Q(y) \leftrightarrow y = x] \wedge P(x)]]$. Plural is ignored.

verbal predicate, i.e. nominalizations contribute a concept-correlate in Fregean terms, cf. e.g. Cocciarella (1996). The main fragment given above implements the second stance: *e* symbolizes the nominal concept-correlate, the underlying verbal concept describes *E* and $\approx$ stands for their link to each other.[10] *-ung* thus introduces a new event argument embedding the verbally given eventive concept. Crucially, such bipartite structure provides two possible targets for modifiers: if the modifier applies to the underlying concept *E*, it is l-related and thus to be read internally. If it applies to the nominal *e*, it is e-related and hence externally interpreted. The task will be to show how these landing sites can be systematically predicted.

The secondary fragment of *-ung* takes care of the adequate integration of the verbal base it takes. Importantly, I presuppose a Neo-Davidsonian approach (cf. Parsons 1990) in order to conceive of verbs as denoting properties of eventualities with thematic roles being referred to by additional conjuncts. This spares taking along potential verbal arguments throughout the whole computation; instead, it allows for making arguments available by the characteristics of specific affixes. The proposal in (16-b) thus reads as follows: First, *-ung* binds a property of eventualities *P*, regardless of the amount of thematic arguments. Second, *-ung* influences the secondary fragment of the emerging nominalization by introducing the theme argument potentially associated with the verbal base, i.e. the verbal theme argument is made available for binding by a subsequent DP argument.[11]

In order to derive the meaning of *Verarbeitung* (‘processing’) from the lexically given verbal base and affix, a suitable rule for the interface between morphology and semantics has to be specified, cf.(17):

(17)
$$[_{\mathtt{X}}\ \mathtt{Bs\ Aff}] \overset{\text{(morph)}}{\Rightarrow} \begin{array}{l} \llbracket \mathtt{X} \rrbracket : \llbracket \mathtt{Aff} \rrbracket(\square) \\ \quad \llbracket \mathtt{X_S} \rrbracket : \llbracket \mathtt{Aff_S} \rrbracket(\llbracket \mathtt{Bs} \rrbracket) \end{array}$$

This MSI-rule retains basic intuitions of the MSI-rule already given in Egg (2006): specifically, affixes are assumed to be functions taking stems as arguments; furthermore, by introducing a yet undetermined hole in the main fragment, the rule ensures the semantic flexibility that is needed for computing the attested scopal interaction with modifiers. Other than the MSI-rule in Egg (2006), (17) is a bit simpler in not explicitly λ-binding thematic arguments of the base in the main fragment. The way thematic arguments are integrated is thus left to the semantics of the affixes themselves.

The ingredients set forth so far yield the following representation for *Verarbeitung* (‘processing’) via insertion and λ-conversion:

(18)
a. $\llbracket \mathtt{N} \rrbracket : \lambda P \lambda e.e \approx \lambda E.P(E)(\square)$

$\qquad \llbracket \mathtt{N_S} \rrbracket : [\lambda P \lambda y \lambda e.P(e) \wedge \mathbf{theme}'(e,y)](\mathbf{process}')$

b. $= \llbracket \mathtt{N} \rrbracket : \lambda e.e \approx \lambda E.\ \square\ (E)$

$\qquad \llbracket \mathtt{N_S} \rrbracket : \lambda y \lambda e.\mathbf{process}'(e) \wedge \mathbf{theme}'(e,y)$

---

[10]It is not trivial to appropriately define the relation $\approx$. For the present purpose, I rely on a merely intuitive grasp: *e* instantiates an *E* being characterized by the underlying verbal eventuality property *P*.

[11]I assume that *-ung* does not introduce the verbal agent; but nothing essential hinges on that.

According to representation (18-b), *Verarbeitung* denotes a set of concept-correlates which are characterized by a set of event concepts. These event concepts are determined as processing events with an open position for a theme argument. The given constraint is underspecified in that there is a dominance relation between the two fragments allowing the integration of additional material in its solutions.

The next step comprises the integration of the DP argument *der Daten* ('of the data'). The following SSI-rule for complementation is a category independent generalization of the rule for verbal DP arguments given in Egg (2005):

(19) $[_{\bar{\mathrm{X}}}\ \mathrm{X}\ \mathrm{DP}] \overset{(\mathrm{SSI})}{\Rightarrow} [\![\bar{\mathrm{X}}]\!]\text{: } [\![\mathrm{DP}]\!];\ [\![\bar{\mathrm{X}}_{\mathrm{S}}]\!]\text{: } [\![\mathrm{X}_{\mathrm{S}}]\!]([\![\mathrm{DP}_{\mathrm{S}}]\!])$

The DP semantics in Egg's framework rests upon standard assumptions about the lexical meaning of the respective D head as generalized quantifier. However, their semantic contribution is split into a secondary fragment that is identified with the bound variable and a fragment above that codes the quantificational information. The lexical entries (ignoring plural) are repeated in (20), (21) cites the SSI-rule needed (cf. Egg 2009), and (22) provides the corresponding computation:

(20) a. $[\![\text{die}]\!] = \lambda Q \lambda P \exists! x.[Q(x)] \wedge P(x)$

b. $[\![\text{Daten}]\!] = \lambda x.\mathbf{data'}(x)$

(21) $[_{\mathrm{DP}}\ \mathrm{D}\ \mathrm{NP}] \overset{(\mathrm{SSI})}{\Rightarrow}$ $[\![\mathrm{DP}]\!] : [\![\mathrm{D}]\!]([\![\mathrm{NP}]\!])(\lambda z.\ \square\ )$

$[\![\mathrm{DP}_{\mathrm{S}}]\!] : z$

(22) a. $[\![\mathrm{DP}]\!] : [\lambda Q \lambda P \exists! x.[Q(x)] \wedge P(x)](\lambda y.\mathrm{data'}(y))(\lambda z.\ \square\ )$

$[\![\mathrm{DP}_{\mathrm{S}}]\!] : z$

b. $= [\![\mathrm{DP}]\!] : [\lambda P \exists! x.[\mathrm{data'}(x)] \wedge P(x)](\lambda z.\ \square\ )$

$[\![\mathrm{DP}_{\mathrm{S}}]\!] : z$

c. $= [\![\mathrm{DP}]\!] : \exists! x.[\mathrm{data'}(x)] \wedge\ \square$

$[\![\mathrm{DP}_{\mathrm{S}}]\!] : x$

Putting pieces together according to (19), i.e. applying the semantics of *Verarbeitung* in (18-b) to the DP meaning in (22), yields the following constraint for *Verarbeitung der Daten* ('processing of the data'):

(23) $\lambda e.e \approx \lambda E.\square(E)$ $\qquad [\![\bar{\mathrm{N}}]\!] : \lambda e \exists! x.[\mathrm{data'}(x)] \wedge \square\ (e)$

$[\![\bar{\mathrm{N}}_{\mathrm{S}}]\!] : \lambda e.\mathbf{process'}(e) \wedge \mathbf{theme'}(e, x)$

The secondary fragment $[\![\bar{\mathrm{N}}_{\mathrm{S}}]\!]$ fixes x as the theme argument via λ-conversion; the main fragment $[\![\bar{\mathrm{N}}]\!]$ is identified with $[\![\mathrm{DP}]\!]$. Additionally, the DP semantics introduce a new λ-abstracted e; this is necessary for providing event variables at the very top of the final representation.[12] The affix information on the left remains unaffected.

[12]This is parallel to the sentential level where adverbials and DPs introduce event variables, needed e.g. for the integration of tempus. For an appropriate typing of event variables see below.

The next step consists of the modifier's integration. Egg (2006) proposes the SSI-rule (24):[13]

(24)
$$[_{\bar{\mathtt{X}}_1}\ \bar{\mathtt{X}}_2\ \mathtt{Mod}] \overset{(SSI)}{\Rightarrow} \quad \begin{array}{l} [\![\bar{\mathtt{X}}_{1\mathtt{S}}]\!] : \lambda x.[\![\mathtt{Mod}]\!](x) \wedge \square\,(x);\ [\![\bar{\mathtt{X}}_1]\!]:\ [\![\bar{\mathtt{X}}_2]\!] \\ \qquad\qquad\qquad\qquad\quad [\![\bar{\mathtt{X}}_{2\mathtt{S}}]\!] \end{array}$$

The idea behind reads as follows: the main fragment of the modifie is inherited by the main fragment of the new complex constituent without any change. The new secondary fragment though integrates the modifier: a hole is applied to the same variable x as the modifier fragment is. Furthermore, this hole dominates the original secondary fragment of the modifie. Crucially, whereas both main and secondary fragment of the resultant constituent hence dominate the modifie's original secondary fragment, their scopal interaction with each other is not determined.

Applying (24) to $\bar{\mathtt{N}}$ *schnelle Verarbeitung der Daten* ('fast processing of the data') yields (25); finally, Egg's SSI-rule for phrasal completion given in (26) generates the complete diamond in (27) for the full NP:[14]

(25)
$$\begin{array}{ccc} [\![\bar{\mathtt{N}}]\!] : \lambda e \exists ! x.[\mathbf{data}'](x) \wedge \square(e) & \lambda e.e \approx \lambda E.\square(E) & [\![\bar{\mathtt{N}}_{\mathtt{S}}]\!] : \lambda y.\square(y) \wedge \mathbf{fast}'(y) \\ & \lambda e.\mathbf{theme}'(e,x) \wedge \mathbf{process}'(e) & \end{array}$$

(26)
$$[_{\mathtt{XP}}\ \bar{\mathtt{X}}] \quad \overset{(SSI)}{\Rightarrow} \quad \begin{array}{lcl} [\![\mathtt{XP}]\!] : \square & & \\ [\![\mathtt{XP}_{\mathtt{S}}]\!] : [\![\bar{\mathtt{X}}]\!] & & [\![\bar{\mathtt{X}}_{\mathtt{S}}]\!] \end{array}$$

(27)
$$\begin{array}{ccc} & [\![\mathtt{NP}]\!] : \square & \\ [\![\mathtt{NP}_{\mathtt{S}}]\!] : \lambda e \exists ! x.[\mathbf{data}'](x) \wedge \square(e) & \lambda e.e \approx \lambda E.\square(E) & \lambda y.\square(y) \wedge \mathbf{fast}'(y) \\ & \lambda e.\mathbf{theme}'(e,x) \wedge \mathbf{process}'(e) & \end{array}$$

How many solutions, i.e. readings, does this diamond have? In principle, there are 3! (= 6) solutions. However, there seem to be only two readings empirically attested (i.e. the internal vs. the external one). Since this flexibility concerns the fragments coding the meaning of the affix and the modifier, it seems reasonable to block on principled grounds the scopal interaction with the information for the complement DP. In Egg (2006), certain unwanted ambiguities are surpressed by taking advantage of the fact that holes are typed, i.e. not compatible with random fragments but only with those matching type-theoretically. This aspect of semantic construction paves way for blocking in case of (27). The idea is to type the different event variables: I assume that verb semantics (on a par with adverbials) introduce event variables maximally flexible, i.e. a general event type e_g comprising all other types. However, whereas the inner structure of event nominalizations introduce a variable E for event concepts, the DP semantics is assumed to

[13]The version cited rests upon intersective modification as discussed e.g. in Higginbotham (1985). Adjectives are thus of type $\langle e,t \rangle$. Egg prefers a version based on functional application with adjectives typed $\langle \langle e,t \rangle, \langle e,t \rangle \rangle$. The choice between these options is irrelevant here.

[14]The top hole supports possible ambiguities between the fragments below, cf. Egg (2006).

introduce variables e for concept-correlates.[15] With e and E being incompatible with each other, such typing rules out any solution where the fragment on the left – coding the DP semantics – must be identified with the hole in the central fragment. For this hole takes an E type variable. Accordingly, three of six possible solutions are ruled out, specifically those where the affix fragment takes scope over the DP fragment.

There are three well-formed solutions left: let us first look at those two cases where the DP fragment on the left gets widest scope, i.e. is identified with the top hole. The subsequent computation can take two directions: either one first plugs in the affix fragment and then the modifier's fragment or one starts out the other way round, cf. the results (28-a) versus (28-b) after λ-conversion:

(28) a. $\lambda e \exists ! x.[\mathbf{data}'(x)] \wedge e \approx \lambda E.\mathbf{theme}'(E,x) \wedge \mathbf{process}'(E) \wedge \mathbf{fast}'(E)$
b. $\lambda e \exists ! x.[\mathbf{data}'(x)] \wedge e \approx \lambda E.\mathbf{theme}'(E,x) \wedge \mathbf{process}'(E) \wedge \mathbf{fast}'(e)$

These are exactly those readings aimed at: in (28-a), the modifier pertains to the event concept, thus leading to an internal modification. In (28-b) though, it has wide scope over the concept-correlate, thus displaying the holistic external reading.

What about the third solution compliant to types? It is achieved by first identifying the modifier fragment with the top, then integrating the DP semantics and finally plugging in the affix fragment, cf. (29):

(29) $\lambda y \exists ! x.[\mathbf{data}'(x)] \wedge y \approx \lambda E.\mathbf{theme}'(E,x) \wedge \mathbf{process}'(E) \wedge \mathbf{fast}'(y)$

This final third representation is identical to the one for the external reading in (28-b); hence it is not at odds with the empirical evidence for merely two readings.

3 Scopally underspecified locatives

Locative PP modifiers are another instance of the contrast between internal and external modification. As in case of AP modifiers, internally interpreted locatives pose a problem for a 1:1 mapping between c-command and scope since they surface in distance to their modifie, cf. repeated from above (30):

(30) die *Zubereit*ung des Huhns in einer Pfeffersauce
the preparation the chicken$_{GEN}$ in a pepper-sauce

Construing a constraint according to the rules and the procedure above yields diamond (31). It simplifies DP semantics in representing the DP argument as a ι-term and the PP as a simple predicate. (32) lists the constraint's solutions.

[15] Admittedly, such typing is a stipulation. One might argue that DP semantics and nominal concept-correlates are compatible because both are nominal; however, note that at the sentential level, DP arguments must also be compatible with the event argument introduced by the verb.

(31)

$$\Box$$

$$\lambda e.e \approx \lambda E.\ \Box\ (E) \qquad\qquad \lambda y.\ \Box(y) \wedge \mathbf{in}'(y, \mathbf{P})$$

$$\lambda e_g.\mathbf{theme}'(e_g, \iota x.\mathbf{chicken}'(x)) \wedge \mathbf{prepare}'(e_g)$$

(32) a. $\lambda y.\mathbf{in}'(y,\mathbf{P}) \wedge y \approx \lambda E.\mathbf{theme}'(E, \iota x.\mathbf{chicken}'(x)) \wedge \mathbf{prepare}'(E)$
b. $\lambda e.e \approx \lambda E.\mathbf{in}'(E,\mathbf{P}) \wedge \mathbf{theme}'(E, \iota x.\mathbf{chicken}'(x)) \wedge \mathbf{prepare}'(E)$

In the external reading, i.e. (32-a), the preparation event as a whole is localized in the pepper sauce. This is pragmatically deviant but otherwise unproblematic. The internal reading is not that straightforward: according to (32-b), the locative applies to the event concept *E*. This suits the intuition that an internal locative somehow modifies the conceptually specified inner event structure. However, it remains unclear what such localization of the conceptual essence exactly amounts to. Particularly, one has to assure that, finally, it is the chicken that is localized in the pepper sauce. In order to tackle this problem more precisely, I will first sketch Maienborn (2003)'s proposal for corresponding adverbial locatives and then transfer her solution to the nominal case at hand.

Maienborn proposes an abstract modification template MOD* which is accompanied by a structural condition, cf. (33):

(33) MOD*: $\lambda Q \lambda P \lambda x[P(x) \& R(x,v) \& Q(v)]$
Condition: if MOD* applies to categorial type X, *R* = **part-of′**, otherwise (i.e. in an XP-environment) *R* is the identity function.

MOD* conforms to common analyses of intersective modification by mapping two properties instantiated by the meaning of modifier and modifie to a conjunction of corresponding predicates. However, it additionally introduces a free relation variable mediating between the resultant predicates. Crucially, its interpretation is conditioned structurally and thus compositional in nature. Applying MOD* to the adverbials in (34-a) vs. (34-b) leads to the respective representations in (35).

(34) a. [$_{VP}$ [$_{PP}$in einer Küche] [$_{VP}$ das Huhn zubereiten]]
[$_{VP}$ [$_{PP}$in a kitchen] [$_{VP}$ the chicken prepare]]
b. [$_{VP}$ das Huhn [$_{V}$ [$_{PP}$in einer Pfeffersauce] [$_{V}$zubereiten]]]
[$_{VP}$ the chicken [$_{V}$ [$_{PP}$in a pepper-sauce] [$_{V}$prepare]]]

(35) a. $\lambda e.\mathbf{prepare}'(e) \wedge \mathbf{theme}'(e, \iota x.\mathbf{chicken}'(x)) \wedge \mathbf{in}'(e, \mathbf{K})$
b. $\lambda e.\mathbf{prepare}'(e) \wedge \mathbf{theme}'(e, \iota x.\mathbf{chicken}'(x)) \wedge \mathbf{part\text{-}of}'(e,v) \wedge \mathbf{in}'(v, \mathbf{P})$

The locative's projection above the VP triggers the identity function for the relation variable and thus yields an external modification with the event as a whole being localized in the kitchen. On the contrary, the interpretation for internal locatives, projected in V-adjacent position, is bound to a mediating variable *v*: *v* is localized in the pepper-sauce and **part-of′** identifies *v* as integral to *e*. Whereas this integrity constraint relies upon semantics, the particular value for *v* is fixed at the conceptual level, thus not part of compositional semantics proper. In the case at hand, the most plausible candidate for *v* is the chicken; in effect, this leads to the desired interpretation with the chicken referent localized in the peppersauce.[16]

A straightforward transfer to the case at hand is impeded by the fact that internal versus external locatives are not distinguished by surface syntax. Assuming the very same structure for both readings, a truly compositional condition is trivially impossible. However, based upon the derivation along the lines of Egg's interface rules, the different targets of locatives can be paired with respective event types. I thus reformulate MOD* for the adnominal cases as follows:

(36) MOD*: $\lambda Q \lambda P \lambda x[P(x) \& R(x,v) \& Q(v)]$
Condition: if the free variable relates to the verbal concept E, R = **part-of′**; if it relates to the nominal concept-correlate e, R is the identity function.

Such reformulation constrains the way locatives are integrated in terms of semantics alone. I do not consider it stipulative but rather intuitively conclusive: if the locative is related via v to the nominal event concept-correlate e, i.e. a variable for concrete whole events, it 'sees' a potential target right from the start. Thus v and e are identified. On the contrary, the abstract verbal concept E is not a conceivable candidate to be localized. Thus it turns out to be necessary to infer an integral part to such a concept that could be a plausible target for localization.

Building (36) into the modificational analysis from above yields the following representations for external vs. internal locatives:

(37) a. $\lambda e.\mathbf{in}'(v,\mathbf{P}) \wedge R(e,v) \wedge e \approx \lambda E.\mathbf{theme}'(E, \iota x.\mathbf{chicken}'(x))$
$\wedge\, \mathbf{prepare}'(E)$
b. $= \lambda e.\mathbf{in}'(e,\mathbf{P}) \wedge e \approx \lambda E.\mathbf{theme}'(E, \iota x.\mathbf{chicken}'(x)) \wedge \mathbf{prepare}'(E)$

(38) a. $\lambda e.e \approx \lambda E.\mathbf{prepare}'(E) \wedge R(E,v) \wedge \mathbf{in}'(v,\mathbf{P})$
$\wedge\, \mathbf{theme}'(E, \iota x.\mathbf{chicken}'(x))$
b. $= \lambda e.e \approx \lambda E.\mathbf{prepare}'(E) \wedge \mathbf{part\text{-}of}'(E,v) \wedge \mathbf{in}'(v,\mathbf{P})$
$\wedge\, \mathbf{theme}'(E, \iota x.\mathbf{chicken}'(x))$
c. $\lambda e.e \approx \lambda E.\mathbf{prepare}'(E) \wedge \mathbf{in}'(\iota x.\mathbf{chicken}'(x), \mathbf{P})$
$\wedge\, \mathbf{theme}'(E, \iota x.\mathbf{chicken}'(x))$

The results (37-b) and (38-b) suit the intuitively given readings for *Zubereitung des Huhns in einer Pfeffersauce* ('preparation of the chicken in the pepper sauce').[17] Pragmatically, the internal reading can be strengthened by identifying v and the referent for the chicken, cf. (38-c).[18]

[16]Maienborn builds upon 'Two-Level Semantics' as advanced in Bierwisch (1982) and subsequent related work. Thus she distinguishes the grammatically determined semantic form of a linguistic expression from its conceptual structure being fixed by world-knowledge and context.

[17]To be sure, as before the pragmatic nonsense of external modification in this case is neglected.

[18]One might ask if a free choice between **identity′** and **part-of′** for R would do the same job as the condition in (36). In terms of the given proposal, it would cause two additional readings:

(i) a. 'an entity v being integral to the concept-correlate e is located in the pepper-sauce'
b. 'the event concept E is localized in the pepper-sauce'

As mentioned, the given computation for locatives simplifies DP semantics. There is no harm in simple cases. However, examples with interacting quantifiers as (39) having the readings in (40) enforce a more involved analysis:

(39) die Zubereitung aller Hühner in einer Pfeffersauce
the preparation all chicken$_{GEN}$ in a pepper-sauce

(40) a. internal with $\exists > \forall$ 'there is a pepper-sauce in which all chicken are prepared'
b. internal with $\forall > \exists$ 'for all chicken there is some pepper-sauce in which they are prepared'
c. external with $\exists > \forall$ 'there is a pepper-sauce in which the preparation of all chicken takes place'
d. external with $\forall > \exists$ 'for all chicken there is some pepper-sauce such that the preparation of these takes place in it'

One might ask if the sketched mechanism can predict exactly these readings.[19]

Adding the quantificational force of DPs to the constraint leads to the diamond (41). I omit the free variable for the locative's integration in order to facilitate readability:

(41)

$$\begin{array}{ccc}
 & \square & \\
 & & \lambda e \exists p.\mathbf{pepper\text{-}sauce}'(p) \wedge \square(e) \\
\lambda e \forall h.\mathbf{chicken}'(h) \rightarrow \square(e) & \lambda e.e \approx \lambda E.\square(E) & \lambda x.\square(x) \wedge \mathbf{in}'(x,p) \\
 & \lambda e_g.\mathbf{theme}'(e_g,h) \wedge \mathbf{prepare}'(e_g) &
\end{array}$$

Taking into account that the embedded event concept of type *E* is incompatible with the *e* introduced by the DP semantics, (41) has four solutions, cf. (42):[20]

Reading (i-b) is the same as (32-b); it thus does not display any explanatory progress. I do not know what (i-a) amounts to since it seems unclear if there is any plausible distinction between an integral part of *E* vs. an integral part of *e*. Maybe, (i-a) just collapses with the internal reading; maybe, it does not make any sense. If one considers (i-a) a possible formulation for the case of internal modification, one might question the whole enterprise taken up here. Instead of modelling internal vs. external reading as landing site underspecification, adnominal locatives could be just dubbed underspecified due to the free variable. Still, formulating a condition for the variable's assignment as done in (36) makes more transparent which assignment to choose during computation by linking it to the difference between concept-correlates and event concepts.

[19]Interestingly, at the sentential level a quantifying internal modifier can scope out notwithstanding the assumed base position next to V, cf. (i) with both '$\forall > \exists$'- and '$\exists > \forall$'-reading:

(i) Er hat alle Hühner in einer Pfeffersauce zubereitet.
He has all chicken in a pepper-sauce prepared

[20]Most importantly, the λ-term for the affix in the middle is not allowed to have wide scope over any DP *e*, i.e. the identification with the top has to first process both quantifier fragments. There are four instead of merely two readings because the PP's semantic contribution – being coded within the two separate λ-terms on the right hand side – can go up as a whole or as separate constraints. If they are identified with the top together, the two external readings are generated; if they are kept apart, the internal readings are built up.

(42) a. $\lambda e \exists p.\mathbf{pepper\text{-}sauce}'(p) \wedge \forall h.\mathbf{chicken}'(h) \rightarrow e \approx \lambda E.\mathbf{theme}'(E,h) \wedge \mathbf{prepare}(E) \wedge \mathbf{in}'(E,p)$

b. $\lambda e \forall h.\mathbf{chicken}'(h) \rightarrow \exists p.\mathbf{pepper\text{-}sauce}'(p) \wedge e \approx \lambda E.\mathbf{theme}'(E,h) \wedge \mathbf{prepare}'(E) \wedge \mathbf{in}'(E,p)$

c. $\lambda e \exists p.\mathbf{pepper\text{-}sauce}'(p) \wedge \forall h.\mathbf{chicken}'(h) \rightarrow [e \approx \lambda E.\mathbf{theme}'(E,h) \wedge \mathbf{prepare}(E)] \wedge \mathbf{in}'(e,p)$

d. $\lambda e \forall h.\mathbf{chicken}'(h) \rightarrow \exists p.\mathbf{pepper\text{-}sauce}'(p) \wedge e \approx \lambda E.\mathbf{theme}'(E,h) \wedge \mathbf{prepare}'(E) \wedge \mathbf{in}'(e,p)$

These are (if supplemented by the free variable account for locatives) exactly those four readings empirically attested.

4 Conclusion and Outlook

The present paper addressed the challenge that AP and PP modifiers to eventive *ung*-nominalizations trigger – besides straightforward event external readings – event internal interpretations not expected by isomorphically mapping surface-oriented c-command on semantic scope. By applying Egg's flexible syntax-semantic interface built upon underspecification to the cases under discussion, both internal and external readings could be derived in a principled compositional manner without resorting to some form of syntactic preprocessing.

Crucially, the analysis relies on a bipartite eventive structure for *ung*-nominalizations: the affix introduces a secondary eventive concept-correlate *e* being related via $\approx$ to a lexically determined event concept argument *E* that is fed by the verbal base. This split provides two targets for the modification: whereas external modifiers apply to *e* and thereby trigger the holistic event modification, internal modifiers apply to *E* and thus specify event concepts from inside. Supplementary to such landing site ambiguity, the additional flexibility observed for internal locative PP modifiers is captured by introducing a free variable to be instantiated on conceptual grounds.

The most obvious follow-up question in view of the proposed analysis is if it covers other event nominals. Particularly, nominalized infinitives show the same flexibility as *ung*-derivations do although they lack an overt nominal affix, cf. (43):

(43) das schnelle Verarbeiten der Daten
the fast process$_{nominal}$ the data$_{GEN}$

One thus might ask more generally whether there is any other evidence for the assumption that event nominals have a bipartite eventive structure. In other words: it must be shown independently that event nominals do not simply render the verbal event argument visible but trigger some sort of secondary reifying process.

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Embedding Imperatives in English

Luka Crnič
Dept. of Linguistics
MIT

crnic@mit.edu

Tue Trinh
Dept. of Linguistics
MIT

tuetrinh@mit.edu

Abstract

Although it has generally been claimed otherwise (cf. Katz and Postal 1964, Sadock and Zwicky 1985, Palmer 1986, Rivero and Terzi 1995, Platzack and Rosengren 1998, Han 1998 among others), it holds that embedded imperatives exist in English. We describe their main characteristics and provide an account of these by relying on Schwager's (2006) propositional analysis of imperatives, where imperatives are treated as modalized sentences. The imperative modal is thereby relativized to eventualities (cf. Hacquard 2006).

1 Introduction

It has been claimed that imperatives cannot be embedded in English (cf. Katz and Postal 1964, Sadock and Zwicky 1985, Palmer 1986, Rivero and Terzi 1995, Platzack and Rosengren 1998, Han 1998, among others). This claim has been motivated in at least two distinct ways: by treating imperatives as inherent speech act objects which resist embedding on conceptual grounds (cf. Han 1998), and by taking paradigms like (1) as conclusive empirical evidence against their embeddability (cf. Sadock and Zwicky 1985, Palmer 1986 and others). (1a) and (1b) show that declarative and interrogative clauses can occur as complements of attitude verbs, while (1c) purportedly shows this not to be the case for imperative clauses.

(1) a. John claimed that [Mary sang]
    b. John knows [what Mary sang]
    c. *John said that [call Mary]

Both arguments against there being embeded imperatives in English are based on questionable premises. On the one hand, the paradigm in (1) is misleading. We should rather take the sentence in (2), where the complement of the intensional verb lacks an overt complementizer, as the indicative example. On the other hand, the assumptions that imperatives are essentially speech act objects and that such objects cannot be arguments of attitude verbs – namely, that attitude verbs do not select for illocutionary acts – have independently been argued to be unwarranted (cf. Schwager 2006).

(2) John said [call Mary]

The theoretical import of the existence of embedded imperatives is evident. Namely, theories of imperatives that predict their unembeddability need to be modified to accommodate (2) and similar data, while theories that predict such embeddings receive empirical support. Furthermore, if embedded imperatives exist, we can study their semantic contribution to the interpretation of the structures containing them in order to (i) get at a proper analysis of imperatives in general, embedded and matrix, as well as (ii) gain new insights about the nature of the embedding verbs. In this respect, the understanding garnered by the existence and the nature of embedded imperatives should be utilized in a way that insights about embedded interrogatives were (Karttunen 1977).

The paper is organized as follows: Section 2 presents evidence that embedded imperatives are neither quotations nor elliptical *to*-infinitives and that the embedding verb is not used parenthetically. Section 3 compares felicity conditions on embedded and matrix imperatives. Section 4 describes analogous behavior of epistemic modals and provides an analysis for it. Section 5 introduces a theory of imperatives according to which they are modalized sentences. Section 6 provides an account for the parallelism observed between embedded and matrix imperatives by combining the insights of sections 4 and 5. Section 7 points out some issues for further research, while Section 8 concludes.

2 Imperatives as complements of attitude verbs

The sentence in (2) raises several questions related to the nature of the obligatory absence of an overt complementizer, the markedness of parallel sentences with other intensional verbs (3), and the reference of the imperative subject. However, before these questions may be addressed, it must first be shown that (2) is indeed an example of an embedded imperative and not a quoted imperative. This is achieved by showing that, unlike quotes, the string resembling an embedded imperative in (2) and similar examples is not grammatically opaque. Subsequently, we provide evidence that the embedded imperative is also not a bare infinitive, and that *Mary said* is not a parenthetical.

(3) a. *John claimed (that) [call Mary]
 b. *John knows (that) [call Mary]

The standard tests for determining whether certain seemingly embedded clauses are quotations (cf. Anand 2006 and others) involve checking for felicitous occurrences of demonstratives, clause-external variable binding, association with external focus-sensitive operators, *wh*-extraction, external licensing of negative polarity items, and (non-)interaction of clause-external and clause–internal nominals with respect to binding. If what we have characterized as embedded imperatives pass these tests, this can be taken as an indication that we are dealing with indirect speech.

The facts strongly suggest that embedded imperatives are grammatically transparent. The first relevant datum is the contrast in (4). We see that in (4a), *John* and *his* can be corefential, whereas in (4b), where it is clear that the pronoun *his* is contained in a quote, the coreference reading is marked due to the unlikelihood that John would refer to himself with a third person pronoun.

(4) a. John_1 said call his_1 mom
b. #John_1 said: ”Hey, call his_1 mom”

The data in (5) is related. In a situation where the examples in (5) are uttered and the respective indexical *that* is accompanied by a pointing gesture, (5a) but not (5b) is felicitous. Namely, if an indexical is inside a quotation, it should not be evaluated with respect to the utterance situation of (5b) but with respect to the situation of John’s original utterance. The pointing gesture would thus be misplaced. Accordingly, the contrast in acceptability in (5) is an indication that the sentence in (5a) is an instance of indirect speech and does not contain a quotation.

(5) Speaker points at a book
a. John_1 said buy *that* book
b. #John_1 said: ”Hey, buy *that* book”

Furthermore, focus-sensitive adverbs like *only* are able to associate with focused elements inside the complement of *say*: (6a) conveys that the only thing that John said that you should give to his mom is roses. (6b) cannot convey this, nor does it have a metalinguistic reading in which there is quantification over parts of the quotation.

(6) a. John only said give roses_F to his mom
b. #John only said: ”Hey, give roses_F to his mom”

The same reasoning applies to examples in (7) as well: In (7a) we see that a variable contained in the complement of *say* may be bound by a quantifier external to it; in (7b) we see that *wh*-extraction out of the complement of *say* is not ill-formed; and in (7c) it is shown that the licenser of an NPI inside the complement of the attitude verb does not have to be its immediate clausemate. All of these facts corroborate that the construction studied here allows for syntactic interaction with the rest of the clause and can appropriately be characterized as an embedded imperative.

(7) a. Every professor_1 said buy his_1 book
b. $^?$Who did John say call at three?
c. $^?$No one said buy anything

Furthermore, sentences containing embedded imperatives may be arguments of further attitude verbs (8). Along with the data introduced above, this is an indication that the cases of embedded imperatives do not involve paranthesis (cf. McCloskey 2006).

(8) John thought Mary said call her mom

Finally, it cannot be claimed that the imperative clauses under discussion are actually *to*-infinitives in which the auxiliary has been elided: In (9) we see that although past participles may occur in *to*-infinitives, they are illicit in the constructions studied here. In (10) we see that negated *to*-infinitives cannot be the source of negative embedded imperatives.

(9) a. John said to have called his mom by tomorrow
b. *John said have called his mom by tomorrow

(10) a. John said not to call his mom
b. *John said not call his mom
c. John said don't call his mom

In this section it was conclusively shown that imperatives can be embedded in English. In particular, we have shown that the respective constructions do not share the characterizing properties of quotations, parentheticals and elliptical *to*-infinitives. However, embedded imperatives also differ in certain respects from embedded declaratives and interrogatives: the former are subject to certain felicity conditions that the latter two are not. These constraints will be exemplified in the next section.

3 Matrix and embedded imperatives

The use of matrix imperatives is subject to a different set of constraints than the use of declaratives and interrogatives. Embedded imperatives are restricted in a similar manner. The constraints involve primarily the authority status of the speaker, her epistemic state, and her approval of what is commanded by the imperative[1]. Between them, they condition the performative nature of the imperative (Schwager 2006). Now, it clearly holds that the performativity of imperatives does not disappear with embedding under an attitude verb: a felicitous use of an embedded imperative is conditional on the reported utterance having been performative. This is illustrated by the contrast between (11a), in which the reported utterance solely described a state of affairs, and (11b), in which the reported utterance was performative. The performativity of the embedded imperative is thereby not anchored to the actual speech context but to the speech context of the reported utterance.

[1] In this paper, the focus will be on the command reading of imperatives. All the observations as well as the proposed analysis holds for other readings (wish, advice etc.) of imperatives as well.

(11) a. John to Sue: ”Peter has an obligation to call Mary”
Sue to Peter: #John said call Mary
b. John to Sue: ”I hereby order that Peter call Mary”
Sue to Peter: John said call Mary

Building on the fact that the performative nature of imperatives is conserved under embedding, an entire class of similarities between matrix and embedded imperatives can be derived. In (12a), it is illustrated that a matrix imperative cannot be followed by a statement that negates the truthfulness of the person who utters the imperative. In (12b), the infelicity stems from negating the truthfulness of the person whose performative utterance is being reported. A shift in the locus of the explanation of the markedness of discourses in (12) can be observed: the locus in (12a) was in contradicting the actual speaker, while in (12b) it was in contradicting the subject of the attitude verb.

(12) a. A: Call Mary right away! B: #That's not true
b. A: John said call Mary right away! B: #John lied

A similar reasoning applies to (13) and (14). In (13a), we see that it is infelicitous for the speaker to be certain that her addressee will call Mary independently of the utterance of the imperative and still command it; in (13b) it is the epistemic state of the subject of the attitude verb that is responsible for the markedness of the respective discourse. In (14a), it can be seen that it is infelicitous for the speaker to command something that she does not consider to be a good outcome; in (14b), the infelicity is due to subject of the attitude verb having had such considerations.

(13) a. #I know you're going to call Mary. Call her!
b. #John knew you were going to call Mary. He said call her

(14) a. #Call Mary right away. But I don't think you should
b. #John said call Mary right away. But he didn't think you should

To summarize: certain parallels hold between the infelicitous use of embedded and matrix imperatives. The intuitive reason for the markedness of the (a) sentences in (12)-(14) is that there is a conflict between the imperative uttered by the agent of the actual speech event and the accompanying context (cf. Schwager 2006). The markedness of (b) sentences, on the other hand, is due to a conflict between the imperative uttered by the agent of the reported speech event and the context of that speech event. Thus, while the explanations of the markedness of discourses in (a) and (b) have the same underlying architecture, the ingredients are distinct – in (a) examples, the ingredients are the circumstances of the actual speech event, while in (b) examples, the ingredients are the circumstances of the reported speech event. A similar pattern has been noted in the evaluation of epistemic modals, to which we turn in the next section.

4 Matrix and embedded epistemic modals

Epistemic modality is context-sensitive (Hacquard 2006, Stephenson 2007, Yalcin 2007 and many others), i.e. it depends on the context whose epistemic state is relevant for determining the sentence's truth conditions. In particular, the epistemic agents that feature in the assessment of matrix epistemics (15a) come from the actual speech context, while the epistemic agents featured in the assessment of embedded epistemic modals are determined by the context of the reported attitude situation (15b). For the purposes of this paper, we assume that the knowledge that is relevant for matrix epistemic modals is that of the speaker (cf. DeRose 1991, Stephenson 2007, MacFarlane 2008 for a more sophisticated treatment and caveats), while the knowledge that is relevant for embedded epistemic modals is that of the subject of the respective attitude verb. This is illustrated by the paraphrases in (15a') and (15b').

(15) a. It might be raining
a'. It's not the case that I know that it isn't raining
b. John believes that it might be raining
b'. It's not the case that John knows that it isn't raining

As an illustration, these assumptions provide a natural explanation of the infelicity found in epistemic contradictions (cf. Yalcin 2007 for discussion): since the epistemic modal is evaluated in relation to her knowledge, by uttering (16a) the speaker is being cognitively dissonant. The markedness of (16b) is due to cognitive dissonance being attributed to the subject of the attitude verb.

(16) a. #It's raining and it might not be raining
b. #John believes it's raining. He also believes that it might not be raining

It is clear that an unmodified Kratzer (1978) approach does not capture this context-sensitivity: *John believes that it might be raining* is true according to that theory iff, roughly, in all the worlds w doxastically accessible to John, at least one world w' is epistemically accessible from w in which it is raining – there is no mention of whose epistemic state is relevant in determining the latter accessible worlds. Several different types of accounts of epistemic modals have been proposed that try to remedy this shortcoming. Among them is also the event-relative approach in Hacquard (2006) that is based on Kratzer's classical treatment of modality[2]. Hacquard assumes that the first argument of a modal is an accessibility relation that assigns a set of accessible worlds to the modal's second argument, an event; the modal's third argument is a proposition. The denotation of *might* is given in (17).

(17) $[[\text{might R e}]] = \lambda p.\ \exists w \in R(e){:}\ p(w) = 1$

[2] A slightly simplified version of Hacquard's (2006) approach is presented here. The simplifications, which are primarily related to the treatment of root modality and tense, are harmless since we are dealing with 'high' modals, i.e. deontic addressee-oriented modals, and the role of tense is ignored.

The accessibility relation in (17) is epistemic and Hacquard proposes that it assigns to an event a set of worlds compatible with the content of that event (18a). The content of an event is thereby the set of propositions that are associated with the event in a certain manner, e.g. they are known in the event(uality) (18b). The epistemic accessibility relation thereby presupposes that its event argument is contentful.

(18) a. $R_{epist} = \lambda e$: CONTENT(e)$\neq\varnothing$. λw. w is compatible with CONTENT(e)
 b. CONTENT = λe. λp. p is known in e

Furthermore, Hacquard proposes that modals may merge either with a VP – i.e. below tense and aspect – or T' – i.e. above tense and aspect. They are then relativized to the closest c-commanding event variable, which provides the temporal and individual anchoring of the modal – namely anchoring to the time and the individual participants of the event. In the case of unembedded modals that merge with T', that event is the speech event. In the case of embedded modals that merge with T', that event is the attitude event. In the cases of modals that merge with a VP, the event they are relativized to is the event introduced by the aspect operator. This event-relativization is formally captured by the event argument of the modal being bound by the closest event-binder:

(19) Syntactic assumptions
 a. Event and world variables are bound by the closest binders
 b. 'λw' and 'λe' can be inserted freely to ensure interpretability

This system can account for the dependence of matrix epistemics on the cognitive state of the speaker as well as the switch of dependence which occurs with embedding of epistemic modals. It also provides a natural explanation for why epistemic modals merge above aspect (and tense). Namely, their accessibility relation selects for contentful events – speech and various attitude events are contentful, while events in the denotation of most other VPs are not. Accordingly, merging the epistemic modal with a VP, where the modal's event argument is relativized to the event introduced by aspect, would lead to a clash between the requirements of the accessibility relation and the nature of the event argument (cf. Hacquard 2006 for more details).

A simplified structure for matrix epistemics is given in (20). In (20b), instead of binding the modal's event argument, we represent the speech event with e* – a more elaborate speech act projection likely dominates the structure in (20b) but will not feature in our representations. We collapse the tense and aspect heads into Infl complex, whose denotation is given in (20c); the semantic contribution of tense is ignored.

(20) a. John might come
 b. [[might R e*] [λw [Infl w] [λe [John come(e)]]]]
 c. [[Infl w]] = $\lambda P. \exists e \leq w[P(e) = 1]$

The truth-conditions of (20b) are computed in (21): the minimal speech event of uttering (20a) has only the speaker as a participant. Accordingly, it is the speaker's cognitive state that determines the epistemic content of the event, i.e. the domain of the first existential quantifier contains only those worlds that are compatible with the speaker's knowlege. It is asserted that in at least one of those worlds, John comes.

(21) $[[(20a)]] = 1$ iff $\exists w \in R_{epist}(e^*)$: $\exists e \leq w$[agent(e)(John) & come(e)]

If an epistemic modal is embedded under an attitude verb, its event argument is co-indexed with the event(uality) argument of the attitude verb – they are both bound by the same event binder (22b). Accordingly, since the modal is relativized to the attitude event, it is the beliefs of the attitude holder that will be relevant in determining the accessible worlds. The holder of the attitude event is denoted by the subject of the attitude verb. Accordingly, the content of the event, which determines the domain of existential quantification over worlds, consists of the beliefs of the subject. This accounts for the observed shift in the epistemic agent relevant for evaluating epistemic modals from the speaker in (21) to the subject of the attitude verb in (22d).

(22) a. Mary believes that John might come
b. [Infl w*] λe' [Mary believe(e') [λw' [might R e'] [λw [Infl w] [λe [John come(e)]]]]]
c. $[[\text{believe}]] = \lambda e.\ \lambda p.\ \lambda x.$ holder(e)(x) & believe(e) & $\forall w \in \cap\textsc{Content}(e)[p(w) = 1]$
d. $[[(22b)]] = 1$ iff $\exists e \leq w^*$[holder(e)(Mary) & believe(e) & $\forall w \in \cap\textsc{Content}(e)[\exists w' \in R_{epist}(e)[\exists e' \leq w'$[agent(e')(John) & come(e')]]]]],
i.e. iff $\exists e \leq w^*$[holder(e)(Mary) & believe(e) & $\exists w \in R_{epist}(e)[\exists e' \leq w$ [agent(e')(John) & come(e')]]]

This section has illustrated some basic facts related to the context-sensitivity of epistemic modality. In particular, we have focused on the shift of the individual relevant for determining the possible worlds over which the modal quantifies; such a shift was shown to occur when epistemics are embedded under an attitude verb. An approach in which modals are relativized to events was adopted to account for these facts. The next section will introduce a modal semantics for imperatives. Combined with the event-relative treatment of modality, this will allow us to analyze the facts described in Section 3.

5 Imperatives as modalized sentences

There are several distinct approaches to semantics of imperatives (Han 1998, Schwager 2006, Portner 2007 among many others). These approaches differ in whether they predict embeddability of imperatives. In particular, if a standard analysis of embedding attitude verbs – i.e. attitude verbs select for propositions – is adopted, approaches that assume that imperatives are not propositional cannot be maintained in light of the preceding discussion. However, if imperatives are treated as denoting modal propositions, their embedding is expected. Schwager's (2006) semantics of imperatives exemplifies the second type of approach: she analyzes imperatives as performatively used deontic modal sentences. More precisely, imperatives and performative modals are treated as having the same assertive content as non-performative modals, but they additionally trigger three presuppositions[3].

An illustration of the first restriction on the use of imperatives and performatively used deontics is in (23). In (23a), it is shown that it is infelicitous to contest the verity of a peformatively used deontic modal. The same observation was shown to hold for imperatives in (12a), repeated in (23b). The restriction can be characterized as the speaker possessing a rational authority which makes disputing her truthfulness infelicitous. This is the authority condition.

(23) a. A: You must call Mary right away! B: #That's not true
b. A: Call Mary right away! B: #That's not true

The second presupposition triggered by imperatives and performative deontics is the following: prior to the utterance of the imperative, the speaker must not believe that the addressee will fulfill the obligation imposed by the imperative independently of the utterance of the imeperative. She must not be convinced that her command will be ignored either. This is the epistemic uncertainty condition, and it is illustrated in (24) (cf. (13a) above).

(24) a. #I know you're (not) going to call Mary, (but) you must call her
b. #I know you're (not) going to call Mary, (but) call her

The third presupposition is that the speaker must endorse what she commands. This is the accessibility relation affirmation condition (ordering source affirmation in Schwager 2006). Again, a parallelism between imperatives and performatively used modals obtains (25) (cf. (14a) above).

(25) a. #You must call Mary right away! But I don't think you should
b. #Call Mary right away! But I don't think you should

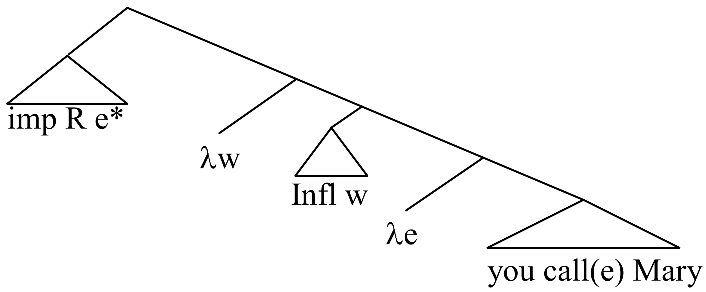
The standard meaning of a universal modal is given in (26a); the LF of *You must call Mary* is in (26b). (26a) also represents the content of the assertive component of the imperative modal and the performative deontic modal *must*. In addition, both the imperative and the performative *must* select for a deontic accessibility relation that takes a contentful event of appropriate kind as its argument. They are also subject to the three conditions discussed above: the speaker has to be an authority in the speech

[3] A sparse version of Schwager's analysis is instrumentalized in this paper. Furthermore, some liberties are taken in formulating some points. For more details, cf. Schwager 2006.

event, she has to affirm the accessibility relation, and she must be epistemically uncertain in an event immediately preceding the speech event about whether the proposition denoted by the complement of the imperative modal would obtain. The denotation of the imperative modal is in (27a); the LF of *Call Mary* is in (27b). The truth-conditions of (27b) are computed in (27c).

(26) a. $[[\text{must}]] = \lambda R.\ \lambda e.\ \lambda p.\ \forall w \in R(e): p(w) = 1$
b. [must R e*] [λw [[Infl w] [λe [you call(e) Mary]]]]

(27) a. $[[\text{imp}]] = \lambda R.\ \lambda e$: authority(agent(e),e) & affirm(agent(e),R,e). λp: uncertain(agent(e),p,e_{pre}). $\forall w \in R(e): p(w) = 1$
b.



c. [[(27b)]] is defined only if the speaker is an authority, affirms the accessibility relation, and is epistemically uncertain about the addressee calling Mary. If defined, [[(27b)]] = 1 iff $\forall w \in R(e^*)$ [$\exists e \leq w$ [agent(e)(the.addressee) & call(e)(Mary)]]

The above representation leaves the domain of universal quantification underspecified. We will assume that this domain consists of worlds that are compatible with what was said in the respective speech event. That is, we propose that the imperative modal selects for the accessibility relation given in (28a). The natural content of a speech event is thereby the set of propositions that the speaker conveyed to an addressee by her utterance (28b).

(28) a. $R_{imp} = \lambda e$: CONTENT'(e)$\neq\varnothing$. λw. w is compatible with CONTENT(e)
b. CONTENT' = $\lambda e.\ \lambda p$. p was conveyed in e

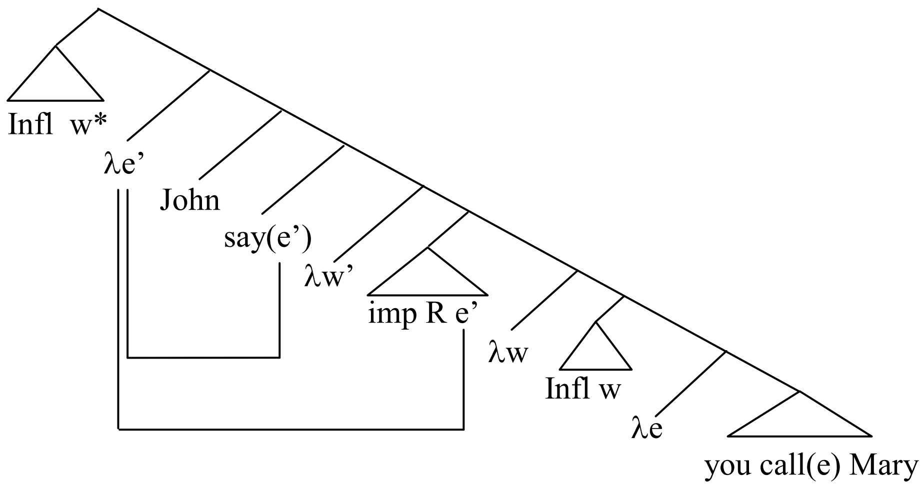
This section introduced Schwager's propositional analysis of imperatives and performative modals, which was transposed to an event-based framework introduced in Section 4. In particular, imperatives are clauses headed by a modal that has the same semantics as non-performative modals but is subject to three additional conditions that are encoded as presuppositions: authority, epistemic uncertainty and accessibility relation affirmation. The following section will combine the proposals introduced in the last two sections to derive the facts described in Section 3.

6 Shift with embedded imperatives

The imperative modal shares a crucial property with epistemic modals: it merges above aspect (27b). The reason for this is the same as the reason for high merger of epistemic modals: the imperative modal selects for contentful events which are due to local event co-indexation (19) not available if the modal merges with the VP. Consequently, if an imperative is embedded under an attitude verb, the event argument of the imperative modal is bound by the same event binder as the event argument of the attitude verb. This can be seen in (29b), which is the LF of the sentence in (29a). The meaning of *say* is given in (29c).

(29) a. John said call Mary

b.



c. $[[\text{say}]] = \lambda e.\lambda p.\lambda x.\ \text{agent}(e)(x)\ \&\ \text{say}(e)\ \&\ \forall w \in \cap\textsc{Content}(e)[p(w) = 1]$

The imperative modal is thus anchored to the attitude event. Accordingly, this is the event that is subject to definedness conditions on imperatives discussed in Section 5, i.e. the authority, epistemic uncertainty and accessibility relation affirmation conditions. Since the agent of the attitude event is denoted by the subject of the attitude verb, it is the authority status, epistemic state and affirmative stances of this individual that the felicity of the embedded imperative depends on. This is exemplified in (30) where the truth-conditions of (29b) are computed.

(30) If defined, $[[(29b)]] = 1$ iff $\exists e \leq w^*[\text{agent}(e)(\text{John})\ \&\ \text{say}(e)\ \&\ \forall w \in \cap\textsc{Content}(e)[\ \forall w' \in R_{imp}(e)[\exists e' \leq w'[\text{agent}(e')(\text{the.addr.})\ \&\ \text{call}(e')(\text{Mary})]]]]$ iff $\exists e \leq w^*[\text{agent}(e)(\text{John})\ \&\ \text{say}(e)\ \&\ \forall w \in R_{imp}(e)\ [\exists e' \leq w\ [\text{agent}(e')(\text{the.addr.})\ \&\ \text{call}(e')(\text{Mary})]]]]$.

[[(29b)]] is defined only if in the reported speech event, John is an authority, he is uncertain about the addressee calling Mary and affirms the addressee calling Mary.

These truth-conditions are accountable for the patterns observed in Section 3, repeated in (31). Namely, the operative condition responsible for the markedness of (31a) is John having to be an authority in the reported saying event. The second sentence of (31a) contradicts this condition. In (31b), the first sentence expresses that prior to uttering the imperative, John was epistemically certain about the addressee calling Mary. The use of an embedded imperative in the second sentence, however, comes with the precondition that the subject of the attitude verb was uncertain prior to the utterance of the imperative whether the addressee will call Mary. This precondition cannot be satisfied in light of the first sentence. Finally, as it is illustrated in (30), the first sentence in (31c) presupposes that John has an affirmative attitude towards the addressee calling Mary, while the second sentences negates this.

(31) a. A: John said call Mary right away! B: #John lied
b. #John knew you were going to call Mary. He said call her.
c. #John said call Mary right away. But he didn't think you should.

In summary, the infelicity of discourses in (31) can be shown to follow from the incompatibility of the event-relative semantics of the imperative modal and the accompanying context: by relativizing modals to events, the definedness conditions of imperatives become characterizable as restrictions on events in which the imperative is uttered. If these events cannot fulfill the felicity requirements imposed by the imperative modal, as is the case in (31), the sentence is marked. This accounts for the parallel behavior of matrix and embedded imperatives described in Section 3. The next section describes another prediction of the analysis developed here and touches upon some further issues.

7 Some puzzles

There are two puzzles concerning embedded imperatives that were mentioned only very briefly in the preceding exposition: the limitations on the embedding verb and the nature of the imperative subject. The first puzzle was illustrated in (3), which is repeated below. It concerns the fact that the only attitude verb that allows for embedding of imperatives in English is *say*.

(3) a. *John claimed (that) [call Mary]
b. *John knows (that) [call Mary]

The approach to imperatives and modality espoused above allows for a natural explanation of some restrictions on what the embedding verb may be: it has to be a verb of saying that describes events in which, roughly, a command has been expressed. Namely, as it is defined in (28), the accessibility relation of imperatives and other performative deontic modals selects only for events in which certain properties hold of the agent, e.g. the speaker in the speech event. The sentences in (3) have the structures given in (32) where the event arguments of the imperative modal are co-indexed with the event arguments of the attitude verbs *claim* and *know*, respectively. On the one hand, although a minimal knowing event(uality) e does contain a cognizing individual – a holder of certain beliefs and knowledge – that individual is not an *agent* of the event and, accordingly, $R_{imp}(e)$ is undefined (presuppositions of the imperative modal require there to be an agent in the respective speech event). On the other hand, the agent of a claiming event does not satisfy the authority presupposition triggered by the perfomative modal. This explains why embedded imperatives can occur only under attitude verbs that can be used to describe events in which a command was uttered.

(32) a. [Infl w*] λe' [John claim(e') [λw' [imp R e'] [λw [Infl w] [λe [you call(e) Mary]]]]]
 b. [Infl w*] λe' [John know(e') [λw' [imp R e'] [λw [Infl w] [λe [you call(e) Mary]]]]]

However, it is not all verbs of commanding that allow embedded imperatives; for example, *demand* and *order* are unacceptable with an imperative complement (33). Descriptively, all the verbs of commanding that are such that if they take a CP argument, that CP has to have an overt complementizer (34), do not embed imperatives.

(33) a. *John demanded (that) call his mom
 b. *John ordered (that) call his mom

(34) a. John demanded *(that) Mary call his mom
 b. John ordered *(that) Mary call his mom

Accordingly, the fact that the only verb of saying that can embed imperatives is *say* could be explained along the following lines: It is a common assumption that imperatives are CPs where either an imperative feature (Schwager 2006) or some directive feature (Han 1998) is situated in C. This is a position that is also targeted by the complementizer *that*, which cannot have an imperative feature. Therefore, if an attitude verb selects for CPs with an overt complementizer *that* (e.g. *claim, order*), an embedding of imperatives is illicit.

The second puzzle concerns the reference of the imperative subject. In matrix imperatives, the subject refers to the addressee in the actual context. This is frequently captured by assuming that the imperative subject *pro* has a second person feature that requires the denotation of *pro* to be the addressee of the utterance. In embedded imperatives, however, the referent of the imperative subject is not necessarily the actual addresse.

(35) a. John said call his mom, so you should
 b. John said call his mom, and I did
 c. John said call his mom, and Bill did
 d. John said call his mom, so we will

The sequences in (35) are felicitous. If the denotation of the imperative were just the actual addressee, only (35a) would be expected to be licit: the obligation of the actual addressee to call John's mom cannot be satisfied by anyone other than the actual addressee. The behavior of the subject of the embedded imperative thus resembles the behavior of arbitrary PRO. The fact that such behavior is not observable with matrix imperatives might be due to pragmatic reasons. A further investigation of this issue is mandated.

In this section, the restricted distribution of embedded imperatives in English was to some extent derived from the semantics of the imperative modal and event-relativity of modality. Furthermore, it was suggested that cases of non-embedding of imperatives under verbs of commanding were due to syntactic restrictions. Finally, it was shown that the denotation of the subject of the embedded imperative does not always straightforwardly correspond to the actual addressee.

8 Conclusion

Although it has often been claimed otherwise, there are embedded imperatives in English. Their semantic properties thereby closely resemble the properties of embedded epistemic modals: their evaluation is to some extent context-sensitive. We have captured this resemblance by adopting Schwager's (2006) account of imperatives (imperatives denote modal propositions) and Hacquard's (2006) approach to modality (modals are event-relative).

There are several issues that require further investigation: the restriction of English attitude verbs that allow embedded imperatives to *say*; the cross-linguistic variation in the embedding of imperatives; the semantics of the embedded imperative subject and its implications for the analysis of imperative subjects in general. First steps in resolving some of these issues were made above, but a lot of theoretical and typological work still lays ahead.

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Reference Processes in Intensional Contexts

Francesca Delogu
Center for Mind/Brain Sciences
University of Trento

francesca.delogu@unitn.it

Abstract

This paper presents two reading experiments investigating reference processes in intensional contexts. Both studies employ sentence pairs containing a definite NP whose potential antecedent is embedded in an intensional context, where definite anaphora is not supported. Previous work on this topic has shown that the interpretation of such sentences elicit a cost in terms of reading times, because readers undertake inferential or revision processes to derive a coherent text representation. The results of the experiments, however, do not support these accounts. Instead, they are consistent with a new theoretical development based on the notion of non-actuality implicature (Frazier 2008).

1 Introduction

It is well known in natural language semantics that intensional verbs like *want, need* and *look for* give rise to contexts in which indefinite noun phrases (NPs) can receive two readings. For example, on one reading of (1a), Mary wants a horse for her birthday, but no particular one, on the other reading, there is a certain horse such that Mary wants it for her birthday:

(1) a. Mary wants a horse for her birthday.
    b. John is looking for a unicorn.

The two readings are usually referred to as unspecific and specific, respectively. On unspecific readings, indefinite NPs do not presuppose the existence of their referent, giving rise to what is often called a lack of existential import. For example, a sentence like (1b) may well be true although unicorns do not exist[1]. As a

[1] Another major property of intensional verbs is that substitution of coreferential terms in the complement may not preserve the truth value of the original sentence (for an overview of properties of intensional (transitive) verbs, see Forbes, 2004). In the remainder of the paper, I will refer to verb phrase constructions headed by an intensional verb as intensional contexts.

consequence, complements of intensional verbs generally do not support definite anaphora (Karttunen, 1976; Moltmann, 1997), as seen in (2a) as opposed to (2b) (here '#' means 'infelicitous on the unspecific reading of the indefinite'):

(2) a. Mary wanted a horse for her birthday. # The horse / it was white and had a golden mane.
b. Mary got a horse for her birthday. The horse / it was white and had a golden mane.

Although the theoretical investigation on intensionality has a rich tradition, going back at least to Frege (1892) and Quine (1956), the topic has not figured prominently in psycholinguistics. Intensionality has entered this field of research as a 'tool' to set up contexts that do not support definite anaphora, as in (2a), in order to investigate whether modal information elicits empirical effects with regard to discourse processing (Dwivedi, Phillips, Lague-Beauvais, & Baum, 2005) and the nature of the inferential processes that readers undertake to achieve coherent text representations (Haviland & Clark, 1974). The empirical evidence collected in these studies suggests that intensionality affects discourse processing. However, the nature of the mechanisms that underlie the online processing of sentence pairs such as (2a) is still an open question.

In the present paper I present two experimental studies focusing on the interpretation of definite NPs in intensional contexts. I argue that the results of these experiments do not support previous accounts of intensionality effects in discourse processing. Instead, they are predicted by a new theoretical development (Frazier, 2008) based on the notions of accommodation and non-actuality implicature.

The paper is organized as follows. In the following section I provide a brief overview and a critical assessment of the relevant psycholinguistic literature. Section 3 presents the two experimental studies that have been carried out. In Section 4, the experimental results are discussed with respect to previous models of discourse comprehension and Frazier's (2008) notion of non-actuality implicature. Section 5 provides a brief summary and a conclusion.

2 Background

As mentioned above, intensionality is not a core topic in psycholinguistics. However, intensional verbs have been exploited to test theories of reference processes during discourse comprehension. Specifically, sentence pairs such as (2a) as opposed as (2b) have been used to investigate anaphoric bridging processes (Haviland & Clark, 1974, Experiment 2) and theories of modal subordination (Dwivedi et al., 2005). These studies were motivated by the basic assumption in discourse processes research that, while processing a text, the reader's goal is to build a coherent representation in which incoming information is related to earlier portions of text via anaphoric or inferential processes (e.g. van Dijk & Kintsch, 1983; Kintsch & van Dijk, 1978; Gerrig & McKoon, 1998; Sanford & Garrod, 1981; Wolf, Magliano, & Larsen, 2005). A consequence of this assumption is that if readers are not initially successful in identifying an antecedent for an anaphoric expression, they resort to alternate strategies for establishing coherence.

In the two-sentence discourses illustrated in (2), both the definite NP *the horse*- which normally presupposes the existence of a referent (Russell, 1905; Strawson, 1950) and signals that it is already given or familiar to the interlocutor (Heim, 1982)- and the pronoun *it* require an antecedent to be interpreted. While in (2b) the antecedent is already given in the context sentence, in (2a) it must be accommodated as a new discourse entity, provided that the indefinite in the context sentence is interpreted as unspecific. As a consequence, readers must undertake additional processing in order to build a coherent text representation. In support of this prediction, the experimental studies reported in Haviland & Clark (1974) and Dwivedi et al. (2005) consistently showed a processing cost associated with sentences containing definites whose potential antecedents are embedded in an intensional rather than an extensional context. The two studies, however, offer two different accounts of their findings and, more important, both are problematic from the methodological point of view.

To begin, Haviland & Clark (1974; Experiment 2) used intensional contexts to control word repetition effects in the investigation of inferential bridging processes. Specifically, in their first experiment, they showed that a sentence like *The beer was warm* is more difficult to process when it follows a context sentence like *We checked the picnic supplies* than *We got some beer out of the trunk* because readers need time to make a bridging inference which relates *beer* to *picnic supplies*, in order to generate a coherent text representation. Although the reading time difference could be indicative of bridging processes, there was an obvious alternative explanation of their finding: the repetition of the word *beer* in the easier condition might have facilitated the processing of the target sentence, causing faster reading times than in the harder, bridging condition. To control word repetition effects, Haviland & Clark (Experiment 2) tested sentence pairs like those in (3), where a repetition of the critical word was obtained in both conditions but, crucially, definite anaphora was supported only in (3a, b):

(3) a. Ed was given *an alligator* for his birthday.
a'. Ed wanted *an alligator* for his birthday.
b. The alligator was his favourite present.

Haviland & Clark hypothesized that in order to establish a coherent representation of the sentence pair (3a’, b), the comprehender needs to infer that *Ed actually got an alligator for his birthday, and that alligator was his favourite present* (Haviland & Clark, 1974, p. 516). The bridging process, here, consists in accommodating a new discourse referent for the definite NP and interpreting it as standing for the alligator that Ed got for his birthday. The results of the experiment supported this hypothesis showing longer reading time for (3b) following (3a’) than (3a). This finding, however, does not necessarily prove that intensional contexts affect discourse processing. The experimental paradigm used in the study does not enable us to assess whether the costly process is the accommodation of a new discourse referent due to the anaphorically inaccessible context, as claimed by Haviland & Clark, or an otherwise motivated bridging inference. Consider the sentence pair given in (4):

(4) The day of his birthday, Ed saw an alligator at the pet shop.
The alligator was his favourite present.

Here, nothing prevents the definite NP to be interpreted as coreferentially linked to the indefinite in the context sentence. However, a bridging inference is required to coherently connect the event of seeing an alligator and the information that that alligator was Ed's favourite present (at least, it is necessary to infer that someone gave Ed the alligator as a birthday present!).

More important, Haviland & Clark instructed participants in the experiment to "[…] be sure to read and pay attention to the first sentence in each pair since it would be related to the second. But, [*they were*] told, it was the second sentence that [*they*] were interested in […]" (p. 515). These instructions might have induced participants to actively find a detailed bridge between the two sentences in each pair, producing reading time differences as a function of task demands rather than the experimental manipulation.

Finally, Haviland & Clark did not take into consideration that, upon encountering the definite NP in the target sentence, participants might have been biased to adopt a specific interpretation of the indefinite in the context sentence. When computed, a specific reading of the indefinite supports definite anaphora and makes the discourse coherent. The latter hypothesis has been investigated in an Event Related Potential (ERP) study by Dwivedi et al. (2005).

The experiment tested materials like (5):

(5) a. John is writing a novel. It ends quite abruptly
b. John is considering writing a novel. #It ends quite abruptly.

In (5a), the indefinite *a novel* can act as antecedent for the pronoun in the target sentence. In (5b), by contrast, the intensional verb *consider* produces an intensional context where anaphora resolution is blocked. The results of the experiment showed a P600-like effect, with a frontal distribution, elicited by the verb in the second sentence (*ends*) of (5b) compared to (5a), suggesting a revision in discourse structure. The revision process was explained within the theory of modal subordination outlined in Roberts (1987, 1989, 1996). Robert's theory builds on Kamp's (1981) Discourse Representation Theory in which information that is conveyed in discourse is structurally represented in a Discourse Representation Structure (see also Kamp & Ryle, 1993). In Robert's theory, elements that are under the scope of modal or intensional operators are represented in subordinate structures and are not accessible for anaphoric reference from entities appearing in the main structure, where factual information is represented. The P600-like effect was thus interpreted as a structural revision of the context sentence in which the processor computes a specific interpretation of the indefinite NP in order to authorize anaphora resolution. Such specific interpretation comes about by accommodating the discourse referent associated to the indefinite into the main discourse structure, where it becomes accessible to the pronoun. The interpretation of (5b)- as achieved through this structural revision process- would be paraphrasable as *John is considering writing a certain novel that he has in mind and it ends quite abruptly.*

Although Dwivedi et al.'s study used pronouns instead of full definite NPs, their results suggest that in Haviland & Clark's Experiment 2 participants might have spent additional time in revising the context sentence in order to provide the definite NP with a structurally accessible antecedent. However, a word of caution is in order. The results reported in Dwivedi et al. may be questionable at the methodological level. The analysis at the verb position, in fact, used as baseline correction a time window where the authors had shown a negative ERP effect starting at about 500 ms after the onset of the pronoun in the intensional condition. This may have produced a seeming long lasting positivity after the verb at similar scalp locations.[2]

To summarize, the experimental investigation on reference processes in intensional contexts has produced controversial results. Several questions are still open and need further investigation. For example, even supposing that reference processes in intensional contexts elicit a cost in terms of reading times, it would be useful to investigate the locus and time-course of such cost. A clear prediction in this respect can be made if we consider that anaphora support is possible when the anaphor occurs in the context of modal subordination (Roberts, 1996; Moltmann, 1997), as in (6):

(6) Mary wants a horse for her birthday. It *must* be white and have a golden mane.

The consequence for a theory of processing is that, upon encountering the pronoun, the processor has still the possibility to build a coherent representation of a sentence like (6). It is at the verb position of the second sentence that the felicity of the discourse can be judged and, if need be, a repair strategy undertaken. Thus, we might expect a cost to be localized around the verb region of the second sentence of (3a', b). This prediction has been tested in the following studies.

3 Two experimental studies on intensionality in discourse processing

The two experimental studies reported in this section build on previous research to investigate how intensional contexts affect discourse processing. Before presenting the experimental investigation, a few remarks are in order with respect to the experimental methodologies that have been used. The first experiment employed the self-paced reading method, which is one of the most commonly adopted method to investigate sentence and discourse comprehension. In this method, items can be presented

[2] In ERP experiments, it is crucial to ensure that an effect is not already present in the signal before the target stimulus was actually presented. If this was the case, it would indicate that the signal is contaminated by a confound that is not stimulus-related.

sentence-by-sentence, phrase-by-phrase, or word-by-word. Experiment 1 used a non cumulative phrase-by-phrase presentation, which is also called moving window technique. In this technique, segments appear first in the form of a set of dashes, with each dash corresponding to a character and with spaces between dashes corresponding to spaces between words. With each press of a key, a segment is revealed on the screen and, with each subsequent press, the subsequent segment appears and the previous one disappears. Thus, participants are able to control the rate of presentations of the materials, and reading times are recorded between each press of the key. The moving window technique is informative about possible processing difficulties associated with a fragment: the greater the processing difficulty and the longer the reading times. Experiment 1 used this technique to assess whether the cost previously found by Haviland & Clark (1974)- a cost detected by the time taken to read the *whole* target sentence- could be replicated and, if so, at which phrase of the sentence it would be revealed.

Experiment 2 used the eye-tracking methodology, which allows participants to read in a more naturalistic way and to look back at earlier portions of the text. By monitoring eye-movements during reading, this technique measures fixation times on critical words or regions of a text as well as regressive movements towards previous regions. A lot of factors, both lexical (e.g., length and frequency of a word) and contextual (e.g., predictability and ease of integration of a word into a sentence or discourse) have been found to influence fixation times during reading (Just & Carpenter, 1980; McConkie, Hogaboam, Wolverton, Zola, & Lucas, 1979; Rayner, Sereno, Morris, Schmauder, & Clifton, 1989; see Rayner, 1998 for an overview). Interestingly, there is abundant evidence that fixation time in the region of an anaphoric expression varies as a function of how it is easy to make the link between the anaphor and its antecedent (e.g., Ehrlich & Rayner, 1983; Albrecht & Clifton, 1998; Garrod, Freudenthal, & Boyle, 1994; Kennison & Gordon, 1998; Paterson, Sanford, Moxey, & Dawydiak, 1998).

To determine the existence, locus, and time-course of processing difficulties, it is first necessary to define the region of interest and then analysing the temporal processing associated with that region. There are several measures that can be used as an index of processing time. In Experiment 2, the following measures have been considered: first-pass time, which is defined as the sum of all fixations beginning with the reader's first fixation in a region until the reader's gaze leaves the region; total time, which is the sum of all the fixations made in a region, including the time spent in the region after regressing back to it; second-pass time, which is the time spent in a region after leaving it either to the left or to the right. Notice that reference processes are assumed to be captured by early processing measures, like first-pass times, while higher-level integration processes, like bridging inferences, are more likely to be detected by measures of later processes, like second-pass or total reading time (Sturt, 2003).

3.1 Experiment 1

3.1.1 Method and materials

Experiment 1 was designed to replicate the effect obtained by Haviland & Clark (1974; Experiment 2) using different materials in a different language (Italian)[3]. The experiment tested sentence pairs such as those illustrated in (7)[4]:

		Context									
(7)	a.	Il	cuoco	comprò/	una	pentola	nuova/	per	il	suo	ristorante.
		The	chef	bought/	a	pot	new/	for	the	his	restaurant.
		'The chef bought a new pot for his restaurant.'									
	a'.	Il	cuoco	voleva/	una	pentola	nuova/	per	il	suo	ristorante.
		The	chef	wanted/	a	pot	new/	for	the	his	restaurant.
		'The chef wanted a new pot for his restaurant.'									
		Target									
	b.	La	pentola/	costò/	parecchio.						
		The	pot/	cost/ (PAST)	a lot.						

The first sentence of each item began with a definite NP or a proper name followed either by an extensional construction [*bought a saucepan* in (7a)] or an intensional one [*wanted a saucepan* in (7a')]. The target sentence (7b) always began with a definite NP lexically identical to the indefinite in the context sentence, followed by a verb in the indicative past tense. Given the similarities between the present manipulation and the one employed by Haviland & Clark, it was expected to find longer reading times for the target sentence following (7a') than (7a). However, the main interest was in the locus of the expected effect. Based on Roberts (1996) and Moltmann (1997), the prediction was to observe an effect localized at the verb position, where it becomes clear that the referent for the definite NP must be accommodated as a new discourse entity.

A set of 40 target sentences was created in the form illustrated in (7b) above. Two context-sentences for each target sentence were created, one containing an extensional construction and the other an intensional one. The intensional constructions were built using a total of 13 intensional (transitive) verbs, including, among others, *cercare* (look for), *desiderare* (wish), *temere* (fear for).The 80 sentence pairs were divided up into two lists of 40 pairs. Each list contained 20 extensional sentence pairs and 20 intensional ones, with the constraint that if an extensional pair occurred on one list, its matched intensional pair occurred on the other. Half the

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[3] Cross-linguistic differences between English and Italian are assumed to be not relevant for the purposes of the experiment.

[4] The character '/' indicates the section break between the chunks of the sentences that were displayed at one time in the moving-window display.

subjects received one list, and half the other. Stimuli presentation and recording of latencies were controlled by E-Prime Software. Sentences were divided up into three chunks and presented using the moving-window technique. On the first screen, all characters of the first sentence were replaced by dashes. Participants had to press the space bar to see the first chunk of the sentence. When they pressed the space bar again, the first chunk was replaced by dashes, and the second chunk was displayed. Another press of the space bar caused the context sentence to disappear and the dashes replacing the characters of the target sentence to appear. At this point the procedure was the same as before.

Experimental items were displayed along with 139 filler sentences of various type and length. Comprehension questions, to which participants had to answer pressing one of two buttons, followed 50% of the trials. 16 native speakers of Italian took part in the experiment.

3.1.2 Results and discussion

The mean reading times for each segment of the target sentences are shown in Table 1. Data from each segment were subjected to analysis of variance (ANOVA), treating participants ($F1$) and items ($F2$) as random variables. Reading times that were 3 standard deviations above or below the mean in each phrase position were excluded by the analysis. This resulted in less than 3% of the trials discarded.

Table 1. Mean reading times [ms] for conditions by segment: 1, 2, and 3 refer to the three segments of the target sentence.

	target segments		
	1 *La pentola* *(The pot)*	2 *costò* *(cost)*	3 *parecchio* *(a lot)*
Extensional context	600	572	620
Intensional contexts	594	565	609

The analysis revealed no significant differences at any phrase of the target sentence [all *Fs*<1]. Therefore, the bridging effect reported in Haviland & Clark (1974) was not replicated in the present experiment. Quite surprisingly, readers seemed to find target sentences following an intensional context as easy to process as following an extensional one. It is, however, possible, that the bridging effect was somehow masked by the way in which materials were presented. In the present experiment, whenever a new chunk appeared, the previous one disappeared. Consequently, readers were not able to reread portions of the target sentence whenever they needed to. Haviland & Clark's experiment, by contrast, used a whole sentence presentation, so that participants were able to re-access previous portions of the target sentence without restraints. The bridging effect might have emerged during such re-reading stages. In view of this possibility, the following experiment employed the eye-tracking methodology which gives an extremely fine-grained and continuous picture of the time-course of processing, while allowing participants to read in a more naturalistic way and to look back at earlier portions of the text.

3.2 Experiment 2

3.2.1 Method and materials

The aim of Experiment 2 was twofold: first, to assess whether the failure to replicate Haviland & Clark's effect in Experiment 1 was due to the way in which materials were presented; secondly, to test Dwivedi et al. (2005) hypothesis that the interpretation of anaphoric expressions whose potential antecedents are indefinite NPs in intensional contexts requires a revision in discourse structure to compute a specific reading of the indefinite. The basic strategy to test these hypotheses was to present participants with sentence pairs in four conditions, like those illustrated in (8):

(8) a. John devoured a pastry for dessert at the dinner with his friends.
The pastry was his favourite course.

b. John wished a pastry for dessert at the dinner with his friends.
The pastry was his favourite course.

c. John devoured a pastry that his mother had prepared for him.
The pastry was his favourite course.

d. John wished a pastry that his mother had prepared for him.
The pastry was his favourite course.

As in Experiment 1, the first sentence of each item began with a proper name or a definite NP followed by either an extensional construction (*devoured a pastry*) or an intensional transitive one (*wished a pastry*). The final clause of the sentence, however, was manipulated in order to obtain a condition in which the indefinite NP in the intensional construction could be interpreted as specific. The specific reading was obtained using, for example, a 'that'-clause. In (8d), if John wished a pastry that his mother had prepared for him, it means that he wished a specific pastry. Thus, in this condition, the discourse referent associated with the indefinite can act as antecedent for the definite in the target sentence and revision strategies such as those hypothesized by Dwivedi et al. (2005) are unnecessary.

To summarize, the experimental manipulation combined two factors: the type of verb (extensional *versus* intensional) and the type of object (unspecific *versus* specific), which resulted in a 2X2 design. The verb-type manipulation allowed us to investigate whether the bridging effect found in Haviland & Clark (1974) could be replicated using the eye-tracking methodology. On this hypothesis, it was expected a main effect of verb type with longer (re)reading times on the target sentence following an intensional context than an extensional one. The object-type manipulation allowed us to investigate the hypothesis advanced in Dwivedi et al. (2005) according to which the interpretation of the target sentence in (8b) requires a computation of a specific reading of the indefinite, which is unnecessary in (8d). On this hypothesis, it was expected an interaction between the two experimental factors, with longer reading times for the target sentence in condition (8b) compared to all the others.

The study included 32 sentence pairs in each of the four conditions. The sentence pairs were counterbalanced across conditions in four lists. Participants saw each sentence pair in one condition. A Generation 5.5 Fourward Techonologies Dual Purkinje Image eye-tracker monitored participants' eye movements. At the beginning of the experiment, participants were seated at the eye-tracker, and a bite-bar and a forehead rests were used to minimize head movements. The tracker was then aligned and calibrated using a series of nine fixation boxes that participants were asked to fixate as they appeared on the computer screen. Before each trial, a pattern of boxes appeared on the computer screen. Participants were instructed to fixate the upper left box, at which point the target text appeared, with the first characters of the text replacing the fixating box. Experimental items were presented as two written lines, with two blank lines between each line of text. The experiment included 158 filler items of various type and length. Comprehension questions, to which participants had to answer pressing one of two buttons, followed 50% of the trials. 32 native speakers of English took part in the experiment.

3.2.2 Results and discussion

For the purpose of the analysis the target sentences were devided up into two regions, the first one containing the definite NP (*The pastry*), and the second one containing the other words of the sentence. First-pass, second-pass and total reading time data for the two regions of analysis were subjected to a 2X2 ANOVA that treated both factors as within-participants ($F1$) and within-items ($F2$).

The analysis of total time data did not show any main effects or interactions. The analysis of first-pass data at the region containing the definite NP revealed an interaction between the two experimental factors that was significant only in the analysis by participants ($F1(1, 31) = 4.486$, $p<.05$; $F2 <1$). Simple effects analysis revealed that for sentences contining unspecific objects, first-pass reading times were longer when the verb was *extensional* rather than intensional, while for sentences contining specific objects there were no differences. The lack of significance in the analysis by materials, however, prevents us from generalizing this result over items (Clark, 1973). The analysis of second-pass times in the final region of the target sentence produced a main effect of object-type, which was significant by participants, and marginally significant by items ($F1(1, 31) = 5.532$, $p < .05$; $F2(1, 31) = 2.918$, $p < .1$), with longer re-reading times when the first sentence contained a specific object than an unspecific one. No other main effects or interactions were revealed in the second-pass measure.

To summarize, the experimental manipulation did not produce any main effect or interactions that could be interpreted as supporting bridging or antecedent reanalysis hypothesis. First-pass data at the definite NP, although not significant in the analysis by items, could be interpreted as an example of the 'repeated name penalty', according to which the use of a repeated NP to refer to an highly accessible referent results in more demanding integration processes (Almor 1999). The main effect of object type in second-pass reading times at the post anaphoric region appears to be unrelated to bridging or reanalysis processes as well. Thus, the question arises as to whether reference processes are affected by intensional contexts and, if so, how. The following section discusses the results with respect to a new theoretical development outlined in Frazier (2008). It will be argued that Frazier's account provides new insight into how intensional contexts affect reference processes in discourse comprehension and, more important, predicts the kind of results here reported.

4 The role of intensionality during discourse processing

The results from both Experiment 1 and Experiment 2 do not support previous accounts of reference processes in intensional contexts. The processing cost associated with sentences containing definites whose potential antecedents are indefinite NPs embedded in intensional contexts- a cost reported by both Haviland & Clark (1974) and Dwivedi et al. (2005)- has not been replicated in the present experiments. This null result, however, does not imply that intensional contexts do not affect reference processes during discourse comprehension. The previous experimental investigation on this topic, in my view, suffers from a key problem: too little attention has been paid to the processing of intensional contexts.

It has been argued, both in theoretical and empirical research, that sentences containing modal and intensional operators carry a negative presupposition (Roberts, 1996) or, in Frazier's (2008) terminology, a 'non-actuality implicature'. A sentence like *A trip should be planned for August,* for example, implies that a trip has not already been planned. Similarly, a sentence like *John is looking for a horse* implies that John has not already found one. Following Frazier's account, in this latter example, the non-actuality implicature can be represented as in (9), where Wo stands for the actual world:

(9) Wo: NOT (John finds a horse)

In this example, the implied contrast between the actual world and the asserted content may implicitly focus the content of a certain goal state that, if it was achieved, would be represented as the proposition that [*John finds a horse*]. Thus, non-actuality implicatures make salient a certain goal state that, crucially, may influence processing of subsequent elided constituents. In other words, "non actuality implicatures serve as a focusing device, guiding the processor to, *seemingly effortlessly*, build just the structure/interpretation required for elided constituents with flawed antecedents" (Frazier, 2008; p. 26, the italic is mine).

To illustrate the relevance of this prediction for our topic of research, suppose that the interpretation of a sentence pair such as (10a) requires the accommodation of an implicit restrictor for the definite NP, as illustrated in (10b):

(10) a. Mary wanted a horse for her birthday. The horse was her favourite present.

b. Mary wanted a horse for her birthday. The horse <u>*that she got*</u> was her favourite present.

The content of the implicit restrictor can be easily reconstructed from the non-actuality implicature carried by the context sentence (*i.e., Mary does not have an horse in the actual world*). Such implicature makes salient the goal state achieved when Mary *gets* a horse for her birthday. The content of this goal state can act as antecedent for the implicit restrictor that should be reconstruct to interpret the definite NP in the continuation sentence. The consequence for a theory of processing is that the non-actuality implicature hypothesis predicts that sentences such as those investigated in the experiments reported here are likely to be processed at no cost. In other words, the non-actuality implicature hypthesis predicts the kind of results we have found.

It remains to be explained the discrepancy between our results and those reported in the literature, particularly in Haviland & Clark (1974). One possible explanation lies in the materials used the experiments. Haviland & Clark reported only two examples of their experimental materials which, crucially, differ in the presence of a non-actuality implicature. In the first one, (a) *Ed wanted an alligator for his birthday. The alligator was his favourite present,* the context sentence implies that Ed did not have an alligator, thereby providing a salient antecedent for the definite NP. In the second one, (b) *Andrew was especially fond of beer. The beer was warm*, the context sentence does not carry a non-actuality implicature and, consequently, there is no salient goal state that can guide the reader to build an interpretation for the second sentence. As a result, the second sentence of (b) should elicit a cost, either because the reader needs to build from scratch a bridge between the two sentences, or because the bridge is even impossible to build. Since Haviland & Clark's list of materials is no longer available, we are not able to ascertain how many items were like (a) and how many like (b).

To conclude, although Frazier's account requires further investigation, what it seems to suggest is that, contrary to what has been argued in the literature, intensional contexts affect reference processes by facilitating, under certain circumstances, the recover of a coherent text representation. As a consequence, the experimental investigation of reference processes in intensional contexts cannot disregard how intensional contexts are actually processed and understood. Further investigation should take into careful consideration the semantic and pragmatic properties of intensional contexts and their influence on online sentence and discourse processing.

5 Conclusion

I have argued that the results from the studies reported here do not support previous accounts of reference processes in intensional contexts according to which comprehenders undertake costly inferential or revision processes to recover coherent text representations. The results, however, are consistent with a recent view developed by Frazier (2008), according to which non-actuality implicatures triggered by intensional contexts can guide comprehenders to effortlessly reconstruct coherent text representations. The crucial implication for future research on this topic is that the investigation of how intensionality affects discourse processing cannot disregard a detailed study of the online processing of intensional constructions.

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Metalinguistic Comparatives in Greek and Korean: Attitude Semantics and Expressive Content

Anastasia Giannakidou
Dept. of Linguistics
University of Chicago

giannaki@uchicago.edu

Suwon Yoon
Dept. of Linguistics
University of Chicago

suwon@uchicago.edu

Abstract

In this paper, we present a parallel between Greek and Korean in metalinguistic comparatives (MCs), and propose an analysis for both languages that combines an *attitudinal* semantics (building on Giannakidou and Stavrou 2008) with *expressive* meaning. The comparative morpheme supplies the former, and the *than*-particle supplies the latter. We discuss also data from Korean showing a two way distinction between "regular" MCs, and *antiveridical* MCs.We argue that the use of MC *than* particles, in all variants, brings about an individual's emotive state, and propose that the morphemes contain expressive indices in the sense of Potts 2007. Our analysis has two implications: first, it allows the hypothesis that *all* metalinguistic functions in language are indeed part of the grammar in the particular way formulated here; second, our use of expressive indices supports Potts's view of the expressive component as separate, but interacting, with the descriptive content: the *than* particle is not vacuous, but the place where descriptive and expressive meaning interact.

1 **Introduction**: metalinguistic comparative in English and Greek

Metalinguistic comparatives (MCs) are a topic that remained largely unexplored in the literature on comparatives. With the exception of very brief discussions (McCawley 1968, Bresnan 1973, Embick 2007), until recently very few works addressed the question of how MCs differ, if at all, from 'regular' comparisons of degrees. MCs were easy to think of as just non-canonical uses of regular comparatives, just like with metalinguistic negation (Horn 1989).

In a recent paper, Giannakidou and Stavrou (GS) argue that MCs in Greek are indeed grammatical creatures, with a syntax and semantics distinct from that of regular comparatives. In Greek, MCs are realized with the preposition *para* 'than', which is lexically distinct, as we see, from the regular clausal comparative *apoti:*

(1)

Ta provlimata	su	in	perissotero	ikonomika	**para**	nomika.
the problems	yours	are	more	financial	than	legal

‘Your problems are financial more than legal.’
‘Your problems are financial **rather** than legal.’

(2)

O Pavlos	ine	perissotero	filologhos	{**<u>para/apoti</u>**}	glossologhos.
the Paul	is-3s	more	philologist	than	linguist

‘Paul is more of a philologist than he is a linguist.’
“Paul is a philologist **rather** than a linguist.”

Para comparatives have the meaning of metalinguistic comparison, reinforced in English with the order reversal between *financial* and *more*, which is only allowed in MC, and the use of *rather.* The sentence in (1) is intended to convey that the speaker believes it is more appropriate to say that the addressee’s problems are financial, than that they are legal; likewise, (2) conveys that the speaker believes that the proposition “Paul is philologist” is more appropriate than the proposition “John is a linguist”.

Using *para* is optional mostly, but when *para* is used, the sentence is not simply a variant of the *apoti* comparative. Sentences with *para* are more emphatic, expressing disapproval or dispreference towards the *than* part. The use of *rather* in English, likewise, conveys some kind of emphatic dispreference too, and implies that the speaker believes John to be not a good linguist.

In this paper, we maintain that the lexicalization of MC observed in Greek is not an accident—Korean too, we show, exhibits a MC *than* like *para*: *kipota*. Strikingly, Korean lexicalizes additionally a “negative” comparative morpheme, *charari*, the analysis of which, we will argue, carries over to *rather.* The discussion proceeds as follows. First, in section 2 we present the properties of *para* and *kipota* comparatives which render them distinct from regular comparisons. In section 3, we give an attitudinal semantics for MCs, and in section 4, we further identify *charari* as an antiveridical (i.e. negative) version of MC. In section 5, we augment the attitudinal semantics with expressive indices (Potts 2007) that range over a negative interval. This is the contribution of the *than*-particles. We conclude with brief comments on NPI licensing—which we discuss more thoroughly in Giannakidou and Yoon 2008).

2 Metalinguistic Comparatives in Greek and Korean

In this section we summarize the properties of MCs following GS. In particular, the *than*-clause in the MC is clausal, and that it has undergone ellipsis (in the sense of Merchant 2006). In the literature on Greek comparatives (Stavrou 1982, Merchant 2006), two types are distinguished: a **clausal** one, introduced by *apoti* “than.wh” (with a variant *aposo* for amounts), and a **phrasal** one, introduced with *apo*. The *para* clause is a variant of the *apoti* syntactically.

Regarding the comparison forms used, in Greek, two types are distinguished: (a) a **synthetic** form, based on the bound morpheme *-(o)ter-* attached to the adjectival stem and followed by the inflectional affix, and (b) two **analytic** forms consisting of the free morphemes *pjo* or *perissotero* 'more' followed by the adjective:

(3) I Kiki ine psil<u>oter</u>i <u>apoti</u> i Ariadhni.
the Kiki is taller than the.nom Ariadne

(4) I Kiki ine <u>{pjo/perissotero}</u> psili <u>apoti</u> i Ariadhni.
the Kiki is more tall than the.nom Ariadne
'Kiki is more tall than Ariadne.'

(5) I Kiki pezi kithara kalitera apoti i Ariadhni.
the Kiki plays guitar better the.nom Ariadne
'Kiki plays the guitar better than Ariadne.'

With *para*, the degree adverbial is usually the synthetic of the adverb *poli* 'much'—*perissotero*—, but it can also be *pjo* 'more', the base adverb *poli*, and quite often *kalitera* 'better'. *Kalitera* comparatives sound a bit more emphatic and "negative", as we see later. The *para* remnant can belong to various syntactic categories:

(6) Perissotero xazevi <u>para</u> dhjavazi. (TP)
more is goofing off than studying
'He is goofing off rather than studying.'
['It is more accurate to say that "he is goofing off" than to say that "he is studying".']

(7) Kalitera na se dino para na se taizo!
better to you dress than to you feed
'I would rather clothe you than feed you.'
[= It costs me more to feed you than to clothe you—i.e., you eat a lot!]

Korean employs *pota* for both clausal and phrasal comparative (for diagnostoc of the prepositional use of *pota* see Giannakidou and Yoon 2008). In the clausal comparative *pota* is a complementizer, preceded by a free-relative clause marker *kes*.

(8) Kim-un [Lee-ka khun-<u>kes</u>]-<u>pota</u> (te) khu-ta. (clausal)
he-Top [Lee-Nom tall-FRel]-than more tall-Decl
'Kim is taller than Lee is tall.'

The comparative predicates (*taller*) are formed in free variation with or without the comparative modifier *te* (*more*) in Korean regular comparative, just like the Greek analytic form (the synthetic form is unavailable in Korean). Hence, we assume that the *pota* clause contains an operator yielding an ordering relation between two degrees of properties, following the standard semantic analysis (von Stechow 1984; Kennedy 1997; Heim 2000 among others).

In parallel to Greek, MCs are also lexically marked in Korean: by *kipota:*

(9) Kim-un enehakca-**la**-<u>kipota</u> chelhakca-i-ta. (N)
Kim-Top linguist-Decl-saying.than philosopher-be-Decl
'Kim is more of a philosopher than he is a linguist.'

(10) Ku-nun kongpwuhan-**ta**-<u>kipota</u> nolkoiss-ta. (TP)
he-Top studying-Decl-saying.than goofing off-Decl
'It is more accurate to say that "he is goofing off" than to say that "he is studying".'

Importantly, clause types in Korean are distinguished by the use of sentence-ending illocutionary force markers such as interrogative *ni*, exclamative *ela*, and declarative marker *la* or *ta*. Since the role of these markers is to indicate the communicative purpose of a *sentence*, they only attach to a "propositional" content rather than a predicate. For instance, even when the declarative *ta* is attached to an apparent noun form as in *Sue-ta* (Sue-Decl), it is interpreted as 'It is Sue' rather than 'Sue'. (This is unsurprising considering that Korean is a pro-drop language and the expletive subject 'it' is only optional.) Our *kipota* comparatives, as we see, are accompanied by *la* or *ta*, which mark them formally as clausal.

With this basic background, we can now proceed to show how *para* and *kipota* comparatives differ from regular comparatives in Greek and Korean.

2.1 *Para* and *Kipota* do not express "regular" comparison

Consider the simplest case of predicative comparative:

(11) * I Kiki ine pjo psili para i Ariadhni.
the Kiki is more tall than the Ariadne
[Intended: 'Kiki is taller than Ariadne.']

(12) Kim-un Lee-{*<u>kipota/pota}</u> khu-ta.
Kim-Top Lee-saying.than/than tall-Decl
(Intended: Kim is taller than Lee.)

These sentences cannot be used to convey that the degree to which Kiki/Kim is tall is greater than the degree to which Ariadne/Lee is tall. The impossibility of *para* and *kipota* as predicative comparatives suggests that there is no degree abstraction of the regular kind in the *para*-clause.

2.2 Incompatibility with the synthetic comparative

Para is not compatible with the synthetic form of the comparative adjective or adverb:

(13) *O Pavlos ine eksipnoteros para erghatikos.
'#Paul is smarter than he is industrious.'

The same effect has been observed for MCs in English (McCawley 1988, Embick 2007 and references). Again, this suggests a deviation of the *para*-clause from the regular comparative in terms of routine degree abstraction. In Korean, as we noted earlier, synthetic comparatives are unavailable, but the difference arises in terms of the availability of *te* ("more"). While *te* is totally optional in regular *pota* comparatives, *kipota* is incompatible with it:

(14) * Lee-nun pwucirenha-ta-<u>kipota</u> **te** ttokttokha-ta.
Lee -Top industrious-Decl-saying.than more smart-Decl
'Lee is clever more/rather than industrious.'

2.3 No *para* or *kipota* in comparison of deviation

Para is not possible in a comparative of deviation:

(15) I Mesoghios ine pjo vathia {<u>apoti</u>/*<u>para</u>} i Adhriatiki ine rixi.
the Mediterranean Sea is more deep than the Adriatic is shallow.
'The Mediterranean Sea is deeper than the Adriatic is shallow.'

The impossibility of *para* here is another manifestation of the general inability of this type of comparative to express regular degree comparison. These structures also tell us that the *para* remnant must contain one term only, not more, as is the case here where two pairs are compared: the Adriatic and Mediterranean, and the predicates *deep* and *shallow*. Korean *kipota* follows the Greek pattern:

(16) * Cicwunghay-nun aduriahay-ka nac-<u>kipota</u> kip-ta.
Mediterranean-Top Adriatic-Nom shallow-saying.than deep-Decl
'The Mediterranean Sea is deep more than the Adriatic is shallow.'

2.4 Comparative float

The comparative morpheme *perissotero* can "float": it can precede or follow the contrasted constituent, and can also appear sentence-initially. In regular comparatives it can only immediately precede the adjective, as we see:

(17) a. Ine (perissotero) eksipnos (<u>perissotero</u>) para erghatikos.
is (more) clever (more) than industrious
b. <u>Perissotero</u> ine eksipnos para erghatikos.
More is clever than industrious
He is clever more than he is industrious.

(18)	a.	??Perissotero	ine o Janis	eksipsnos	apoti i Maria.
		more	is the John	clever	than Maria
	b.	??O Janis ine	eksipsnos	perissotero	apoti i Maria.
		John is	clever	more	than Maria.
	c.	O Janis ine	perissotero eksipsnos		apoti i Maria.
		John is	more clever		than Maria.

Apoti is thus less flexible vis-à-vis adverb position, as we see. By contrast, the MORE adverbial can be positioned in various places when we have *para*. This flexibility of MORE with *para* encourages us to think of it as as a (sentential) adverb. We cannot apply this test to Korean because because *te* is incompatible with *kipota*.

2.5 Single remnant constraint

GS note that *para* comparatives contain only a single constituent. (This test cannot be applied to Korean.) Contrast the sentences below with *apoti* and *para*:

(19) a. Ghnorizo perissotero tin Elena <u>apoti</u> ghnorizo tin adherfi tis.
know-1sg more the Elena than know-1sg the sister hers
'I know Elena more than her sister.'
b. *Ghnorizo perissotero tin Elena <u>para</u> ghnorizo tin adherfi tis.

The verb in the *para* version must be omitted, but it need not in the *apoti* version; hence the ellipsis with *para* appears to be stricter than with *apoti.* A useful way of looking at this is to assume that it has to do with the *expressive* nature of *para*. It is helpful to note an observation by Potts and Roeper 2006 that some expressives—n *expressive small clauses*— are predicate bare, and disallow systematically the use of verbal functional elements:

(20) a. You fool!
b. *You a fool.
c. *You are fool.
d. You are a fool.

(The example in *d* is just a regular proposition.) According to Potts and Roeper, impoverished structure is part-and-parcel of the fact that expressives are generally very bad at combining directly with the material around them. As a result, they are either very minimal (like *a*, and the MC *para* clauses), or they are indifferent to what is around them (as in *'abso-fucking-lutely'*). If our analysis (to be fleshed out soon) that *para* contains expressive content is correct, then the predicate dropping can be understood as a typical behavior of the natural class *para* belongs to.

To conclude, we saw in this section Greek and Korean employ MC *than* markers that are lexically distinct from the *than*s used in regular clausal degree comparisons. This is an impressive fact, first, because Greek and Korean are genetically not related, and second, because if metalinguistic functions are just pragmatic, we don't expect systematic lexicalizations. We now turn to the semantics.

3 An attitude semantics for metalinguistic MORE

By choosing to use a comparative with *para*, the speaker expresses a disbelief or disapproval towards the *para*-proposition, and she believes the proposition expressed by the main clause to be more appropriate, desirable, or preferable. GS suggest that the MC must thus have an attitudinal component in it, and locate the attitude in metalinguistic MORE. We will rely here on this analysis, and define a metalinguistic MORE_{ML}, distinct from the "regular" MORE of the comparative, which contains a propositional attitude. This attitude is anchored to an individual (the *individual anchor* employed in the definition below); the anchor is typically the speaker:

(21) $[\![\text{MORE}_{\text{ML}}]\!] = \lambda p \lambda q \exists d[R(\alpha)(p)(d) \wedge d > \max(\lambda d'[R(\alpha)(q)(d')])]$ (GS: (40))
where R is a gradable propositional attitude supplied by the context: either an epistemic attitude such as belief; or an attitude expressing preference (desiderative or volitional); α is the individual anchor (see Farkas 1992; Giannakidou 1998) of the attitude.

Syntactically, MORE_{ML} is like a sentential adverb (recall its flexibility in positioning), and in the semantics, MORE_{ML} relates two propositions in terms of how much they are R-ed by the speaker α: the proposition expressed by the main clause *p,* and *q*, the proposition of the *para* clause. MORE_{ML} compares the two propositions in terms of the degree to which α believes them to be appropriate, prefers them, or is willing to assert them.[1] This individual is typically the speaker, as we said, and GS emphasize that the individual anchor is implicit (i.e., it is not syntactically present as an argument). This claim renders the individual anchor of the MC similar Lasersohn's 2005 *judge*, i.e. the

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[1] A brief final comment is in order here regarding the extension of the attitude semantics we propose to metalinguistic uses that do not prima facie appear to involve propositions, e.g.:

(i) Pio sixna leme "dear" para "darling".
(ii) More often we say "dear" than "darling".

Such cases are often discussed in connection to metalinguistic negation (Horn 1989)—and metalinguistic negation is known to negate various aspects of the sentence including pronunciation, words (as in the examples here), and at any rate non-propositional aspects of the sentence. We will take it that even in these cases a propositional attitude is expressed (see also GS's a analysis (section 6) of metalinguistic negation as a binary connective along this line). Recall that the propositional nature of the MC *than*-constituent is further evidenced in Korean by the use of the declarative marker *la* (or *ta*), which would be used even in cases like the ones here:

(iii)	Pothong	wuri-nun	"darling"-**la**-kipota	"dear"-**la**-ko	han-ta.
	normally	we-Top	"darling"-Decl-saying.than	"dear"-Decl-Comp	say-Decl

individual who is a parameter for the evaluation of predicates of personal taste and is only implicit; but the individual anchor expresses a parameter for evaluation that, unlike the judge, can be explicit – as is the case, e.g., of the embedded subject in mood choice and veridicality (Giannakidou 1998).

GS note that individuals other than the speaker may be plausible individual anchors; for instance, we can have a quantifier subject:

(22) Kathe fititis pistevi oti o Pavlos ine perissotero glossologhos *para* filologhos.
Every student believes that Pavlos is a linguist rather than a philologist.

Here, the individual anchor of comparison ranges over *every student*— a fact that is expected since we have overt embedding under a propositional attitude verb, which makes the embedded (in this case, quantificational) subject a possible anchor. These cases suggest that the notion of anchor is the one we need for MC, and not a judge (which tends to be implicit only).

A singular main clause subject can also serve as an anchor:

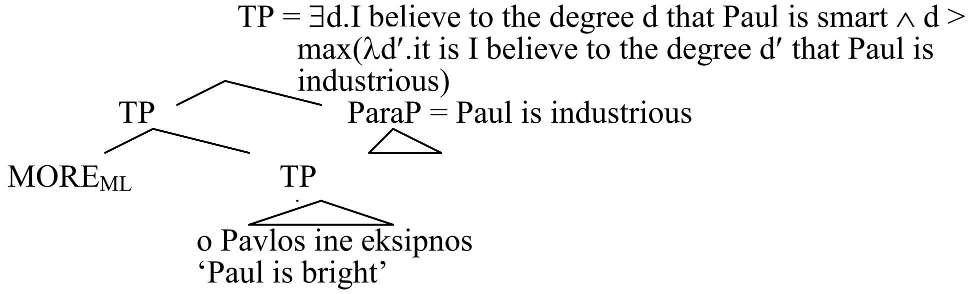
(23) I Maria pistevi oti o Janis ine perisotero eksipnos para ergatikos.
Mary believes that John is bright more than intelligent.

Here the MC can be anchored to the main clause subject, Maria, and need not be tied to the speaker only. This observation correlates with Lasersohn's (2008) that, although the judge is typically the speaker, occasionally judges can be third parties; and likewise, it is reminiscent of Potts's (2007) observation that expressive meaning, though typically anchored to the speaker, in embedding, may get associated with the embedded individual. In both accounts, these extraordinary associations of the anchor do not threaten the general validity of the claim that the anchor is typically the speaker. In our account, overt embedding under a propositional attitude makes additional anchors available, and there is no reason why these should not serve as appropriate evaluation parameters for the *para* clause.

This semantics captures the perspective dependence of MC, by putting all the action in the comparative morpheme (no attitude is argued to be syntactically present):

(24) O Pavlos ine perissotero eksipnos para erghatikos.
Paul is bright more than he is industrious.

(25)



The structure of the *para* clause in particular is given in (38):

(26) ParaP = para ~~o Pavlos ine~~ erghatikos 'than ~~Paul is~~ industrious'

P FP
para AP_F
erghatikos F[E] <TP>
'industrious' [uFoc*] <O Pavlos ine t>

We see that we have ellipsis of the TP in the *para* clause, consistent with the fact that clausal comparatives involve TP ellipsis in Greek.

If MORE_{ML} gives attitude semantics, what is the contribution of *para* and *kipota*? So far, no special role is assigned to *para* (and likewise *kipota*), apart from being selected by MORE_{ML}. In section 5 we address the role of the particles themselves; but before we do so, we want to identify next a more "negative" version of MORE_{ML} that is lexicalized in Korean.

4 Antiveridical metalinguistic comparatives in Korean

We claimed so far that the *kipota*-clause is like a *para*-clause: it introduces the second argument of MORE_{ML}. In Korean, there is no overt comparative morpheme, so we will hypothesize that MORE_{ML} is there abstractly. At this point we would like to bring into the discussion the case of *nuni. Kipota*, just like Greek *para*, is emphatic and expresses dispreference towards the proposition it embeds—but this dispreference does not imply negation in the clause. If one wants to express a completely negative stance, *nuni* will be used with *charari*, which is equivalent to *rather* below:

(27) Ku-wa kyelhonha-nuni (charari) nay-ka cwukkeyss-ta.
him-Dat marry-rather than rather I-Nom die-Decl
'I would rather die than marry him.'

(28) It is not preferable for me that I marry him and it is more preferable that I die.

As paraphrased here, the combination of *charari* and *nuni* brings about a completely negative attitude: the speaker's strong unwillingness to accept the first proposition (that I marry him) by juxtaposing itself with another dispreferred proposition (that I die). This latter proposition is obviously also dispreferred under normal circumstances, but *in the context,* it appears as more preferable than the *nuni*-clause.

In Greek, the effect of *nuni* and *charari* is achieved with *para* and *kalitera.* But notice that in this case, the use of *apoti* is excluded:

(29) Kalitera na pethano {para/*apoti} na ton pandrefto!
I would rather die than marry him!

The fact that in Greek *apoti* is excluded suggests that we are dealing here with a qualitatively different comparison from regular MC, where *apoti* and *para* are generally interchangeable.

We will assume here that *charari* entails some kind of negation, though it is not itself morphologically negative. We define *charari* below as the negative variant of $\mathrm{MORE_{ML}}$ which imposes a total dispreference of the *q* argument, i.e. the proposition supplied by the *nuni*-clause. The negative component is added as a third conjunct in the underlined part in the formula in below:

(30) Antiveridical $\mathrm{MORE_{ML}}$ (Neg-$\mathrm{MORE_{ML}}$)
$[\![\text{charari}]\!] = \lambda p \lambda q \exists d[R(\alpha)(p)(d) \wedge d > \max(\lambda d'[R(\alpha)(q)(d')]) \wedge \underline{\max(\lambda d'[R(\alpha)(q)(d')]) = 0})]$
where R is a gradable attitude provided by the context, expressing preference (desiderative or volitional); α is the individual anchor of the attitude.

This definition renders *charari* a $\mathrm{MORE_{ML}}$ that asserts zero preference of *q* by the speaker. Zero preference will render *charari* antiveridical (though not strictly speaking negative, since there is no negation). Antiveridicality alone is sufficient to license NPIs, as is shown in Giannakidou and Yoon (2008). Greek *para* is obviously compatible with the Neg-$\mathrm{MORE_{ML}}$ meaning, and indeed in cases like (42) only this meaning is triggered. However, we cannot posit a covert Neg-$\mathrm{MORE_{ML}}$ in this case because the *para*-clause generally does not license NPIs that need antiveridical licenser—unlike the *charari* (Giannakidou and Yoon 2008).

We have evidence, then, from Korean, Greek, and English that, when lexicalized, MC affects two positions: the comparative morpheme itself ($\mathrm{MORE_{ML}}$, or Neg-$\mathrm{MORE_{ML}}$), and the *than-* position. We find distinct lexicalizations in either or both positions, as we saw. We gave an attitude semantics for two variants of $\mathrm{MORE_{ML}}$, and we are now finally ready to consider the contribution of the particle.

5 The expressive dimension of MC

When a speaker chooses to use *para, kipota* and *nuni,* the utterance becomes emphatic. The lexical choice is thus not redundant, or a mere reflex of syntactic selection, but rather a reflection of the speaker's emotive stance. MC particles, we suggest, add the speaker's heightened emotional perspective— a property typical of the class of expressive expressions such as *damn* and *bastard*, studied in Potts (2005, 2007).

The hallmark property of expressives is that when uttered, they have "an immediate and powerful impact on the context" (Potts 2007: 1). Almost invariably, "a speaker's expressives indicate that she is in a heightened emotional state. They can tell us if she is angry or elated, frustrated or at ease, powerful or subordinated" (Potts 2007: 8). Potts call this property *perspective dependence,* and MCs exhibit this property clearly. Before offering our specifics of the idea that MC particles contain expressive content, we would like to elaborate just a little bit more on the properties of the particles that we believe render them expressives. We are using here the typical properties of expressives we find in Potts (2007).

Independence. Expressive content contributes a dimension of meaning that is separated from the regular descriptive content:

(31) That bastard Kresge is famous.

This sentence asserts that Kresge is famous (descriptive meaning), and it also conveys that "Kresge is a bastard in the speaker's opinion" (expressive meaning). One can accept the assertion as truthful without also accepting the characterization of Kresge as "bastard". Potts argues that "the expressive and descriptive meanings that a sentence can convey should not be combined in single unit" (Potts 2007: 3), but also that "some expressive meanings act as bridges between the two realms, by mapping descriptive content to expressive content". This is exactly how we envision the function of the MC particles.

Nondisplacebility, ineffability. Expressives always tell us something about the utterance situation itself, and cannot be used to report on past events, attitudes or emotions (Potts 2007: 5). This is what we find typically with MC particles:

(32) Kalitera na pethano **para** na ton pandrefto!
I would rather die than marry him!

(33) Ku-wa kyelhonha-**nuni** (**charari**) nay-ka cwukkeyss-ta.
him-Dat marry-rather than rather I-Nom die-Decl
I would rather die than marry him'.

These sentences can only be understood with the possibility of undesired marriage as very imminent.

Structural isolates. Potts, and Potts and Roeper 2006 argue that expressives tend to not connect with the linguistic material around them, they are in this sense isolates: e.g. *'abso-fucking-lutely'.* This property is certainly consistent with the predicate dropping and restriction to one remnant that we observed earlier with *para* clauses, as well as the fact that all metalinguistic particles are incompatible with the synthetic forms of the adjective. They exhibit in this case a discontinuity that can be seen as a manifestation of their expressive nature.

Expressive indices. Expressive indices are the main objects manipulated by expressive denotations. We are not going to elaborate on the whole system here, but we go directly to the definition that Potts offers (Potts 2007: (37)):

(34) An expressive index is a triple $<a \mathbf{I} b>$, where $a,b \in D_e$ and $\mathbf{I} \in [-1, 1]$.

Expressive indices are the foundation for expressive domains, and are contained in expressives such as *damn.* These indices encode the degree of expressivity as well as the orientation of the expressive, and they are defined via numerical intervals $\mathbf{I} \subseteq [-1, 1]$. We can read $<a \mathbf{I} b>$ as conveying that individual *a* is at expressive level **I** for an individual *b*. Mapping emotional stance onto expressive intervals has the advantage of allowing flexibility from very neutral (if **I** = [-1, 1])—in Potts's words, "*a* has no feelings for *b*"—to very negative. Emotive relations emerge as we narrow down **I** to proper subintervals of [-1, 1]; the more positive the numbers, the more positive the expressive relationship, and conversely. For example:

(35) a. <⟦tom⟧ **[-.5, 0]** ⟦jerry⟧>: Tom feels negatively toward Jerry
b. <⟦ali⟧ **[-.8, 1]** ⟦jerry⟧>: Ali feels essentially indifferent to Jerry
c. <⟦kevin⟧ **[0, 1]** ⟦jerry⟧>: Kevin is wild about Jerry

Expressive indices are just entities—this explains why they are not amenable to paraphrases (ineffability), but they have propositional implications: we see that from objects like <[[tom]] **[-.5, 0]** [[jerry]]> we tend to infer propositions, in this case that *Tom feels negatively toward Jerry.* Importantly, the indices are built by relating two individuals by means of **I**; in our case, however, we will need to express the fact that an individual stands in an emotive relation to a proposition.

We noted that the emotional state is not constant across MCs, but ranges from mildly negative (*para*, *kipota*), to negative (*nuni*); we thus argue that *para, kipota*, and *nuni* contain expressive indices. We thus claim that the particles contain expressive relations between an individual and a *proposition,* and this is our innovation on Potts:

(36) *Expressive indices of metalinguistic comparative complementizers*
Nuni, *kipota* and *para* contain expressive indexes <a **I** *q*>, where a is the individual anchor, *q* the proposition they embed, and **I** $\subseteq$ [-1, 0].

Para/ kipota's index ranges through the negative interval, at most approaching zero:

(37) a. *para/kipota*: <t, ε> : para/kipota combine descriptive content *t (*the type of propositions) and expressive content ε.
b. ⟦para/kipota⟧c : λp.p (identity function); c is the context
c. Expressive content of *para/kipota* in c:
Para/kipota contain an expressive index <a **I** *q*>, where a is the individual anchor, *q* the proposition they embed; and **I** ranges between [-1, 0].

With *nuni* we have an even narrower interval: the length of I cannot range more than -.5. This is the very negative part of the interval:

(38) a. nuni: <t, ε>
b. ⟦nuni⟧^{c} =λp.p (identity function); c is the context
c. Expressive content of *nuni* in c:
Nuni contains an expressive index <a **I** *q*>, where a is the individual anchor, *q* the proposition it embeds; and **I** ranges between [-1, -.5].

What is important is to note here is that the semantic (in the sense of truth conditional) content and the expressive remain independent: truth-conditionally *para/kipota* and *nuni* are mappings from propositions to propositions. The negative interval that they contribute in their index is *not* going to affect their truth conditional meaning—i.e. will not render them negative in the sense of antiveridical (Giannakidou 1998). In other words, a negative emotive stance to a proposition does not imply negating that proposition. This means that expressive force alone does not suffice to license NPIs:

(39) * That bastard Kresge said anything!

(40) *Kalitera na mino siopili, para na po KOUVENDA!
I'd rather be silent than say a word.

(41) * Na-nun [kuren-saramtul **amwuto** manna-**nuni**] cipey issko sip-ta.
I-Top such-people anyone meet-rather.than home be want-Decl
'I would rather stay home than meet anyone among such a crowd.'

We see here that the negative expressive force of *bastard* does not suffice to license *any;* and in Korean and Greek, minimizers (which are strong NPIs and need an antiveridical licenser) are simply ungrammatical in *para* and *nuni* clauses. The negativity that comes the expressive intervals is *not* part of the descriptive content, where truth conditions are calculated. Improvement happens only if we add *charari* because it is antiveridical, as we argued earlier:

(42) Na-nun [kuren-saramtul **amwuto** manna-**nuni**] **charari** cipey issko sip-ta.
I-Top such-people n-person meet-rather.than **rather** home be want-Decl
'I would rather stay home than meet anyone among such a crowd.'

More on NPIs in Giannakidou and Yoon 2008. Here, it is important to emphasize that when we posit negative expressive force in the particles, we do not render them equivalent to negation.

5 Conclusion

In sum, our analysis claims that MC has two components: an attitudinal semantics, which is hosted in the comparative morpheme, and an expressive component that is manifested in the choice of *than*-particle. By embedding MC morphemes into the realm of expressives, our analysis achieves a natural coverage of at least this kind of metalinguistic interaction, and allows the hypothesis that perhaps *all* metalinguistic functions in language are combinations of attitudinal semantics and expressivity.

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Sentence-types, Discourse Particles and Intonation in Hungarian

Beáta Gyuris
Research Institute for Linguistics
Hungarian Academy of Sciences

gyuris@nytud.hu

Abstract

The paper looks at the Hungarian particle *ugye*, which has traditionally been classified as an interrogative particle but can also legitimately appear in declarative sentences in present-day Hungarian, and explores the possibility of assigning it a core interpretation that covers all of its uses and attributing apparent remaining differences between its meanings in the various sentence-types to intonation.

1 Introduction

The aim of the paper is to characterise the interpretation of the Hungarian particle *ugye*, which can equally appear in utterances having the force of a question or that of an assertion. (1-b), pronounced with the intonation shown in Figure 1, can be uttered in order to provide a felicitous answer to a question like (1-a), whereas the string-identical (2-a), pronounced with the intonation pattern shown in Figure 2, can be used to ask a question.[1]

(1) a. Why is Thomas so upset?
b. Mari Jánost léptette ugye elő.
Mary John.ACC promoted PRT VM
'As you know, Mary has promoted John.'[2]

(2) a. Mari Jánost léptette ugye elő?
Mary John.ACC promoted PRT VM
'Mary has promoted John, hasn't she?'
b. Yes, she has.

Given the lack of substantial evidence for assuming that the syntactic structures of the string-identical (1-b) and (2-a) should be different (cf. É. Kiss (2002)), it seems to

[1]Note, importantly, that the contribution of *ugye* to the sentences intended as assertions and as questions must be translated differently into English. The particular choices made will be motivated later on.

[2]The abbreviation 'VM' stands for *verbal modifier*.

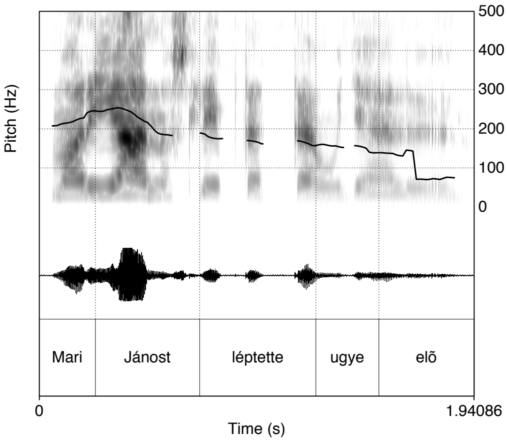

Figure 1: Intonation of (1-b)

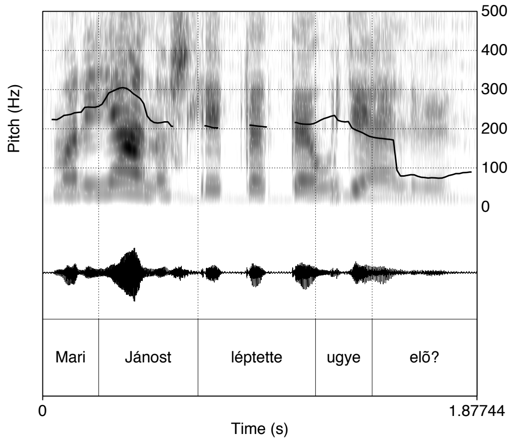

Figure 2: Intonation of (2-a)

be a reasonable assumption that their different functions in the dialogues above should be attributed to their different intonational contours.

The above strategy runs into two difficulties, however. First, the differences between the intonations of (1-b) and (2-a) do not mirror those between 'ordinary' declarative sentences and their string-identical polar interrogative counterparts in Hungarian. According to the standard view (cf. Fónagy and Magdics (1967), Kornai and Kálmán (1988), Rosenthall (1992), among others), Hungarian declaratives are pronounced with a falling contour, whereas polar interrogatives bear a charactertistic rise-fall on their penultimate syllable. Figures 3–4[3] illustrate the standard intonation of declarative and polar interrogative sentences without *ugye*, examples of which are shown in (3) and (4):

(3) Mari Jánost léptette elő.
Mary John.ACC promoted VM
'Mary has promoted John.'

(4) Mari Jánost léptette elő?
Mary John.ACC promoted VM
'Has Mary promoted John?'

(5) and (7) below, pronounced the way indicated in Figures 5 and 7, would both be substitutable for (1-b) in (1), as would (6) and (8), having the prosody indicated in Figures 6 and 8, be substitutable for (2-a) in (2).

(5) Mari ugye Jánost léptette elő.

(6) Mari ugye Jánost léptette elő?

(7) Mari Jánost léptette elő, ugye.

[3]The ToBI labeling of these examples closely follows the suggestions made by Rosenthall (1992) for analogous cases. Due to the lack of consensus concerning the appropriate representation of the system of Hungarian intonation in the ToBI framework (cf. Pierrehumbert (1980)), I have refrained from providing any labels for the rest of the examples, though.

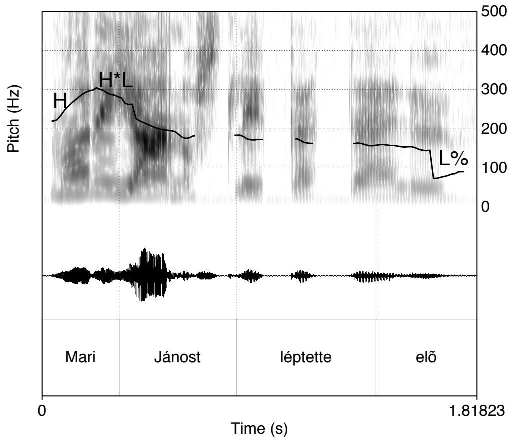

Figure 3: Intonation of (3)

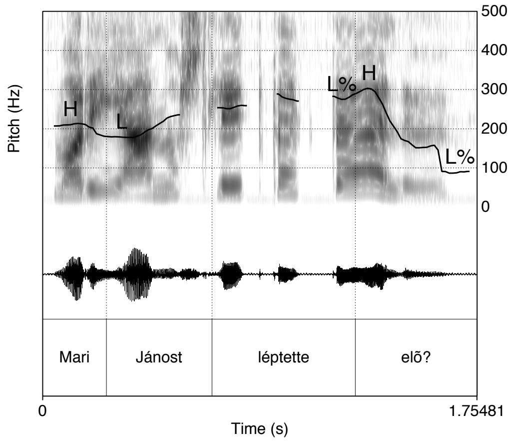

Figure 4: Intonation of (4)

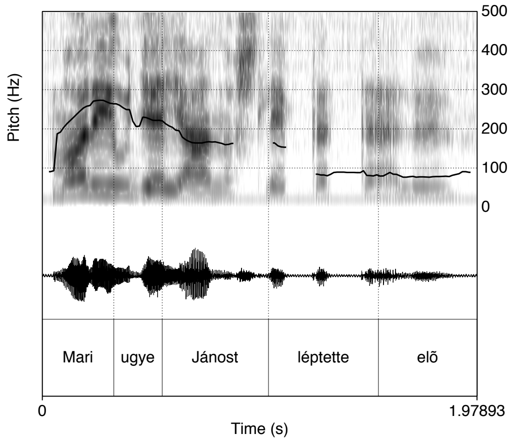

Figure 5: Intonation of (5)

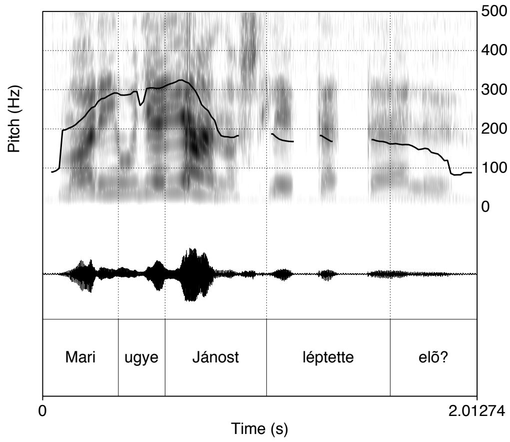

Figure 6: Intonation of (6)

(8) Mari Jánost léptette elő, ugye?

Figures 1-2 and 7-8 show that sentences with postverbal *ugye* that are intended to express questions differ from those intended to express assertions in that the former has a rise-fall pitch, analogous to the final rise-fall of ordinary interrogatives, falling exactly on the bisyllabic particle (cf. Figure 4 above), whereas the prosody of the latter does not differ from that of ordinary declaratives, cf. Figure 3. There is no rise-fall contour on the particle in sentences where it precedes an immediately preverbal pitch-accented focus constituent, but the prosodic difference between sentences of this type intended as questions, as shown in Figure 6 and assertions, in Figure 5, is still apparent.

In the rest of the paper, when we talk about declarative sentences containing *ugye* (ending in a period), we will mean those with a prosodic pattern analogous to that shown in Figures 1, 5 or 7. A question mark at the end of an *ugye*-sentence will indicate that its prosodic pattern is assumed to be analogous to those shown in Figures 2, 6 or 8.

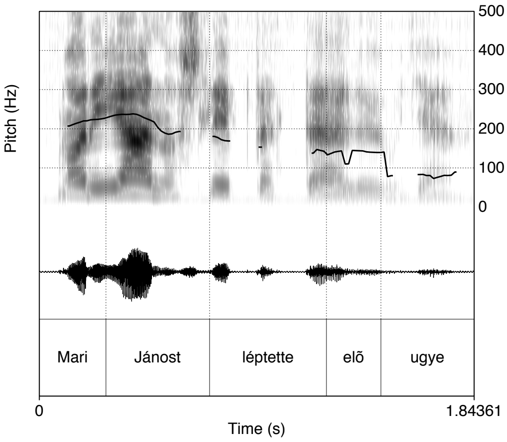

Figure 7: Intonation of (7)

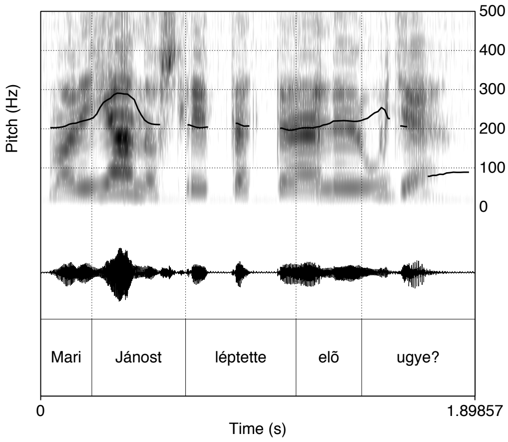

Figure 8: Intonation of (8)

The second difficulty in the way of providing a unified semantic interpretation for the particle is that sentence-internal *ugye* is traditionally viewed in the Hungarian literature as an interrogative particle, that is, as a sufficient means of creating the (form) type of interrogative sentences. (References include H. Molnár (1968), Kugler (1998)[4], Keszler (2000).)

The latter view is most certainly due to the (still transparent) etymology of the particle, according to which it is the result of composing the adverb *úgy* ‘so’ with the interrogative particle *-e*, which resulted in the interpretation ‘is that so?’. The occurrence of *ugye* in sentences that satisfy the criteria of the declarative form type (discussed below) is a relatively new phenomenon (first attested in 1923 according to Benkő (1995)), although quite a pervasive one (in spite of being under great attack by normative linguists).

In the rest of the paper, I wish to explore the possibilities for proposing an interpretation for sentences like (1-b) and (2-a) compositionally, by assuming a unique interpretation for the particle in both sentence-types, and attributing the difference in their illocutionary force potentials to their different intonation patterns. Section 2 looks at the use of the particle in what formally appear to be declarative sentences, and compares it to those of two German particles, whereas Section 3 is concerned with its use in sentences that have traditionally been classified as polar interrogatives. Section 4 describes two proposals for capturing the interpretation of the particle in a way that accounts for both of its usage patterns. The paper closes with the conclusions in Section 5.

2 *Ugye* in declaratives

The only work so far where the use of *ugye* in declaratives has been looked at is Péteri (2002), which argues that *ugye* has an interpretation there that is relatively similar to that of German (unaccented) *ja*. He characterises the difference between the two by saying

[4]Kugler (1998) mentions, however, that *ugye* also has a so-called *shading particle* use.

that with German *ja* the speaker only reminds the hearer of their common knowledge base, whereas with Hungarian *ugye* she also expresses the expectation that the hearer will agree with the propositional content of the sentence. Given the latter proposal, it seems reasonable that the search for the interpretation of *ugye* in declaratives should start with comparing its distribution to that of German *ja*, which seems to be well-described in the literature.

According to Zimmermann (to appear), adding *ja* to a sentence with a propositional content *p* indicates that the speaker considers *p* to be uncontroversial, that is, either being part of the common ground, or its truth being based on evidence that the speaker considers the addressee to be in possession of. The intended meaning of (9-a), containing *ja*, is adequately expressed in its Hungarian counterpart with the help of *ugye*, as shown in (9-b):

(9) *First brother to second brother:*

a. Morgen wird Mama ja siebzig
tomorrow turns mum PRT seventy
'Mum turns 70 tomorrow, y'know.' (from Zimmermann (to appear))

b. Anyu ugye holnap hetven éves lesz.
mother PRT tomorrow seventy years old be.3SG.FUT
'As you know, Mum turns 70 tomorrow.'

The following examples, however, point to some differences between the two:

(10) *S is climbing the stairs in front of W.*

a. W: Du hast ja 'n Loch im Ärmel.
you have PRT a hole in sleeve
'You've got a hole in your sleeve, you know.' (from Lindner (1991))

b. W: Van (#ugye) egy lyuk az ingeden.
be.3SG PRT one hole the shirt.your.on
'You've got a hole in your shirt.'

(11) A: Maria is also coming along.

a. B: Sie ist #ja verreist.
she is PRT left
'She has left.' (from Karagjosova (2004))

b. B: Nem, ő ugye elutazott.
no he/she PRT VM.left
'No, as you know, she left.'

On the one hand, the contrast between (10-a), which is compatible with a continuation of the form *Where?* on the part of the addressee, and the infelicitous (10-b) indicates that it is not enough for the licensing of *ugye* in an utterance that the speaker assumes that the addressee has enough evidence for judging the propositional content of the sentence to be true. On the other hand, the fact that (11-a) is infelicitous in the context indicated, whereas (11-b) could be felicitous if intended as a reminder shows that *ugye* is licensed if there is a way, according to the speaker, for the addressee to arrive at the truth of the proposition, given the information in the common ground. The asymmetries illustrated above indicate that the conditions for the felicitous use of *ugye* are not equivalent to those of German *ja*.

The fact that in the context of (11), the version of (11-a) with the particle *doch*, illustrated in (12-b), is as felicitous as (11-b), might suggest that *ugye* has an interpretation that is more similar to that of German unaccented *doch*.

(12) a. A: Maria is also coming along.
b. B: Sie ist doch verreist.
she is PRT left
'She has left.' (from Karagjosova (2004))

The parallel etymologies of *ugye* and *doch* support the same conclusion. According to Hentschel (1986) (cited in Zeevat and Karagjosova (2007)), German *doch* is of Indogermanic origin, and is composed of the demonstrative *to*, the question marker *–u* and an emphatic marker *h*, and could therefore paraphrased as *That?* or *Is that so?*

According to Zimmermann (to appear) (based on work by Lindner (1991)), the use of *doch* in a declarative with propositional content *p* indicates the speaker's assumption that the addressee is not aware of *p*, either because he has forgotten about it, or because he believes it to be false.

The above characterization for *doch* does not apply to *ugye*, however. On the one hand, as opposed to the case of (12-b), without the negative particle *nem* 'not', (11-b) cannot convey the interpretation that B's utterance contradicts that of A. On the other hand, the two utterances of B in (13-a) and (13-b) give rise to different effects:

(13) *Employee:* Shall I come to work tomorrow?
a. *Boss:* Du bist doch ernsthaft krank!
you are PRT seriously ill
'But you are seriously ill!'
b. *Boss:* Te ugye súlyos beteg vagy!
you PRT serious ill be.2SG
'But you are seriously ill, as we know!'

According to the assumptions about the interpretation of *doch* summarized above, Boss's utterance in (13-a) can only convey that he believes Employee to be temporarily unaware of his own serious illness. With the utterance of (13-b), however, Boss can express his doubt about whether the illness that Employee has previously reported to him is a reality. This is due to the fact that *ugye* does not serve the aim of explicitly indicating a contrast between the current utterance and the previous one, but summarizes instead what is in the common ground or what follows from it under normal circumstances according to the speaker, which leads indirectly to the contrast effect.

Thus, we have established that the distribution of *ugye* in declaratives neither corresponds to that of German *ja* nor to that of *doch*, which indicates that the semantic interpretation of the Hungarian particle cannot be equivalent to those of the German ones. Given that neither of the German particles is allowed to appear in polar interrogatives, cf. Thurmair (1989), this is actually a welcome result.

Based on the examples discussed above, the contribution of *ugye* to the interpretation of Hungarian declarative sentences seems to be best described as marking that, according to the speaker, the propositional content of the sentence follows due to default reasoning from the common ground. Given that p is a proposition, Zeevat (2003) defines the truth of *normally*(p) in an information state along the following lines: the truth of *normally*(p) requires that the "$CG \models \psi_1, \ldots, \psi_n$, and that $\psi_1, \ldots, \psi_n$ together constitute a reason for thinking that p, while at the same time the CG must not contain a reason for thinking that $\neg p$" (p. 183). Given the above definition, I propose that the contribution of *ugye* to the interpretation of Hungarian declaratives can be captured as follows:

(14) In a Hungarian declarative sentence with a propositional content p, given a CG, *ugye* marks that *normally*(p).

Note, importantly, that the above characterisation of the interpretation of a declarative with *ugye* having a propositional content p does not require that p should be in the common ground. Otherwise, the contribution of speaker A in (11), for example, could only be interpreted as committing her to the truth of a proposition that stands in contradiction with the common ground, which is not the case.

Having made a proposal for capturing the interpretation of *ugye* in declaratives, we turn now to the analysis of *ugye*-sentences that have traditionally been classified as interrogatives in the literature.

3 *Ugye* in 'interrogatives'

As mentioned in Section 1 above, *ugye* is viewed in many studies as a constituent that is responsible for the formation of interrogative sentences. In this section we take this view under close scrutiny. As also reviewed above, one characteristic type of polar interrogative main clauses in Hungarian has the same surface order as the corresponding declarative, cf. (3) vs. (4), differing from the latter in its intonation, as shown in Figures 3 and 4 above. The other characteristic type, illustrated in (15), is formed with the help of the interrogative particle *-e*, and has the same, falling intonation contour as declaratives:

(15) Mari volt-e Párizsban?
Mary was-PRT Paris.IN
'Has Mary been to Paris?'

The following example shows that *ugye* is not compatible with the interrogative particle *-e*:

(16) (*Ugye) Mari (*ugye) volt-e (*ugye) Párizsban (*ugye)?

The unacceptability of (16) can, naturally, be accounted for within the frameworks referred to above by saying that *ugye* and *-e* serve the same function, therefore their simultaneous appearance is either excluded by economy principles, or even blocked on syntactic grounds, for example, due to a principle regulating the filling of a functional head like Force^o (cf. Rizzi (1997)).

The following examples illustrate, however, that the functions of the latter two particles are still not identical:

(17) Józsi tudja, hogy Mari volt-e Párizsban.
Joe knows that Mary was-PRT Paris.IN
'Joe knows whether Mary has been to Paris.'

(18) Józsi tudja, hogy Mari ugye volt Párizsban.
Joe knows that Mary PRT was Paris.IN
'Joe knows that, as you know, Mary has been to Paris.'

A comparison between (17) and (18) shows that only the particle *-e* is capable of indicating the interrogative status of an embedded clause. The subordinate clause of (18) can only be interpreted as a declarative. A further evidence for the dissimilar behaviour of polar interrogative main clauses with or without *-e* and *ugye*-'interrogatives' is that whereas the former do support negative polarity items, *ugye* is incompatible with these (cf. Gunlogson (2003)):

(19) Mari volt(-e) valaha is Párizsban?
Mary was-PRT ever Paris.IN
'Has Mary ever been to Paris?'

(20) #Mari ugye volt valaha is Párizsban?
Mary PRT was ever Paris.IN
'Has Mary ever been to Paris?'

The above data thus point to the conclusion that, as opposed to the standard view, *ugye*-sentences intended as question acts do not exemplify the interrogative form type. In this case, however, the question arises what the basis of viewing *ugye* as being responsible for the illocutionary force of the question in examples like (2-a) above is. The etymology of the particle, discussed above, as well as the fact that historically it first appeared in peripheral positions (sentence finally and then sentence-initially) makes it very similar to tags in various languages. The informal descriptions about *ugye*-'interrogatives', according to which they denote biased questions (cf. Károly (1957-62), Fónagy and Magdics (1967), Varga (2002), among others) give further support to viewing them as tag questions, most types of which are also attributed a biased question interpretation in the literature.

According to one dominant view, represented by Sadock (1974), Ladd (1981), Quirk et al. (1985), Reese and Asher (2006), and Reese (2007), among others, the biased question interpretation of most varieties of tag questions[5] is due to the fact that they express two illocutionary acts at the same time: an assertion (due to the declarative sentence) and a question (due to the tag).

The latter claim has been supported by the application of Sadock (1974)'s diagnostics for illocutionary force. According to Sadock (1974), compatibility with the discourse marker *after all* signals that the sentence under consideration expresses an assertive act (at least), whereas compatibility with *by any chance* and *tell me* marks that

[5] One notable exception are negative-anchor postnuclear tag questions, which can have an interpretation of neutral questions (cf. Ladd (1981), Reese and Asher (2006) and further references in the latter).

it expresses a questioning act (at least). The latter two diagnostics can also be used to discriminate between neutral and biased questions: whereas the former is restricted to neutral questions, the latter can appear with both. As the contrast between the following examples shows, Hungarian *mondd csak* 'tell PRT', behaves analogously to English *tell me*. ('\' at the end of (21) is to distinguish the declarative sentence from its string-identical polar interrogative counterpart.) The translations of the Hungarian examples illustrate the relevant tests for English:

(21) *Mondd csak, János itt van.\
tell PRT John here is
*'Tell me, John is here.'

(22) Mondd csak, János itt van-e?
tell PRT John here is-PRT
'Tell me, is John here?'

The fact that (23) patterns with (22) as far as compatibility with *mondd csak* is concerned, indicates that it expresses a question (possibly among other illocutionary acts):

(23) Mondd csak, János ugye itt van?
tell PRT John PRT here is
'Tell me, John is here, isn't he?'

Insertion of *véletlenül* 'by any chance' into the sentences above confirms that questions expressed with the particle *-e* are neutral, whereas those expressed by *ugye* are biased:

(24) János itt van-e véletlenül?
John here is-PRT by any chance
'Is John here by any chance?'

(25) *János ugye itt van véletlenül?
John PRT here is by any chance
'*By any chance, John is here, isn't he?'

Negative questions with *ugye*, which are compatible with *véletlenül*, seem to constitute an exception to the generalization above, and, therefore, seem to pattern with negative anchor postnuclear tag questions in English:[6]

(26) János ugye nincs itt véletlenül?
John PRT be.NEG here by any chance
'By any chance, John isn't here, is he?'

Having shown that Hungarian sentences with *ugye* having 'question-prosody' do satisfy the tests proposed by Sadock (1974) for questioning acts, it remains to be seen whether they can also be proven to express assertive acts as well. There are some trans-

[6]Reese and Asher (2006) account for the neutral question interpretation of the latter tag questions (available in addition to the biased question interpretation) by claiming that the negation of the anchor is to be interpreted as metalinguistic, that is, taking wide scope over an assertion operator. Limitations of space prohibit me from discussing the applicability of this kind of analysis to the Hungarian example in (26).

lation equivalents of the English discourse marker *after all*, such as *elvégre* or *mindennek ellenére*, that seem to be compatible only with sentences that express assertive acts:

(27) Elvégre János itt van.\
after all John here is
'After all, John is here.'

(28) *Elvégre János itt van-e?
after all John here is-PRT
'*After all, is John here?'

(29) Elvégre János ugye itt van?
after all John here is
'After all, John is here, isn't he?'

The data discussed above thus suggest that *ugye*-sentences that can express question acts have an interpretation analogous to English tag questions, that is, they actually express a question and an assertion at the same time. This conclusion is strongly supported by prosodic data, discussed in Section 1, according to which *ugye*-sentences intended to express question acts differ from the corresponding declarative sentences with or without *ugye* in the melodic pattern of the particle itself, which resembles that of a one-word polar interrogative (disregarding the interaction of pitch-accented focus and *ugye* immediately preceeding it). This means that in structures where *ugye* appears sentence-medially, we are talking about an internalized tag. This raises, however, the question of how these sentences are also capable of expressing a simple assertion, as illustrated in (1-b). The next section will address this issue, by trying to disentangle the interpretation of the particle from that of the intonation.

4 Towards a unified interpretation for *ugye*

Having considered the relevant data concerning the interpretation of the particle *ugye* in declaratives and in tag questions, in this section we will explore the possibilities of integrating the two into one unified interpretation. There seem to be two ways this could be achieved. On the one hand, we could follow the path of the historical development and consider the interpretation of *ugye* in tag questions, described in Section 3, as basic and its contribution to sentences that have been classified as declaratives in Section 2 as a derived case. On the other hand, we could consider the interpretation of *ugye* in declaratives as basic, and describe its contribution to tag questions as the result of an interaction between the former meaning and the meaning of the question intonation on the particle.

Let us first assume that the particle *ugye*, that originated as an independent clause, but later became available for being integrated into the sentence structure, is to be analysed as a tag in all its occurrences. Semantically, this means that it always contributes a question to the interpretation of the sentence it occurs in that asks about the truth of the proposition *p* asserted by the rest of the sentence (the anchor). In the default case, the contribution of the particle to interpretation is mirrored by its intonation, which is analogous to that of a polar interrogative in Hungarian. How can this account be extended to cases where the intonation of an *ugye*-sentence is not to be distinguished from those of its declarative counterparts with or without *ugye*, and therefore the sentence can only be used felicitously to answer a question, as shown in (1-b), but not to ask one? Let us assume that low pitch on the particle has its standard iconic function, indicating confidence, assurence and certainty (cf. Ohala (1994)), in other words, the rhetorical question status of the question contributed by the tag. On these assumptions, an *ugye*-'declarative' could be taken to assert that *p* and assert that the answer to the question whether *p* holds is obvious. This characterisation more or less corresponds to the way the interpretation of *ugye*-declaratives was captured in (14) above. This approach, according to which *ugye*-sentences of all kinds are to be considered to belong to the same form-type, namely, tag questions, entails, naturally, that there cannot be any sentence containing *ugye* that is well-formed when pronounced with the question-intonation on the particle, but not when it is pronounced with low pitch, or vice versa. However, there are at least two types of examples, illustrated below, that are only well-formed when pronounced with low pitch on the particle:

(30) (Hát) én mit tehetek ugye?
PRT I what.ACC do.POSS.1SG PRT
'What can I do?'

(31) Kár, hogy nem volt ugye idő.
pity that not was PRT time
'It's a pity that there was no time, as we know.'

(30) is a constituent interrogative with a rhetorical question reading where *ugye* (pronounced with low pitch) marks the truth of the proposition indirectly conveyed by the rhetorical question to be obvious, whereas (31) shows that it can appear in an embedded clause, which is not normally the case with tag questions.[7]

The above data indicating that the particle *ugye* is not equally compatible with all sentence types on both of its pronunciations brings us to the second proposal, which takes the interpretation of *ugye* in declaratives as basic and derives the interpretation of tag questions with *ugye* from the contribution of the anchor, from that of the particle, and from that of the question intonation on the particle. Let us assume that this basic interpretation of *ugye* is equivalent to that described in (14) above. According to this, the particle marks that the propositional content of the sentence it appears in is assumed by the speaker to be entailed from information in the common ground by default reasoning. If we want to make this the basic interpretation of the particle, and assume that localisation of the question intonation contour on a particular constituent means that it is only the contribution of the constituent to the meaning of the sentence is questioned (instead of the propositional content of the whole sentence), the interpretations of the three relevant parts of a tag question with *ugye* could be represented as follows:

[7] There might also be a possibility of analysing (31) as an embedded root phenomenon, cf. Hooper and Thompson (1973). However, this analysis would also have to account for the obligatory low pitch on the particle.

(32) A proposal for capturing the interpretation of tag questions with *ugye*

	Anchor	*Ugye*	Question intonation on *ugye*
INTERPRETATION	p	*normally*(p)	?*normally*(p)

According to (32), on the assumption that *ugye* has a basic meaning characterised in (14), tag questions with *ugye* would have to assert the propositional content p of the anchor, to assert that p follows from the common ground under default reasoning, and to question the truth of the proposition according which p follows from the common ground under default reasoning. Unfortunately, this proposal does not capture the intuitive meaning of tag questions with *ugye* correctly: the answer given to such a question by the hearer does not depend on whether he considers the propositional content p of the anchor to follow by default reasoning from the common ground, but on whether he considers p to be true or not.

5 Conclusion

The present paper investigated the interpretation of the Hungarian particle *ugye*, that can equally appear in sentences intended to express assertive acts as well as in those intended to express questioning acts. We have argued that in the former case, it has an interpretation of a context marker, whereas in the latter case it is to be interpreted analogously to English tags. Two attempts at unifying the interpretation of *ugye* across its two uses were explored, but both of them were found to run into some difficulties. This suggests that the particle has two distinct interpretations in the two sentence-types it can appear in, which are not to be derived from each other.

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Processing Opacity

Martin Hackl
Dept. of Linguistics and Cognitive Science
Pomona College

martin.hackl@pomona.edu

Jorie Koster-Moeller
Dept. Linguistics and Cognitive Science
Pomona College

jorie.koster-moeller@pomona.edu

Andrea Gottstein
Dept. Linguistics and Cognitive Science
Pomona College

andrea.gottstein@pomona.edu

Abstract

Objects of intensional transitive verbs (ITVs) can be in interpreted transparently or opaquely. How to represent this ambiguity has been of considerable interest to the field over the years. This paper presents evidence from real time sentence processing to weigh in on that debate. Our evidence supports approaches that rely in an essential way on a syntactic scoping mechanism to explain the ambiguity. Specifically, our evidence suggests that the object of an ITV is interpreted transparently only if it takes syntactic scope over the ITV. If it is inside the syntactic scope of the ITV, it is necessarily interpreted opaquely. Purely semantic approaches to the ambiguity cannot explain this strict dependency between syntactic scope and interpretation.

1 Introduction

A well known property of intensional transitive verbs (ITVs) such as *look for* is that, unlike their extensional counterparts, e.g. *have* in (1), they give rise to an ambiguity with regard to their DP objects, (2), (Quine, 1960; Montague, 1973, etc.). In the transparent reading (2a), the DP *a secretary* has a specific or extensional reading, while in the opaque reading (2b), it does not.

(1) Mary has a secretary. *Extensional*

(2) Mary was looking for a secretary.
  a. a specific (e.g. the department) secretary *Transparent*
  b. any secretary (e.g. to hire) *Opaque*

A number of questions arise when considering how to formally characterize these readings. First, though both (1) and (2a) can be faithfully paraphrased within extensional first-order predicate logic as in (3) and (4a) respectively, the opaque reading has no adequate characterization in extensional terms, (4b):

(3) $[\![$Mary has a secretary$]\!]$ = 1 iff
  $\exists$x[x is a secretary and Mary has x] *Extensional*

(4) $[\![$Mary was looking for a secretary$]\!]$ = 1 iff
  a. $\exists$x[x is a secretary and Mary was looking for x] *Transparent*
  b. ??? *Opaque*

This suggests that *look for* denotes a modal operator, which creates an intensional environment, and that *a secretary* can be interpreted in that environment. What the representational resources are that natural language uses to create intensional environments of this sort and how the interpretation of DPs can be made sensitive to them are open questions (Larsen et al., 1997; von Fintel & Heim, 2005, etc.).

For our purpose here, the central question is to what extent syntax feeds and bleeds the interpretation system responsible for opacity. We take it to be uncontroversial that an opaque interpretation requires the object DP to be in the scope of *look for*. It is an open question, however, whether or not the transparent interpretation can be generated from the same syntactic structure. To see how a transparent interpretation might arise from a structure in which the object DP is in the scope of the ITV, we present an account, which we call the "world pronouns view,"based on Percus (2000). We contrast that approach with a more traditional account, the "strict-scope view," according to which the transparent interpretation requires that the object DP be structurally higher than the ITV (Montague, 1973, etc.). Our experimental evidence clearly favors the second.

2 Opacity with ITVs

2.1 Opacity and Quantification

A fact about ITVs important for our argument is that typically only weak quantifiers like *a* allow opaque readings. Strong quantifiers (*every, most, the* etc.) do not (Zimmermann, 1993). As Moltmann (1997) argued, this can be seen clearly when comparing the felicity of strong and weak quantifiers in contexts that favor transparent, (5), or opaque, (6), readings.

(5) Who is Mary looking for?
  a. Mary is looking for a secretary. *Transparent*
  b. Mary is looking for the/every/most secretaries. *Transparent*

(6) What is Mary looking for?

a. Mary is looking for a secretary. *Opaque*

b. #Mary was looking for every/the/most secretaries. **Opaque*

In "transparent contexts" such as those introduced by a *who*-question, (5), we see that strong and weak quantifiers are equally felicitous. In "opaque contexts" such as those introduced by a *what*-question, however, only weak quantifiers are felicitous, (6a). The infelicity of (6b) suggests that strong quantifiers do not tolerate opaque interpretations.[1] Why that is so is not important for our purpose. However, that this is the case, is exploited in our experimental design.

2.2 A Possible Worlds Semantics for ITVs

A characterizing property of opaque readings with ITVs is that the object can have an empty extension in the actual world, without making the sentence necessarily false, (7). No such reading is available for extensional transitive verbs, (8).

(7) Mary was looking for a dragon.

(8) #Mary found a dragon.

To capture this property, ITVs are analyzed as modal operators, which allow for the evaluation of predicates across possible worlds, thereby removing the commitment to existence in the actual world (w_0). NPs, in turn, denote properties (type $\langle e, st \rangle$), i.e. predicates whose denotation can vary across possible worlds. In extensional environments, NPs are evaluated with respect to w_0, (9), while in intensional environments, with respect to the set of worlds that are made accessible by the modal operator. Assuming a Quinean paraphrase for *look for* as *try to find*, this set might be characterizable as the set of worlds in which Mary's search (as defined in the actual world) is successful. For (7) to be true, then, existence of a dragon is required in those worlds but not necessarily in w_0, (10).

(9) $[\![\text{Mary caught a dragon}]\!]^{w_0} = 1$ iff
$\exists$x[x is a dragon in w_0 and Mary caught x in w_0]

(10) $[\![\text{Mary was looking for a dragon}]\!]^{w_0} = 1$ iff
$\forall$w[Mary's search in w_0 is successful in w $\rightarrow$
$\exists$x[x is a dragon in w and Mary finds x in w]]

With these ingredients in place, we can now sketch two approaches to the opaque/ transparent ambiguity. The first relies on a syntactic scoping mechanism while the second relies on the possibility of leaving evaluation parameters such as world variables unbound even when they are in the scope of a suitable modal operator.

[1] See Moltmann (1997) for special cases where strong quantifiers are interpreted opaquely.

2.3 Opacity via Scope

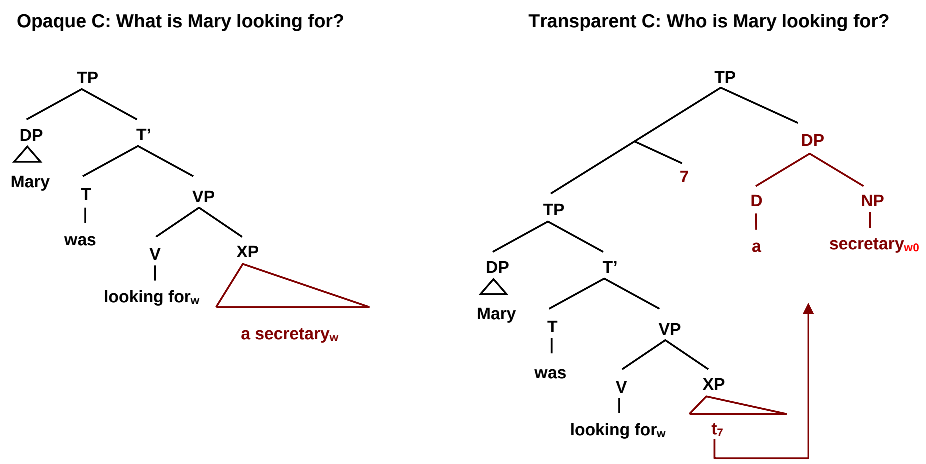
The first solution to the transparent/opaque ambiguity insists on a strict correspondence between the environment that the object DP occurs in and its interpretation (Montague, 1973). DPs that occur in an intensional environment, such as the scope of an ITV, are necessarily interpreted opaquely, (11), while DPs that occur in an extensional environment are necessarily interpreted transparently, (12).

(11) $[\![$Mary was looking for a secretary$]\!]^{w_0}$ = 1 iff
$\forall$w[m search in w_0 is successful in w $\rightarrow$
$\exists$x[x is a secretary in w and m finds x in w]]

(12) $[\![$[a secretary]$_7$ [Mary was looking for t_7]$]\!]^{w_0}$ = 1 iff
$\exists$x[secretary(x) in w_0 and
$\forall$w[m search in w_0 is successful in w $\rightarrow$ m finds x in w]]

The mechanism that is standardly assumed to be responsible for mediating between these two structures is quantifier raising (QR), a covert movement operation that raises the object DP from its base position to a clausal node above the ITV.[2]

(13)



If *a secretary* occurs in its base position, it is in the scope of the ITV, (13) on the left.[3] This results not only in *a secretary* being interpreted non-specifically (in the scope of the universal modal) but also in the evaluation index of *a secretary* being bound by *look for*. If the object DP is covertly moved outside the scope of the ITV, on the other hand, the existential takes scope over the modal operator and the evaluation index remains unbound, (13) on the right. Assuming a default rule that assigns w_0 to unbound world variables, (von Fintel & Heim, 2005), this results in a specific and transparent interpretation of *a secretary*.

[2]Montague's term is "Quantifying in." Following Fox (2002), we assume QR to be rightwards.

[3]Note that the sister node of *look for* is simply labeled as XP in (13), indicating that its categorical status (CP, IP, QP, or NP) is not relevant for our purpose. All that we need is the possibility for object QPs to be interpreted in the scope of the ITV. This can be achieved by assuming that the complement position of ITVs is covertly clausal (Larsen et al., 1997), that ITVs take quantifiers as internal arguments (Montague, 1973), or that they take properties (type-shifted DPs) as arguments (Zimmermann, 1993, e.g.).

To capture the previously described distributional facts about quantifiers in this "strict-scope" view, it needs to be assumed that, for some reason, strong quantifiers lack a narrow scope LF and always undergoing QR, as in (14).

(14) $[\![$[every secretary]$_7$ [Mary was looking for t_7]$]\!]^{w_0}$ = 1 iff
$\forall$x[secretary(x) in $w_0 \rightarrow \forall$w[m search in w_0 is successful in w $\rightarrow$
m finds x in w]]

2.4 Opacity via World Pronouns

Assuming, with Percus (2000), that world variables are not just evaluation parameters of the interpretation function but are, in fact, realized in the object language as pronouns, provides the representational flexibility for an alternative account of opacity. Rather than treating the ambiguity strictly as a matter of syntactic scope, this alternative exploits the possibility of leaving world pronouns unbound even when they are in the scope of a modal operator. For our cases, this means that an in-situ DP can, in principle, be interpreted intensionally, (15), as well as extensionally, (16), depending on whether the world pronoun introduced by the DP is bound by the ITV or defaulted to w_0.[4]

(15) $[\![$Mary was looking for a secretary$]\!]^{w_0}$ = 1 iff
$\forall$w[m search in w_0 is successful in w $\rightarrow$
$\exists$x[x is a secretary in **w** and m finds x in w]]

(16) $[\![$Mary was looking for a secretary$]\!]^{w_0}$ = 1 iff
$\forall$w[m search in w_0 is successful in w $\rightarrow$
$\exists$x[x is a secretary in $\mathbf{w_0}$ and m finds x in w]]

Note that in this system, even strong quantifiers, which presumably do not tolerate opaque readings for independent reasons, can stay in-situ. All that needs to be assumed to ensure a transparent interpretation for strong quantifiers, is that the world parameter associated with them cannot be bound by the ITV.

(17) $[\![$Mary was looking for every secretary$]\!]^{w_0}$ = 1 iff
$\forall$w[m search in w_0 is successful in w $\rightarrow$
$\forall$x[secretary(x) in $w_0 \rightarrow$ m finds x in w]]

2.5 The Question

Though both approaches can account for extensional and intensional interpretations of objects of ITVs, they do so with very different mechanisms, and therefore assume fairly different underlying structures. While both theories agree that for an object DP to be interpreted opaquely, it needs to be interpreted in the scope of the ITV, they differ when it comes to the structures that give rise to transparent readings: in a strict-scope view, transparent object DPs must be QRed above the verb; in a world-pronoun view, transparent object DPs stay in-situ. Thus, distinguishing between these theories can be re-framed

[4]See below for discussion whether (14) can represent the transparent reading of *a secretary*.

in terms of a question of structure: how we can distinguish QRed structures from in-situ structures?

Since the purported movement of transparent object DPs is covert, there is no direct evidence from word order that would distinguish between these two proposals. Furthermore, for definite descriptions and universally quantified objects the in-situ and the QRed structures predict the same truth-conditions. Definite DPs are scopally inert and since they are evaluated relative to the actual world when interpreted transparently, leaving them in-situ will result in the same truth-conditions as moving them above the ITV. Similarly, universally quantified DPs are scopally commutative with other universal quantifiers. Since ITVs express universal modal operators, scoping a universal object over it will yield the same truth-conditions as those that result when the object is left in-situ - again, as long as the object DP is evaluated relative to the actual world.

The only case, then, that might provide evidence for or against a scope-based account of transparent readings are indefinite objects. Scoping *a secretary* over the ITV will generate truth-conditions that are different from those that result when the indefinite DP is left in situ. The former structure, in (18a), yields a "specific" reading, while the latter, (18b), where *a secretary* is left in-situ yet evaluated in w_0, will result in a "non-specific de re" reading.

(18) a. $[\![$Mary was looking for a secretary$]\!]^{w_0}$ = 1 iff
$\exists$x[secretary(x) in w_0 and
$\forall$w[m search in w_0 is successful in w $\rightarrow$ m finds x in w]]

b. $[\![$Mary was looking for a secretary$]\!]^{w_0}$ = 1 iff
$\forall$w[m search in w_0 is successful in w $\rightarrow$
$\exists$x[x is a secretary in w_0 and m finds x in w]]

The existence of non-specific de re readings for indefinite objects, cf. Fodor (1970), prima facie seems to suggest that we need the flexibility provided by a Percus style system. The existence of a specific reading, on the other hand, seems to suggest that we also need a scoping mechanism. However, things are more complicated than that. A defender of an in-situ view might, for instance, point out that the specific reading entails the non-specific de re reading and because of that, the specific reading might arise actually from the in-situ structure as a special case.[5] A proponent of a strict-scope view, on the other hand, might propose a movement analysis of the non-specific de re reading by moving only the NP *secretary* while leaving the scopally active indefinite determiner *a* inside the scope of the ITV.

The upshot is that whether indefinites provide evidence for or against a strict scope view depends on the analysis of the specific and the non-specific de re reading. Since this is not a settled matter, a final evaluation of the evidence from indefinites cannot be given at this point. Similarly, transparent readings of definite and universally quantified objects are compatible both with in situ and as QR structures, and so provide no means of distinguishing between LFs. This means that off line data cannot distinguish between the two competing approaches.

In the next section, we show that evidence from real time sentence processing can

[5]This is a general problem of wide scope indefinites.

distinguish the two approaches. More specifically, building on Koster-Moeller et al. (to appear), we argue that QR-ed and in situ structures have distinct processing implications for sentences with antecedent contained deletion (ACD). Building on those results, we then present processing evidence that strongly supports a strict scope view of transparent readings and that calls into question whether we need a Percus-style system of world pronoun binding.

2.6 Processing Antecedent Contained Deletion

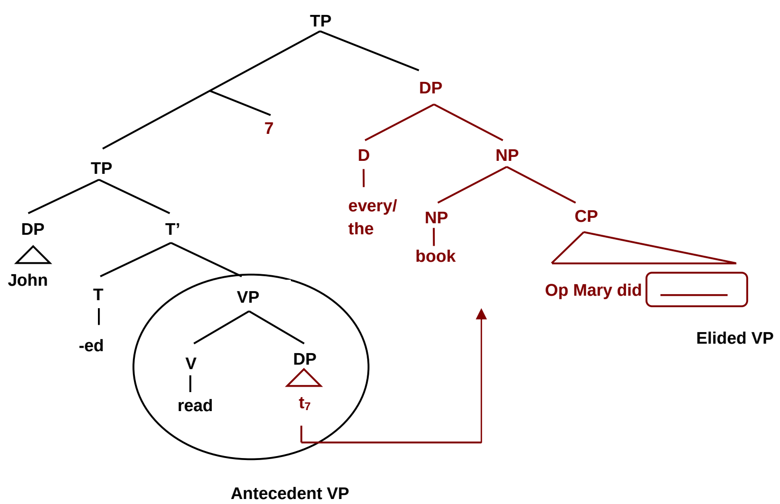
The term antecedent contained deletion (ACD) refers to elided material, ___ in (19), that is properly contained within the expression that serves as its antecedent.

(19) John read every book Mary did ___ .

In (19), the elided constituent is the VP inside the relative clause. Its antecedent is the matrix VP, which seems to contain as a proper part the DP that hosts the elided VP itself. From a general perspective on ellipsis licensing ACD is paradoxical because eliding a constituent is possible only if there is an identical/parallel constituent that serves as its antecedent. Obviously, an elided VP cannot be identical to another VP if the elided VP is a proper part of that VP. This, however, seems to be exactly what is going on in (19), making the acceptability of sentences like (19) on-face paradoxical.

The paradox can be resolved if the sentence is reconfigured using QR. Specifically, if the DP hosting the relative clause, which contains the elided VP, is moved above the matrix VP the ellipsis site is no longer contained within its antecedent, (cf. Sag, 1976; Kennedy, 1997, etc.), (20).

(20)



For our purposes here, it is important to note that in ACD structures, QR occurs regardless of the semantic properties of the DP. Normally, QR of an object DP occurs only if the object DP is quantificational. Quantificational DPs are not directly interpretable in their base position due to a type-mismatch (Montague, 1973). QRing the object resolves that type-mismatch (May, 1985; Fox, 2003, etc.).[6] In ACD structures, however, the motivation for QRing the object DP is to undo antecedent containment. Hence, QR of an object DP hosting an ACD site happens independently of whether or not the DP itself is quantificational.

These two types of triggers for QR can be distinguished in a left-to-right real time sentence processing paradigm, since the parser encounters the determiner, whose semantic properties determine whether or not the object DP is quantificational, before it encounters the ACD site. Importantly, if the determiner of the host DP is quantificational, QR is triggered at the point where the parser encounters the determiner. This incurs a processing cost due to movement (Varvoutis & Hackl, 2006). The ACD site downstream would be only a second trigger for the same operation and since QR has already occurred, incurs no additional processing cost. However, if the determiner of the host DP is definite, QR will not be triggered until the parser encounters the ACD site, incurring the additional processing cost of movement at the ACD site. Thus, we can use a relative increase in processing cost of an ACD site as means to detect whether the host DP has been previously QRed or not: specifically, object DPs that undergo QR facilitate downstream ACD processing, while those that remain in situ do not.

In a self-paced reading study, Koster-Moeller et al. (to appear) demonstrate these processing implications using the paradigm exemplified in (21).

(21) The secretary was trained to manage...
  a. the/every program that the intelligent young professional **designed**
  b. the/every program that the intelligent young professional **did**

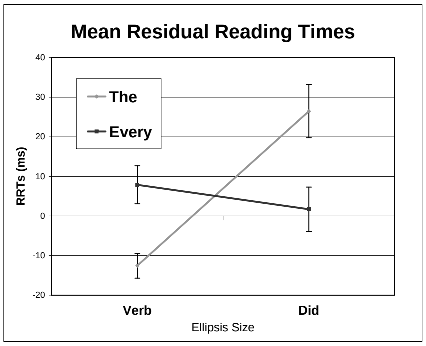
...during her four years at college.

The logic behind this design exploits the linear dependency between QR and ACD as discussed above. Specifically, comparing processing costs for ACD sites, (21b), relative to an identical baseline, (21a), across two determiner conditions reveals a relative advantage for the quantificational determiner because it triggers QR, thereby preparing the parser for an ACD site downstream. The definite determiner, on the other hand, does not trigger QR. Hence, the ACD site itself is the first time the parser encounters a trigger for QR, resulting in a larger increase in processing cost for the ACD relative to the baseline. As can be seen in figure (22), this is exactly what Koster-Moeller et al. (to appear) found. The graph in (22) displays reading times two words after the verb/ellipsis site in two determiner conditions. We see that there is a significant increase in RTs for the ACD condition for the definite determiner. For *every* there is no significant difference in RT between the ACD and the verb conditions. An interaction of this sort suggests that no additional processing cost was incurred when the parser reached the ACD site in the latter case. This, in turn, suggests that encountering a quantificational object triggers QR, facilitating processing in the ACD site.

We can turn this logic around, using ACD reading times to test for whether the host DP has independently undergone QR. Specifically, a relative increase in reading time two words after the ACD site suggests that the host DP has been interpreted in situ.

[6]However, see Montague (1973), Jacobson (to appear), Barker (2002), etc. for alternatives to resolve the type-mismatch.

(22)



No relative increase of this sort, on the other hand, suggests that the host DP has been QRed for independent reasons. The next section shows how we can apply this logic to the question of the ambiguity in ITVs.

3 A Processing Study of Opacity

3.1 Experimental Design: Intensionality and ACD

We can distinguish the strict-scope approach to ITVs from the world-pronoun approach in terms of their predictions for down-stream ACD resolution. For a sentence like (23), which contains both an ITV and an ACD site, the two approaches make different processing predictions for the facilitation of processing the ACD site. Specifically, a strict-scope account predicts an interaction between the opacity of the object DP and ACD, such that transparent readings (which in this view require QR) will facilitate ACD resolution down-stream. A world-pronoun approach, on the other hand, assumes that QR never needs to occur until the ACD site. This predicts a main effect of ellipsis, because ellipsis resolution is never facilitated and so will always be harder than processing a verb.

(23) Mary was looking for a secretary that John was.

We tested these predictions using the following 2-Factor (Determiner by Ellipsis) design. We used three determiners, the weak indefinite *a*, and the strong quantifiers *the* and *every*. We paired each of these with two verb conditions, one with an ACD site, (a), and one with a basic verb, (b), giving rise to six total conditions.

(24) The producer was looking for ...

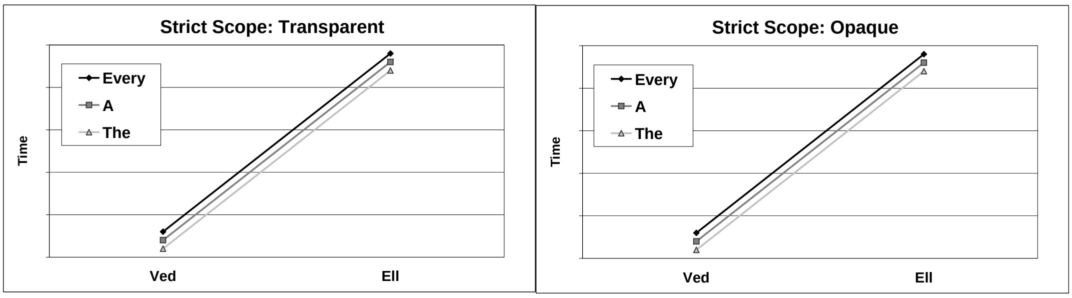
a. an/the/every actress that the director **was**

b. an/the/every actress that the director **wanted**

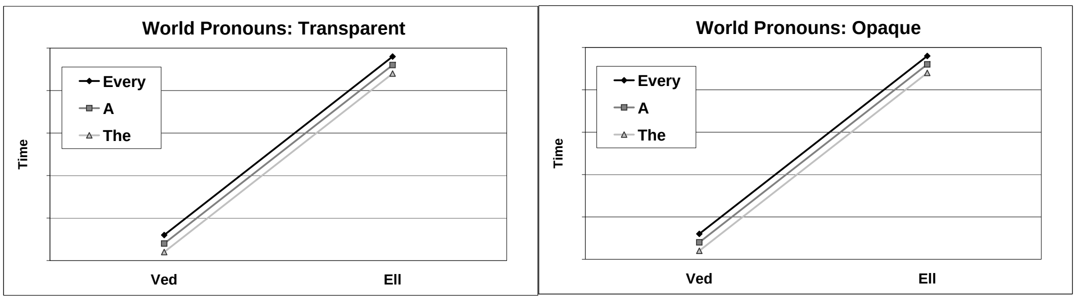
...before finalizing the casting list.

3.2 Predictions

Using this paradigm, we can make explicit predictions for each theory. In a strict-scope view, *the/every* always undergo QR because they are not compatible with an opaque reading. Thus, unlike in the extensional cases of Koster-Moeller et al. (to appear), where we saw only the quantifier to facilitate ACD processing, both *the/every* do that with ITVs. The indefinite *a*, however, facilitates ACD only when the ITV-object is construed transparently, triggering QR, and not when construed opaquely, staying in situ. In other words, for transparent environment, a strict scope account predicts that ACD resolution will be no harder than basic verb resolution for all three quantifiers (as they all undergo QR), while in an opaque environment, it predicts that ACD resolution for indefinites will be noticeably harder (as they do not undergo QR).



This contrasts noticeably with the predictions made by a world-pronoun view. In that view, none of *the*, *every*, or *a* trigger QR, and thus will not facilitate ACD processing, in either a transparent or opaque environment. This predicts that for all three, ACD resolution is noticeably harder than verb resolution.



3.3 Methods and Materials

To investigate whether real time processing of intensional transitive verbs interacts with ACD as discussed above, we use the self-paced, word-by-word moving window reading methodology (Just et al, 1982).

Our target items were constructed following the sample paradigm in (24). The matrix verb was always in the past progressive to allow for ellipsis resolution triggered by *was* in the relative clause.

Adverbs and adjectives were inserted between the object DP and the main point of interest (the verb or auxiliary in the relative clause) to prevent spillover effects from the different determiners interfering with processing difficulties that might arise at the point of interest.

We constructed 60 target sentences, which were combined with 120 fillers of various types. These included sentences that were similar to the target items in structure (employing relative clauses, elided material or covert movement triggers), in length, or because they contained quantifiers. The items were counterbalanced across six lists using a Latin-square design. Items were pseudo-randomized separately for each participant, with at least one filler sentence preceding each target.

65 undergraduates from the Claremont Colleges were tested on Dell PCs running the Linger software developed by Doug Rohde. All were native speakers of English and received course credit or $10.00 cash for their participation.

3.4 Analysis and Discussion

Following standard procedure, residual reading times (rRTs) were calculated to adjust for word length and differences in participants' natural reading rates. RRTs beyond two standard deviations were excluded from analysis and only rRTs from items whose follow-up question was answered correctly were included in the final analysis. Participants with less than 75% accuracy were excluded, (n = 5) and rRTs over 200 ms were trimmed.

Additionally, in order to test the predictions made by each theory for both the opaque and transparent environments, we separated participants into two groups, the "Transparent" group, whose rRTs were longer when the indefinite was accompanied by a verb than when accompanied by an ellipsis site (a-verb $>$ a-was), and the "Opaque" group, whose rRTs were not (a-verb $\leq$ a-was):

a-verb $>$ a-was $\rightarrow$ Transparent (n = 28)
a-verb $\leq$ a-was $\rightarrow$ Opaque (n = 32)

This criterion provides an effective way of dividing participants into those that only got transparent readings for ITVs and those that also got opaque readings - without biasing the results. Specifically, as only the strict scope view predicts any difference between the opaque and transparent conditions, the Opaque group includes all participants who employ a world-pronouns solution, as well as any participants who, using a strict-scope semantics, construed the indefinite opaquely. Thus, the only participants who were separated out from the Opaque group, which we used for the primary analysis, were those who adhere to strict scope.

3.5 Results

Looking at the Opaque group, we see a prominent separation of reading times across conditions at the region of interest, two words after the ellipsis site (marked by *ORDER* in Figure 1). A repeated measures ANOVA (Determiner by Ellipsis) reveals a significant interaction, $F(2,29) = 3.830$; $p < .033$. We see that the interaction is driven by the high reading time of the indefinite in the ellipsis condition (*a-was*), specifically by a det*ell interaction for a/every and a/the, $F(1,30) = 6.991$; $p = .013$, and $F(1,30) = 5.635$; $p = .024$, respectively, Figure 1.

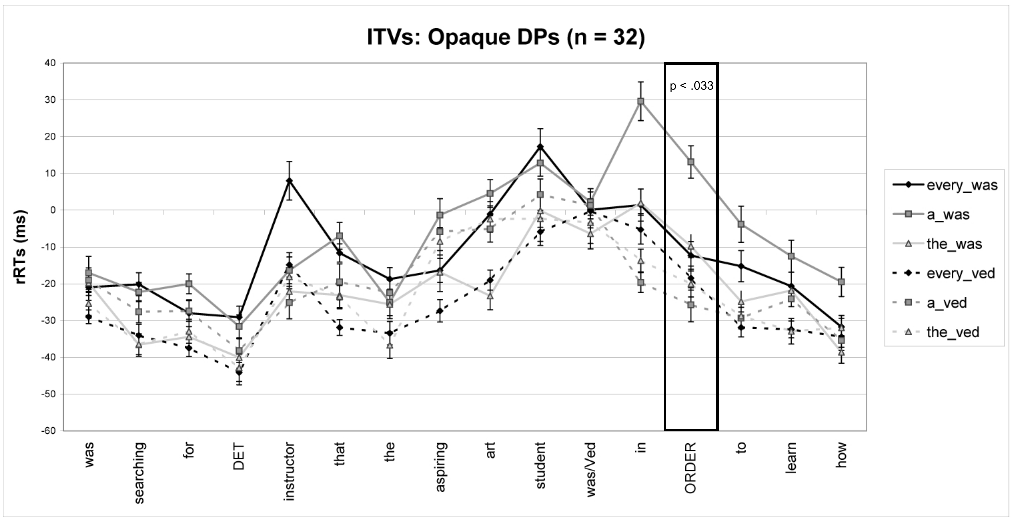


Figure 1: Residual Reading Times: Opaque Group

However, in the Transparent group, we see no significant differences between any conditions at the area of interest (all $p > .5$), Figure 2.

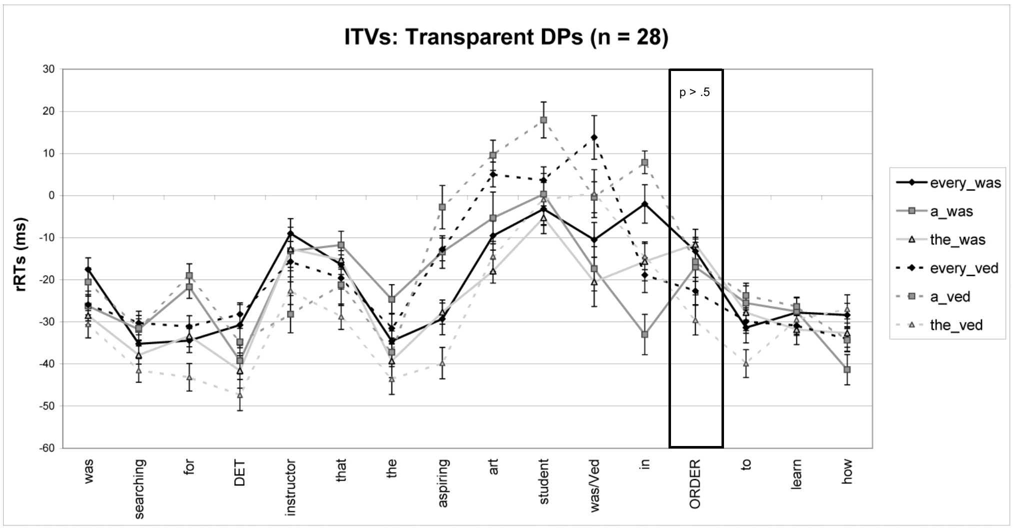


Figure 2: Residual Reading Times: Transparent Group

We can see the results of the experiment more clearly looking at a pullout of the area of interest, which presents the residual readings times for each determiner in the verb condition (*Ved*) and the ellipsis condition (*Ell*), Figure 3. Specifically, for the Transparent group, we see that the ellipsis condition is as easy as the verb condition for all determiners. Based on Koster-Moeller et al. (to appear), this indicates facilitation of ACD in all three determiner conditions, i.e. that all three determiners have undergone QR. For the Opaque group, we see no significant difference between *every* and *the*, but a significant difference for *a*. This indicates that QR occurred upstream for both *every* and *the*, but not for *a*, Figure 3.

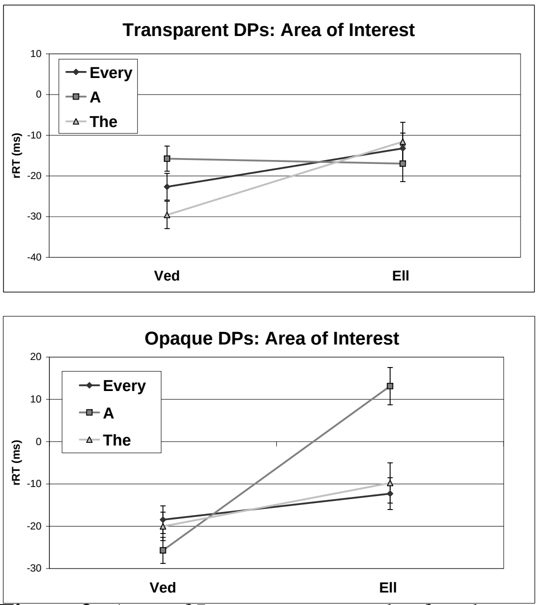


Figure 3: Area of Interest: two words after the gap

Recalling the original predictions, we see that results from both the Transparent and Opaque group strongly support a strict scope analysis of intensional transitive verbs. In the Transparent group, only a strict scope view predicts QR (ease of ACD resolution) for all three determiners. A world-pronoun view would predict no facilitated ACD resolution for any determiner. In the Opaque group, both views predict that the indefinite *a* remains in-situ, but only a strict-scope view predicts that both *every* and *the* undergo QR and facilitate ACD processing downstream.

The fact that both *every* and *the* facilitate ACD resolution contrasts noticeably with the results of Koster-Moeller et al. (to appear), who found facilitation of ACD resolution only for *every* but not for *the*. The difference between these two experiments is the choice of matrix verb: Koster-Moeller et al. used extensional transitive verbs while the present study used intensional transitive verbs. For extensional verbs only true quantifiers require QR to resolve a type-mismatch. Since definite DPs do not give rise to a type-mismatch in object position, they do not trigger QR and, hence, do not facilitate ACD resolution. For intensional verbs, however, our study shows that any DP that does not tolerate an opaque construal undergoes QR, whether or not the DP is quantificational. Importantly, these results are predicted only by a strict-scope view of opacity, which relies essentially on syntactic movement to account for the transparent/opaque ambiguity.

4 Conclusion

This paper presented real time sentence processing evidence weighing in on the correct analysis of intensional transitive verbs. We discussed two accounts, differing in their treatment of the transparent/opaque ambiguity. One employs syntactic movement, while the other has no direct implication for the syntax but relies on the representational flexibility introduced by treating world variables as object language expressions. We argue that only the former approach can account for our experimental results, namely an interaction between the interpretation of an object DP and its ability to facilitate ACD resolution. From this, we conclude that any analysis of the ambiguity must essentially rely on a syntactic mechanism to account for the available interpretations of the objects of ITVs.

Acknowledgments

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Comparison in Turkish: A Rediscovery of the Phrasal Comparative

Stefan Hofstetter
Sonderforschungsbereich 441
University of Tübingen

stefan.hofstetter@uni-tuebingen.de

Abstract

This paper argues that clausal comparatives are completely unattested in Turkish and thus verifies the need for a genuinely phrasal analysis of comparison constructions in this language. It develops such a syntactic and semantic analysis that differs considerably from 'standard' analyses commonly suggested for languages like English and also shows that this phrasal analysis derives the correct predictions for the scopal behaviour of quantified DPs and the comparative operator. It furthermore argues that phrasal comparatives are the 'basic' and potentially universal type of comparatives, in contrast to what has been hypothesised previously, and speculates on how this phrasal analysis might even be applied to solve problems for analysis with English comparatives.

1 Introduction

At least for languages like English and German, there has been a strong tendency in recent linguistic literature to analyse apparently phrasal comparatives featuring nothing but a single noun phrase (or determiner phrase) in the standard term against which the comparison is made such as

(1) a. Mary ran faster than Peter.

by deriving them from an underlyingly clausal source (cf. e.g. Lechner (2004) and references therein). Under such an analysis, the element expressing the gradable property is either copied and subsequently deleted in the *than*-clause, or moved directly to the matrix clause:

(1) b. Mary ran fast-er/fast$_i$-er than Peter ran ~~d fast~~/t$_i$.

Arndt Riester & Torgrim Solstad (eds.)
Proceedings of Sinn und Bedeutung 13, University of Stuttgart, 2009

Such approaches do away with the need for a special phrasal analysis for examples like (1a) and allow us to treat phrasal and clausal comparatives alike. A question that naturally comes to mind, then, is whether this uniform way of analysing all comparatives is only valid for a particular group of languages, or whether it even holds cross-linguistically.[1]

Based on findings from a large-scale empirical study on comparison constructions in Turkish, in which I investigated the variety of possibilities to express a comparison in this language by interviewing a substantial number of native speakers on more than 150 sentences each to obtain a thorough amount of positive and negative evidence alike, I should like to argue that the latter is clearly not the case: After introducing some basic Turkish data in section 2, I shall show in the following section that this language is characterised by a total lack of clausal comparatives altogether, so that the 'standard' syntactic and semantic analysis commonly suggested for comparatives in English-like languages cannot be applied to Turkish comparatives, which, in turn, require a genuinely phrasal approach that I shall develop in section 4. As a next step, I shall produce additional evidence for this analysis by testing the predictions it makes with respect to the scopal behaviour of the comparative operator and quantified determiner phrases (section 5). In section 6, I shall then make a few comments on what the Turkish data make us expect for the cross-linguistic distribution of phrasal and clausal comparatives that contrast sharply with the assumptions presented in Bhatt & Takahashi (2007). Section 7 finally concludes this paper and speculates on how the phrasal analysis developed for Turkish comparatives, here, might also be transferred to languages like English and solve a couple of long-standing problems such as the proper analysis of comparatives featuring quantified determiner phrases in the standard term, there.

2 Comparative Constructions in Turkish – Some Basic Data

Before going into details and taking a look at particular pieces of data in the following sections, I should like to give my readers a first impression of what an 'ordinary' Turkish comparative looks like, here. As can be seen from the predicative comparative in (2), in Turkish, comparatives typically consist of (at least) a comparee term (*Maria*), a standard term that has to appear in the ablative case (*Peter'den*) and a gradable predicate (the adjective *uzun*).[2, 3]

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[1] As a matter of fact, even the first and weaker part of this assumption is far from being uncontroversial, as will be shown for English in section 6 below.

[2] With present tense, the copula is usually left out in Turkish, and in fact, insertion of the corresponding form *dur* would rather decrease than increase the well-formedness of (2) according to my informants.

[3] Readers familiar with Turkish might miss the element *daha* here, which often appears in comparatives in this language and seems to trigger a wide range of semantic effects (with 'ordinary' comparatives, it usually increases the difference between the standard and the comparee term, in comparatives lacking an overt standard, it seems to express the fact that we are dealing with a comparative as such, and in comparatives with an overt differential, it does not seem to make any contribution to meaning whatsoever). Given that this element is rather irrelevant for my present purposes and that its omission

(2) Maria Peter'den uzun.
Maria Peter.Abl. tall
'Maria is taller than Peter.'

(3a) constitutes an example of an adverbial comparative, featuring the adverb *hızlı*[4] and an overt verb form (*koştu*) occupying a position at the very end of the sentence (note that Turkish is a head-final language):

(3) a. Maria Peter'den hızlı koştu.
Maria Peter.Abl. fast run.Past.3Sg.
'Maria ran faster than Peter.'

Finally, I should also like to introduce an example of an equative (4), which displays the same basic structure as its comparative counterpart (2), the only difference being the equative operator *kadar*, which has been added in the appropriate position as well as the fact that *Peter* no longer takes an ablative case morphology:[5]

(4) Maria Peter kadar uzun.
Maria Peter as...as tall
'Maria is as tall as Peter.'

For lack of space, I need to limit myself to these very few examples here and refer the interested reader to Beck et al. (to appear) for further Turkish data including superlatives, the positive, differential comparatives, degree questions, etc. and a lot more.

3 The Overall Absence of Clausal Comparatives in Turkish

When trying to decide whether the overall clausal analysis of comparatives often suggested for English-like languages and sketched in the introductory section above can be transferred to Turkish or not, the first thing to be checked is whether a phrasal comparative such as (3a) can be assigned a corresponding clausal source underlying it. As it turns out, though, this is not the case, as the ungrammaticality of (3b) clearly indicates:

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does not render Turkish comparatives less grammatical or acceptable, I shall simply not consider it here and leave its discussion for another occasion.

[4] What I mean by 'adverb', here, is nothing more than that this element performs the function of a canonical adverb in (3a). From a morphological point of view, it is usually impossible to distinguish between adverbs and adjectives in Turkish, both sharing the same basic form.

[5] This is probably due to the fact that the overt operator *kadar* sufficiently marks the entire construction as an equative, whereas there is no corresponding explicit comparative operator in examples like (2) or (3a) above, so that the ablative case marking on the standard term is obligatory here to mark the comparative quality of the whole construction in the first place.

(3)	b.	*	Maria	Peter'den	(hızlı)	koştu	hızlı	koştu.
			Maria	Peter.Abl.	(fast)	run.Past.3Sg.	fast	run.Past.3Sg.

intended as: 'Maria ran faster than Peter ran.'

People might object at this point that sentence (3b) might simply be out due to a stylistic awkwardness arising from the immediate repetition of *(hızlı) koştu*. However, avoiding this repetition by choosing two distinct verbs in the matrix clause and the subordinate clause, respectively, does not improve the well-formedness of comparatives featuring a clausal standard in the least:

(5)	*	Maria	Hans	(sesli)	ıslık çalmadı	sesli	şarkı söyledi.
		Maria	Hans	(loud)	whistle.Past.3Sg.	loud	sing.Past.3Sg.

intended as: 'Maria sang louder than Hans whistled.'

Conversely, English standard terms that are clausal in nature typically translate as nominalisations into Turkish, as shown in (6), where the possessive pronoun *benim* directly preceding *düşündüğümden* as well as the ability of the latter element to adopt a case ending indicate that the deverbal *düşündüğümden* has indeed taken on nominal characteristics and functions as a noun in (6):

(6)	Maria	benim	düşündüğümden	zengin.
	Maria	my	think.Ptcple.1Sg.Abl.	rich

'Maria is richer than I thought.'

Interestingly enough, the unavailability of clause-like standard terms in Turkish comparatives is not just an isolated phenomenon as such, but matches the fact that finite subordination is generally unattested in the Turkish language, and that canonical subordination constructions in English-like languages such as relative clauses (7) or complements of verbs of perception and thinking (8) typically correspond to Turkish constructions featuring essentially the same nominalisation pattern as the one attested in the comparative in (6) above:

(7)	Maria'nın	aldığı	kitap	enteresan.
	Maria.Gen.	buy.Ptcple.3Sg.	book	interesting

'The book bought by Maria is interesting.'

(8)	Yağmur	yağdığına	eminim.
	rain(N)	rain(V).Ptcple.3Sg.Postp.	think.Pres.1Sg.

'I think (that) it is raining.'

Within the domain of comparison constructions, this complete lack of finite subordination in Turkish leads to an interesting prediction: Given that subdeletion structures are always inherently clausal in nature, this type of construction is predicted to be entirely absent from a language like Turkish, and this prediction is indeed fully borne out, as the ungrammaticality of (9) below confirms:[6, 7]

(9) * Bıçak çekmeceden derin uzun.
knife drawer.Abl. deep long
intended as: 'The knife is longer than the drawer is deep.'

4 The Syntax and Semantics of English vs. Turkish Comparison Constructions

In this section, I shall develop a syntactic and semantic analysis appropriate for dealing with comparison in a language like Turkish. To do so, I shall first of all briefly sketch the analysis standardly assumed for comparatives in English-like languages[8] to show that this type of analysis cannot be successfully transferred to Turkish, thereby verifying the need for a genuinely phrasal analysis to cope with Turkish comparison constructions, and finally, I shall try and establish such a phrasal approach.

As already mentioned in the introduction, the standard analysis for comparative constructions in languages like English parts from the basic assumption that all comparatives (including those that feature nothing but a single nominal expression in the standard term) instantiate an underlyingly clausal standard of comparison. It is furthermore assumed that the matrix clause as well as the (standard) subordinate clause each provide a set of degrees and that the comparative operator then forms their maxima and compares these, as can be seen from the lexical entry for this operator:

(10) $[[\text{Comp.Op.}_{\text{Engl}}]] = \lambda D_1 \in D_{<d,t>}.\ \lambda D_2 \in D_{<d,t>}.\ \max(D2) > \max(D1)$

Moreover, gradable adjectives and adverbs are generally taken to denote relations between individuals and degrees, as shown in the model lexical entry for *fast* in (11):[9]

[6] Since sentences like (9) are perfectly ungrammatical, it is sometimes difficult to establish such negative evidence with native speakers. What (9) represents is the most plausible word order for subdeletion structures, if this phenomenon really existed in Turkish. In the elicitation process, however, I also checked several other structures to make sure that sentences like (9) are not just out for reasons of a simple word order violation.

[7] This is not to say that subcomparative concepts as such cannot be expressed in Turkish at all, but just that different strategies like nominalisations (cf. (i) below) would have to be used and that gradable elements as such cannot form a subcomparative:

(i) Bıçak çekmecenin derinliğinden uzun.
knife drawer.Gen. depth.Abl. long
'The length of the knife exceeds the depth of the drawer.'

[8] Doing so, I shall by and large follow Beck (to appear, subsection 2.1).

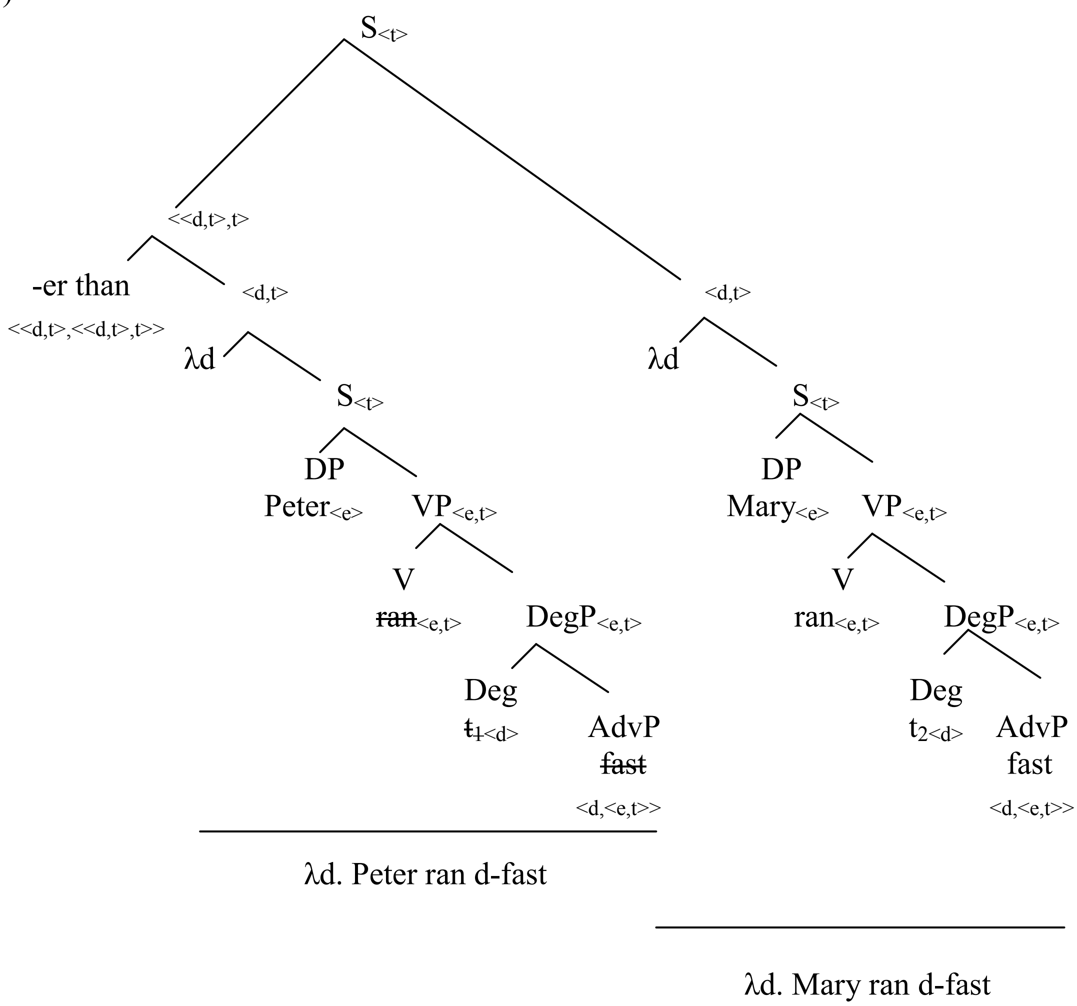
[9] In what follows, I shall be careless enough to simply write "x is d-fast" and the like in order to save space, although I do assume monotonicity, which will play a crucial role in section 5 below.

(11) [[*fast*]] = $\lambda d \in D_d.\ \lambda x \in D_e.\ speed(x) \geq d$/x is d-fast

In (12), I present the logical form for sentence (1a) from above, including semantic types as well as partial calculations:[10]

(1) a. Mary ran faster than Peter.

(12)



As readers may easily check for themselves, (1a) is thus predicted to be true iff ‘max(λd. Mary ran d-fast) > max(λd. Peter ran d-fast)’, which corresponds exactly to what this sentence intuitively means.

[10] I try to keep this representation as simple and straightforward as possible and therefore, I do not take more recent developments in syntax into account that do not directly affect the point I am trying to make, here.

From what has been argued for in section 3 above, it should immediately become obvious that this analysis cannot be transferred successfully to Turkish, because it crucially hinges on the presence of a clausal standard term, which is never the case with comparatives in Turkish. What I suggest instead is the following genuinely phrasal analysis inspired by the one proposed in Heim (1985, cf. in particular pp. 5-7 and the appendix), which I adapted to the special needs of Turkish syntax and also modified in order to take later developments in the analysis of comparatives into account: I stick to the assumption according to which gradable adjectives and adverbs denote relations between individuals and degrees (cf. the model entry for *fast* in (11) above), but in Turkish, I assume that, instead of furnishing a set of degrees, the standard term provides us with an individual which relates to another individual in the matrix clause and that the comparative operator then forms and compares the maximal degrees to which these two individuals possess a quality, perform an action, etc., as specified in the matrix clause, which can be seen from its lexical entry, given in (13):[11]

(13) $[[\text{Comp.Op.}_{\text{Turk}}]] = \lambda x \in D_e.\ \lambda A \in D_{<d,<e,t>>}.\ \lambda y \in D_e.\ \max(\lambda d.\ A(d)(y)) > \max(\lambda d.\ A(d)(x))$

In (14) below, readers will find the logical form for sentence (3a), where I once again include types and part of the actual semantic calculation, so that it can easily be seen that (3a) will come out true iff 'max(λd. Maria ran d-fast) > max(λd. Peter ran d-fast)', and (14) thus derives the correct truth conditions for this sentence:[12]

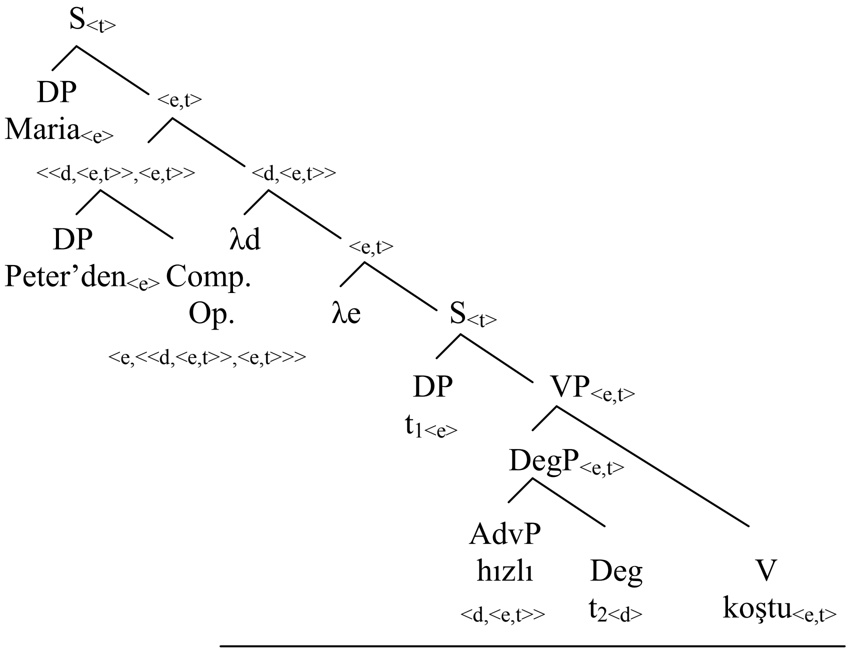
(3) a. Maria Peter'den hızlı koştu.
Maria Peter.Abl. fast run.Past.3Sg.
'Maria ran faster than Peter.'

---

[11] Kennedy (to appear, subsection 3.1) posits essentially the same lexical entry for a phrasal comparative operator as (13) above, and Bhatt & Takahashi (2007, p. 21; to appear, subsection 1.2) also suggest a similar lexical entry. Whereas the entry I propose in (13) is along the lines of von Stechow (1984) (in the version adopted in Heim (2001, pp. 214-217) and Beck (to appear, subsection 2.1)), Bhatt and Takahashi posit a lexical entry for the comparative operator in the tradition of Seuren (1973), which, in my opinion, however, has serious shortcomings when it comes to analysing comparatives featuring an explicit differential.

[12] The logical form in (14) might at first glance look a bit odd, given that the second instantiation of movement targets a position between the first moved element and its binder index, so that we are dealing with a sort of 'parasitic' movement (cf. Kennedy (1997, pp. 170-174; to appear, section 3.3) and Bhatt & Takahashi (2007, pp. 21f.; to appear, subsection 1.2), here. As Beck & Sauerland (2000, in particular pp. 263f.) have argued, however, this special movement strategy is also indispensably at work with cumulative interpretations of relational plurals in combination with definite numerals, indefinite numerals as well as coordinations of proper names, so that there is independent motivation for it anyway and does thus not constitute a mere stipulation for analysing comparatives.

(14)



$\lambda d.\ \lambda x.$ x ran d-fast

With only slight modifications, this phrasal analysis for 'ordinary' comparatives then translates in a simple and straightforward manner to other comparison constructions. If I posit the lexical entry given in (15) for the equative operator *kadar*,

(15) $[[\textit{kadar}]] = \lambda x \in D_e.\ \lambda A \in D_{<d,<e,t>>}.\ \lambda y \in D_e.\ \max(\lambda d.\ A(d)(y)) \geq \max(\lambda d.\ A(d)(x))$

sentence (4) from above

(4) Maria Peter kadar uzun.
Maria Peter as...as tall
'Maria is as tall as Peter.'

will e.g. properly be predicted true iff '$\max(\lambda d.$ Maria is d-tall $\geq \max(\lambda d.$ Peter is d-tall)', i.e. iff Maria is at least as tall as Peter.[13]

[13] Once again, spatial limitations force me to confine myself to the case of the equative as one exemplary illustration, here.

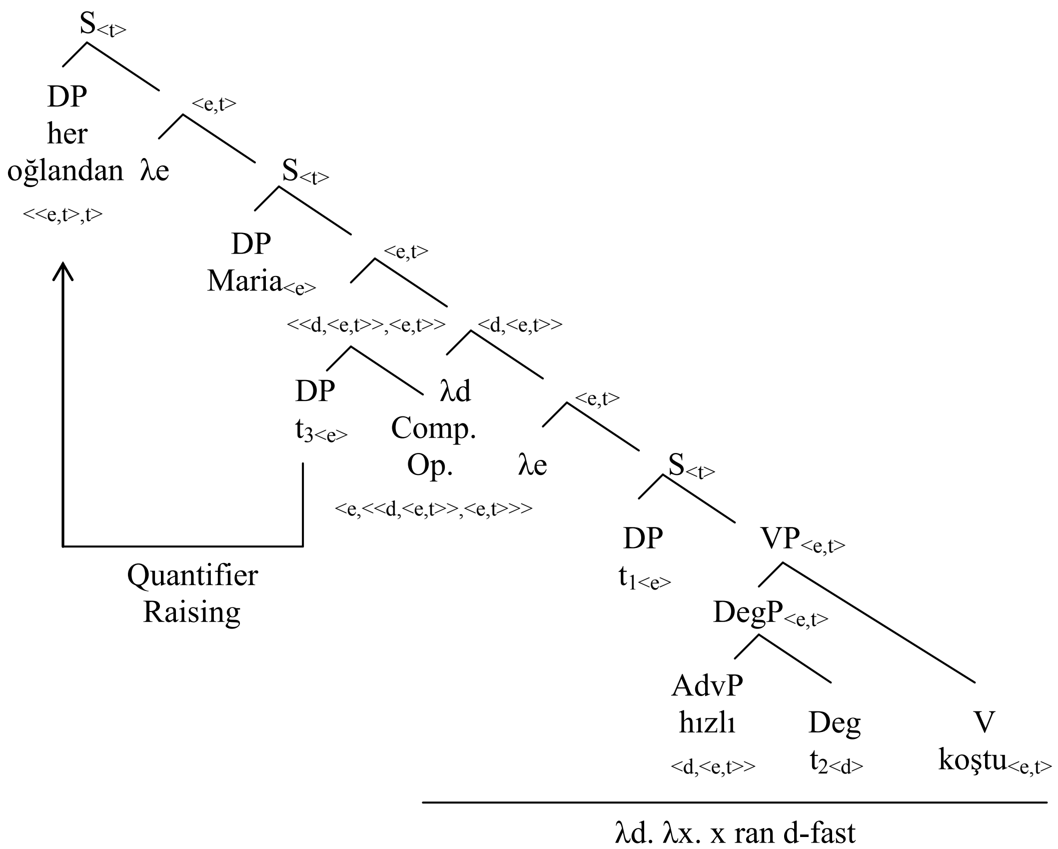
5 Predictions of the Phrasal Analysis for the Scopal Behaviour of the Comparative Operator and Quantified DPs

As a next step, I shall now take a closer look at what my phrasal approach to Turkish comparison constructions predicts for the scopal interaction of the comparative operator and quantified determiner phrases (DPs). To this end, I shall first consider (16), featuring a universally quantified DP in the standard term:

(16) Maria her oğlandan uzun.
Maria every boy.Abl. tall
'Maria is taller than every boy.'

Due to the fact that the Turkish comparison operator looks for two individuals (cf. (13) above), but finds only one individual and a quantified expression of semantic type <<e,t>,t>, instead, a type mismatch arises, which I suggest to remove by Quantifier-Raising (QR-ing) the string of words *her oğlandan* as indicated in the following logical form:

(17)



Observe now, that repairing the type mismatch in this fashion automatically predicts the quantified DP *her oğlandan* to outscope the comparative operator and thus that (16) only comes out true iff Maria is even taller than the tallest among the boys (cf. the truth conditions given in (18a)), and that it won't be considered true iff Maria is only taller than the shortest among the boys, which would correspond to the much weaker truth conditions (specified in (18b)), that would result from a logical form in which the comparative operator would have to take wide scope with respect to *her oğlandan*.

(18) a. $[[(16)]] = 1$ iff $\forall x$ [boy(x) $\rightarrow$ max(λd. Maria is d-tall) > max(λd. x is d-tall)]
b. $[[(16)]] \neq 1$ iff max(λd. Maria is d-tall) > max(λd. $\forall x$ [boy(x) $\rightarrow$ x is d-tall])

According to all my informants, the Turkish sentence (16) has – just as its corrseponding English counterpart *Mary is taller than every boy*. – only the first of the two alternative readings outlined above, so that my phrasal analysis in combination with the requirement to resolve a type mismatch, which cannot even generate the unattested reading, immediately predicts the correct scopal order of the comparative operator and a universally quantified DP.[14]

In a sentence containing an existentially quantified DP such as (19),

(19) Maria herhangi birinden uzun.
Maria somebody.Abl. tall
'Maria is taller than some other person.'

the emerging type mismatch would similarly be fixed by QR-ing *herhangi birinden*, which makes this quantified DP once again outscope the comparative operator and thus leads to the expectation that (19) should be considered true iff Maria is taller than some other person (cf. the truth conditions in (20a)), which is what sentence (19) actually means according to all my Turkish informants. And once again, the other reading with the reverse scopal order of the quantified DP *herhangi birinden* and the comparative operator, according to which (19) would come out true iff Maria is taller than everyone else is (cf. (20b)), is indeed unattested.

(20) a. $[[(19)]] = 1$ iff $\exists x$ [person(x) & max(λd. Maria is d-tall) > max(λd. x is d-tall)]
b. $[[(19)]] \neq 1$ iff max(λd. Maria is d-tall) > max(λd. $\exists x$ [person(x) & x is d-tall])

Finally, it is worth noting that even the counterpart of the totally ungrammatical English (21) is perfectly acceptable in Turkish (22), and that it once more has the reading in which the quantified DP *hiç kimseden* outscopes the comparative operator, so that (22) is true iff Maria is (the) shortest (as specified in (23a)) and lacks the

[14] For a detailed discussion of the scopal behaviour of quantified expressions in the standard term in English comparatives, cf. Schwarzschild & Wilkinson (2002), Heim (2006) or Beck (2009), among others.

alternative reading according to which (22) would have to be considered true iff Maria is simply not (the) tallest (cf. the truth conditions in (23b)), altogether.

(21) * Mary is taller than nobody.

(22) Maria hiç kimseden uzun değil.
Maria somebody.Abl. tall not
'Mary is not taller than anybody.'; intended as: 'Maria is taller than nobody.'

(23) a. $[[(22)]] = 1$ iff $\sim\exists x$ [person(x) & max(λd. Maria is d-tall) > max(λd. x is d-tall)]
b. $[[(22)]] \neq 1$ iff $\sim$max(λd. Maria is d-tall) > max(λd. $\exists x$ [person(x) & x is d-tall])

Additionally, one might consider cases with quantified DPs in the comparee, rather than the standard term, but given that the two potential readings are almost always indistinguishable in this case (cf. Heim (2001, pp. 217f.)), it does not really matter whether the quantified DP takes scope over the comparative operator, or whether the reverse situation obtains,[15] so that although these data are perfectly compatible with the phrasal approach outlined above, they do not really constitute further evidence in favour of it.

6 A Word on the Cross-linguistic Distribution of Phrasal and Clausal Comparatives

Having established the need for a genuinely phrasal approach to comparatives in a language like Turkish, I shall now address the question of what the Turkish data makes us expect with respect to the distribution of phrasal and clausal comparatives cross-linguistically. On the basis of data largely taken from Hindi-Urdu, Bhatt & Takahashi (2007) argue that clausal comparatives constitute the 'basic' type that is taken to be universal and that phrasal comparatives exist only in certain languages. They reach this

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[15] To see this, take an English sentence like

(i) Every boy is taller than Mary.

that would be associated with the two truth conditions in (ii) depending on the scopal order of the quantified DP and the comparative operator:

(ii) a. $[[(i)]] = 1$ iff $\forall x$ [boy(x) $\rightarrow$ max(λd. x is d-tall) > max(λd. Mary is d-tall)]
b. $[[(i)]] = 1$ iff max(λd. $\forall x$ [boy(x) $\rightarrow$ x is d-tall]) > max(λd. Mary is d-tall)

In spite of their quite distinct surface appearance, (iia) and (iib) actually state exactly the same thing, for if the maximal degree to which every boy is tall is larger than that to which Mary is tall, it follows that even the shortest among the boys and thus every boy automatically happens to be taller than Mary.

conclusion (i) by following up on Lechner (2004), who has it that in languages like English and German, all comparatives are underlyingly clausal, and (ii) by observing that Hindi-Urdu displays phrasal comparatives parallelling the ones I found in Turkish alongside with correlative constructions that are undoubtedly clausal in nature. In contrast to this, I should like to defend the exactly opposite hypothesis: Since Turkish is much more radical than Hindi-Urdu in not even allowing correlatives, all Turkish comparatives clearly have a purely phrasal status and I thus seem to have come across a "language that has only individual comparison", the existence of which was already stipulated in Kennedy (to appear, section 3.3). At the same time, I am absolutely convinced that even languages like English and German feature phrasal along with clausal comparatives, for which linguistic literature provides abundant evidence from syntax such as the (un-)availability of extraction operations (24) or that of reflexive pronouns bound by the matrix subject (25),

(24) a. You finally met somebody you're taller than.
b. * You finally met somebody you're taller than is.
[Kennedy (1997, p. 163)]

(25) a. No star is brighter than itself.
b. * No star is brighter than itself is.
[Kennedy (1997, p. 165)]

and empirical observations such as differences in meaning and/or acceptability between a phrasal comparative and its putative clausal source clearly point in this direction, too, as e.g. cases show where phrasal comparatives lack an obvious clausal counterpart (26), where the reverse situation obtains (27), or where the two sharply contrast in meaning (cf. the generic meaning of (28a) that disappears in (28b)):[16]

(26) a. John is older than me.
b. * John is older than me am/is.
[Lechner (2004, p. 179)]

(27) a. There couldn't have been any more people than there were.
b. * There couldn't have been any more people than there.
[Lechner (2004, p. 180)]

(28) a. He loved him more than a brother.
b. He loved him more than he loved a brother.
[Heim (1985, p. 18)]

[16] For additional evidence and detailed lines of argumentation defending the view that languages like English do indeed display both, clausal comparatives as well as truly phrasal ones that cannot be derived from underlying clausal sources, I refer the interested reader to Hankamer (1973), Hoeksema (1983), Napoli (1983), von Stechow (1984, section IX), Heim (1985, section 3.2) and Kennedy (1997, pp. 162-166; to appear, section 3.1).

Therefore, I rather assume phrasal comparatives to represent the 'basic' and potentially universal type of comparatives and that clausal ones are restricted to particular, English-like languages, instead.[17]

7 Conclusion and Outlook

In this paper, I have shown that Turkish comparatives never allow for a clausal standard term and thus cannot be analysed using the inherently clausal 'standard' English-like approach to comparatives, and that languages like Turkish require a truly phrasal account of comparison constructions, instead. I have developed such an analysis that successfully captures various sorts of Turkish comparison constructions and also makes the correct predictions with respect to the scopal behaviour of the comparative operator and quantified DPs, be these in the standard or in the comparee term. The radically phrasal status of Turkish comparatives furthermore led me to reject Bhatt & Takahashi (2007)'s assumption on the cross-linguistic distribution of phrasal and clausal comparatives and to hypothesise instead that it is the phrasal rather than the clausal type that constitutes the 'basic' comparison construction. And if my assumption that English features both, clausal as well as phrasal comparatives, is on the right track, the phrasal analysis could even be transferred to some English comparatives, where it might eventually solve a couple of long-standing problems such as differences in meaning between phrasal comparatives and their clausal counterparts or the fact that an English sentence like

(29) a. Mary is taller than every boy.

has only the reading where the quantified DP outscopes the comparative operator (cf. the truth conditions specified in (18a) above) and not the alternative one (cf. (18b)) with the reverse scopal order (Schwarzschild & Wilkinson (2002); Heim (2006, p.1)), which has hitherto remained unexplained, but follows neatly if I apply my phrasal analysis to this sentence, that cannot even generate the unattested alternative reading. The scope facts, however, seem to parallel those found in the corresponding clausal counterpart (29b).

(29) b. Mary is taller than every boy is.

[17] In Bhatt & Takahashi (to appear), the two authors altered their assumptions somewhat in that they now stipulate that both – phrasal and clausal comparatives – are available cross-linguistically and that it is rather the subcategorisational properties of the individual, language-specific comparative operators that account for their compatibility with phrasal and/or clausal complements. While it is largely unclear to me why phrasal and clausal comparatives should be taken to be universal if it is inherent properties of the specific operators that ultimately decide on their availability in a given language, I should still maintain that in my opinion, English *than* would have to subcategorise for phrasal as well as clausal complements under this approach, and not just for clausal ones only, and that Turkish would still differ from Hindi-Urdu in that, unlike its counterpart in the latter language, the Turkish comparative operator would have to subcategorise for phrasal comparatives, only.

A complete understanding of the English scope facts would therefore require an appropriate analysis of (29b) as well as a systematic way to decide on which English comparatives that display a phrasal surface structure are truly phrasal in nature, and which ones are just elliptical variants of a clausal source, which, however, remains yet to be investigated.

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Partial Semantics for Iterated *if*-Clauses

Janneke Huitink
Dept. of Philosophy/Dept. of Linguistics
University of Nijmegen/University of Groningen

janneke.huitink@gmail.com

Abstract

This paper argues in favor of a partial semantics for indicative conditionals, along the lines of a proposal made by Belnap in the seventies: conditionals only have a truth value if their antecedent is true, and in this case, their truth value equals the truth value of their consequent. I argue that this semantics offers a way out of the impasse following Gibbard's (1981) famous proof that if $\varphi \to (\psi \to \chi)$ and $(\varphi \wedge \psi) \to \chi$ are equivalent, $\to$ cannot be stronger than material implication.

1 Introduction

The present paper concerns the meaning of *if* in indicative conditionals. An example of such a conditional is (1):

(1) If it is snowing, it is cold.

I am going to explore a proposal made by Belnap (1970, 1973) which says that *if* corresponds to a two-place connective $\to$, with a partial semantics, informally as follows:

(2) $\varphi \to \psi$ only has a truth value if φ is true and if $\varphi \to \psi$ has a truth value, this is the truth value of ψ.

The structure of the paper is as follows. Section 2 introduces one of the problems that Belnap's partial semantics helps to solve: the problem of iterated *if*-clauses.[1] After that, section 3 discusses existing solutions and their problems. Then, in section 4 Belnap's semantics is introduced and I will explain how it deals with iterated *if*-clauses.

Of course, once we adopt a partial semantics, we are bound to alter the predictions that classical approaches make about the logic of conditionals. But I will argue in section 5 that we shouldn't be too worried about this. Finally, in 6 I will conclude the

[1] I actually believe that there are further reasons to adopt the partial semantics that I am championing here: (i) it offers a neat account of the interpretation of conditionals in the scope of quantifiers, and (ii) the interpersonal traffic of conditionals in dialogue seems to require a two-place connective just like the one I am advocating here. See Huitink (2008, chapter 5) for discussion.

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paper by some remarks on how the partiality that I propose to write into the semantics of *if* relates to the partiality that is often employed in theories of presupposition projection.

2 The problem: iterated *if*-clauses

2.1 Material implication and its paradoxes

In order to see what is problematic about iterated *if*-clauses, we must consider a traditional proposal about the meaning of *if*. Material implication goes back to Philo of Megara, but was championed by logicians like Frege and Russell. The idea is that an indicative conditional excludes the possibility that its antecedent is true while its consequent is false:

(3)

φ	ψ	$\varphi \supset \psi$
1	1	1
1	0	0
0	1	1
0	0	1

If you believe that *if* is truth functional, material implication is really the only reasonable option (in a classical system, that is). To see this, consider (4):

(4) If Mary and John are both in Paris, then Mary is in Paris.

This conditional is true, come what may. It is thus true when its components are (true, true), (false, true), or (false, false). Now, if conditionals are indeed truth-functional, it follows that they are *always* true in these cases, cf. Edgington (1995, 242).[2]

Nevertheless, material implication seems plain wrong as an analysis of indicative conditionals. In fact, associating the semantics of 'ordinary' indicative conditionals with $\rightarrow$ leads to counterintuitive predictions, known as *paradoxes of material implication* (see Bennett (2003) for an overview). These paradoxes have two sources:

1. Whenever the antecedent is false, the conditional is true.
2. Whenever the consequent is true, the conditional is true.

The first paradox is that the material implication analysis predicts that the falsity of the antecedent is sufficient to affirm the truth of a conditional. However, this doesn't seem to be borne out. We would not reason as follows: I am convinced that the Chinese will stay out of the conflict, therefore I am convinced that (5) is true (example from Stalnaker (1968)):

(5) If the Chinese enter into the Vietnam conflict, the United States will use nuclear weapons.

[2]Obviously, the components of (4) are such that it cannot happen that the antecedent is true while the consequent is false. Hence, (4) does not establish that conditionals should be false in this case. However, no one doubts that conditionals are false in this situation.

The second paradox is that, given an analysis of indicative conditionals as material implications, the truth of the consequent is predicted to be sufficient to affirm the truth of a conditional. This, too, seems unwarranted. If you believe that the US will use nuclear weapons, simply because of their arrogance, the low intelligence of their president or whatever, but have no opinions about the future actions of the Chinese, you wouldn't utter (5), which seems to state that there is some *connection* between the US warfare and Chinese politics. In sum, the problem with analyzing indicative conditionals as material implication is that this makes it far too easy for such conditionals to be true.

Several solutions have been proposed. Some have opted for a pragmatic defense, saying that conditionals with false antecedents (true consequents) are true, but infelicitous, e.g. David Lewis (1976), but it has convincingly been argued by Bennett (2003, 38-42) that such stories don't hold water. In short, the problem is that disbelief in its antecedent does not automatically mean that one shouldn't utter a conditional. Others have proposed stronger, modal truth conditions, i.e. strict implication by C.I. Lewis (1912, 1918). Conditionals do not just exclude that the antecedent is true while the consequent is false, but they claim that this is impossible. Such an analysis still gives rise to some paradoxes. For instance, if the antecedent is contradictory, the conditional is automatically true. Lewis thought that these paradoxes were less severe than those of material implication, but not everyone agreed (relevant logicians did not (Mares, 2008)).

2.2 Iterated *if*-clauses

We are now ready to state the problem about iterated *if*-clauses. The problem is that the following two sentences are equivalent. In fact, both are trivial (Edgington, 1995):

(6) a. If it rains or snows tomorrow, then if it doesn't rain tomorrow, it will snow.
 b. If it rains or snows tomorrow and it doesn't rain (tomorrow), it will snow.

Why is this problematic? This: Gibbard (1981) famously proved that it follows from this equivalence that indicative conditionals cannot have stronger truth conditions than material implication.

Let $\rightarrow$ stand for the indicative conditional, without prejudging its semantics, and suppose we adopt the following principles:

(i) $\varphi \rightarrow (\psi \rightarrow \chi) \equiv (\varphi \wedge \psi) \rightarrow \chi$
(ii) $\varphi \rightarrow \psi \models \varphi \supset \psi$
(iii) If $\varphi \models \psi$, then $\models \varphi \rightarrow \psi$

These principles appear unremarkable. The first of these is just the equivalence we want to account for. Principle (ii) says that whatever truth conditions we assign to $\rightarrow$, they should be such that our conditional entails material implication. It seems agreed upon in the literature that we want this. Note that the modal analysis just alluded to (i.e. strict implication) makes it true. Finally, principle (iii) says that if one sentence entails another, it implies this sentence. For example, 'Mary and John are both in Paris' entails 'Mary is in Paris', and 'If Mary and John are both in Paris, then Mary is in Paris' is indeed tautological.

Yet given these principles, we can proof that indicative conditionals cannot be stronger than material implication. The proof proceeds by showing that (7) is a tautology and that it entails (8):

(7) $(\varphi \supset \psi) \to (\varphi \to \psi)$

(8) $(\varphi \supset \psi) \supset (\varphi \to \psi)$.

To see that (7) is a tautology, note that it is by (i) equivalent to $((\varphi \supset \psi) \wedge \varphi) \to \psi$. This, in turn, is equivalent to $(\varphi \wedge \psi) \to \psi$ (by proposition logic). By (iii), this formula is true in any world. Now, given that $\to$ entails $\supset$ (principle (ii)) (7) entails (8). Now, as (8) is entailed by a tautology, (8) must itself be a tautology, and this must be because its antecedent entails its consequent. It follows that $\to$ cannot have stronger truth conditions than $\supset$.

3 Previous solutions

3.1 Kratzer's solution

Let's now discuss some solutions in the literature. First, Kratzer (1991) argues that Gibbard's proof shows that we were mistaken to assume that such things as conditional connectives exist. She wrote that:

> The history of the conditional is the story of a syntactic mistake. There is no two-place *if... then* connective in the logical forms of natural languages. *If*-clauses are devices for restricting the domains of various operators. Whenever there is no explicit operator, we have to posit one. (Kratzer, 1991, 656)

Take (9), in which a conditional occurs in the scope of a modal:

(9) If it is snowing, it must be cold.

Intuitively, the *if*-clause provides the restrictor of the modal, i.e. quantification ranges over worlds in which it is snowing. This follows if the modal and the *if*-clause are interpreted as a single quantifier-restrictor complex.

(10) (must if it is snowing) (it is cold)
"in all accessible worlds where it is snowing, it is cold"

Of course, not all conditionals occur embedded under an overt quantificational operator, but Kratzer assumes that in these cases, we must postulate a covert operator, which is usually an epistemic necessity modal like *must*. So (11) is analyzed as equivalent to (9), which seems right:

(11) If it is snowing, it is cold.
$\approx$ If it is snowing, it must be cold
"in all accessible worlds where it is snowing, it is cold"

We can now see how Krater would analyze iterated *if*-clauses. She proposes to treat such *if*-clauses as stacked relative clauses, which results in successive restriction of the domain:

(12) If it rains or snows tomorrow, then if it doesn't rain tomorrow, it will snow.
"in all worlds in which it rains or snows tomorrow and in which it doesn't rain tomorrow, it will snow"

Though this gets the predictions right, it requires to drastically rearrange various parts of the sentence (at surface, the *if*-clause occurs sentence-initially, far away from the covert operator that it is supposed to restrict).

Particularly problematic is the position of *then*. Intuitively, this word is some anaphoric element which picks up the *if*-clause (in von Fintel's (1994, chapter 3) version of the analysis, *then* is a phonetic realization of the modal's restrictor variable). However, then it occurs in the wrong place. Compare:

(13) a. If it rains or snows tomorrow, *then* if it doesn't rain tomorrow, it will snow.
b. If it rains or snows tomorrow, if it doesn't rain tomorrow, *then* it will snow.

We want to account for the meaning of (13a), but on Kratzer's analysis one would expect that this meaning could only be expressed by (13b).

3.2 Schlenker's solution

To solve the syntax-semantics mismatch associated with Kratzer's analysis, Schlenker (2004) proposes that *if*-clauses are plural definite descriptions of possible worlds. He would analyze our sentence as follows:

(14) If it rains or snows tomorrow, then if it doesn't rain tomorrow, it will snow.
[ιW: it rains or snows tomorrow (W)][ιW′: W′ $\subseteq$ W and it doesn't rain tomorrow (W′)][all w: w $\in$ W′] (it will snow (w))

Thus, Schlenker takes over Kratzer's assumption that the sentence contains a covert quantifier over possible worlds, but the relevant domain is now determined in a different way. The first *if*-clause denotes all and only those worlds in which it rains or snows. The second *if*-clause narrows this further down to just those worlds in which it rains or snows but doesn't rain. It is asserted that in all of the remaining worlds it snows.[3] Crucially, the (covert) modal in (14) is interpreted *in situ*. Hence, this representation is more natural than Kratzer's analysis from a syntactic point of view. However, the analysis makes different predictions than Kratzer does. For instance, it is now expected

[3]This analysis goes back to Schein (2003), who proposed it to solve a puzzle raised by Barker (1997): if pronouns go proxy for definite descriptions (as the E-type approach has it), how to account for sentences like (i)?

(i) If a theory is classical, then if it is inconsistent, it is usually trivial.

Here, the second occurrence of *it* is to be analyzed as 'the classical inconsistent theory', but this interpretation cannot be derived if *usually* is restricted by the coordination of the *if*-clauses.

that modals can also collectively quantify over the worlds supplied by the *if*-clause. But, as far as I know, such cases have not been attested.

4 Belnap's partial semantics

4.1 Conditional assertion

Belnap (1970, 1973) presents his conditional semantics as a formalization of the idea that conditionals make *conditional assertions*. He traces this idea back to Quine:

> Now under what circumstances is a conditional true? Even to raise this question is to depart from everyday attitudes. An affirmation of the form 'if p then q' is commonly felt less as an affirmation of a conditional than as a conditional affirmation of the consequent. [At this point, Quine credits Dr. Philip Rhinelander in a footnote - JH] If, after we have made such an affirmation, the antecedent turns out true, then we consider ourselves committed to the consequent, and are ready to acknowledge error if it proves false. If on the other hand the antecedent turns out to have been false, our conditional affirmation is as if it had never been made. (Quine, 1950, 12)

To see the point, consider (15), which is taken from McDermott (1996) and concerns the result of the next roll of an ordinary, six-sided dice:

(15) If it is even, it will be a six.

Suppose that you had bet on (15). It seems clear that the bet is won when the result of the next roll is six, and lost when the result is four. But what if it is five? McDermott reports that most people assume that the bet is called off in this case.

Belnap wanted to give a semantic version of conditional assertion. He originally proposed the following in Belnap (1970) (still somewhat vague; to be made precise below):

(16) If φ is true in w, then what $\varphi \rightarrow \psi$ asserts in w is what ψ asserts in w. If φ is false or nonassertive in w, then $\varphi \rightarrow \psi$ is nonassertive in w.

But this doesn't allow for iterating *if*-clauses. Therefore in Belnap (1973) he added the restriction that the scope should be assertive:

(17) If φ is true in w and ψ is assertive in w, then what $\varphi \rightarrow \psi$ asserts in w is what ψ asserts in w. If φ is false or nonassertive in w or if ψ is nonassertive in w, then $\varphi \rightarrow \psi$ is nonassertive in w.

Now, the phrase 'what $\varphi \rightarrow \psi$ asserts in w is what ψ asserts in w' can be understood in two ways. It could be that $\varphi \rightarrow \psi$ has the truth value of its consequent, or it could be that it expresses the same proposition. Then w is a part of the context rather than an index of evaluation. Belnap chose this second option. He reckoned the first option was rather boring, writing that what $\varphi \rightarrow \psi$ asserts in w is identical to what ψ asserts in w "does not boringly mean an identity of truth-values but an identity of propositional content" (Belnap, 1970, 4).

However, I think that the interesting semantics is not at all what we want for conditionals. To see the problem, consider the following example by Edgington (1995, 289):

(18) If you press that switch, there will be an explosion.

Clearly, my saying (18) might well save your life, especially when the antecedent is false. But how is this possible if (18) fails to assert a proposition? How can (18) ever be used to persuade you to not press that switch, if my utterance of it fails to communicate something for you to grasp?[4]

So I define conditional assertion as follows:

(19) $\varphi \rightarrow \psi$ is defined in a world w if φ is true in w and ψ is defined in w
If defined, the truth value of $\varphi \rightarrow \psi$ in w is the same as the truth value of ψ in w

Notice incidentally that (18) also suggests that we should change the norm for assertion. Classically, one should only assert something if one knows/beliefs (depending on your favorite theory of assertion) that it is true. But then (18) couldn't felicitously be asserted, as it probably has no truth value. In our partial system, however, the norm for asserting a proposition should be the knowledge/belief that it is true, given that it has a truth value, cf. McDermott (1996).

Belnap championed this semantics because he wanted to give a uniform analysis of *every crow* and *some crow* as 'for every x, if x is a crow' and 'for some x, if x is a crow', respectively. (Recall that classically, the domain of a universal quantifier is restricted by a conditional, but for existential quantifiers a conjunction is used.)

(20) a. Every crow is black.
for every x, if x is a crow, x is black
b. Some crow is black.
for some x, if x is a crow, x is black

If quantifiers care only about cases for which their scope is defined, this works: "for some x for which 'if x is a crow, x is black' is defined, i.e. for some x which is a crow, it is true that x is black". However, for ordinary restricted quantification, as supplied by common nouns, this is unattractive. First, no one believes that quantifiers are unary operators. Second, this involves postulating an inaudible *if*. Although I don't think Belnap's semantics should be employed in a uniform analysis of (20a) and (20b), I do believe that it provides a solution to the problem of iterated *if*-clauses, which I will argue for next.

[4]Note that the last statement of Quine's quote is thus plain false.

4.2 Solving Gibbard's problem

We can now analyze our sentence as follows:

(21) If it rains or snows tomorrow, then if it doesn't rain tomorrow, it will snow.
(it rains or snows tomorrow) $\rightarrow$ (it doesn't rain tomorrow $\rightarrow$ it will snow)

If (21) has a truth value, i.e. if it rains or snows, and if the embedded conditional has a truth value, i.e. if it doesn't rain, it snows. That is, it snows if it rains or snows but doesn't rain. So (21) comes out equivalent to (22):

(22) If it rains or snows tomorrow and it doesn't rain tomorrow, then it will snow.

Note that on this theory, there is no mismatch between syntax and semantics, as this representation mirrors the surface form of (21). Of course, on this semantics, neither of these sentences comes out as trivial, because they may be undefined (the antecedent may not be true). However, they do come out trivial on the assumption that the sentences have a truth value. Clearly, if they have a truth value, this value is most definitely true. Below in section 5, I will argue that our every-day judgments of validity and triviality are guided by the assumption that the statements involved are defined. That is, I will propose to combine Belnap's semantics with what is known as Strawson-entailment (von Fintel, 1999).

Summing up, there is another way to avoid the conclusion that if we want to have the equivalence between (6a) and (6b), material implication is the only candidate for indicative conditionals. We can assign partial truth conditions to indicative conditionals. This suggests that Gibbard's proof only holds in a classical, two-valued system. Indeed, in a partial system, it is plain that Gibbard's principles do not straightforwardly hold. The problem is his third principle, repeated here:

(iii) If $\varphi \models \psi$, then $\models \varphi \rightarrow \psi$

Given Belnap's semantics, this is simply not true. If all worlds that make φ true are worlds that make ψ true, it doesn't follow that all worlds make $\varphi \rightarrow \psi$ true, for some worlds are $\neg\varphi$-worlds and in these worlds, $\varphi \rightarrow \psi$ has no truth value.

5 Logical implications

By adopting a partial semantics for *if*, we loose the validity of certain laws which "warm the cockles of a logician's heart", as (Belnap, 1973, 51) nicely puts it. Indeed, Lycan (2006) sees this this as the main objection against conditional assertion theories. In Belnap's semantics, the following do no longer hold:[5]

[5]It is very likely that even more laws do no longer hold. We restrict attention to Contraposition and Or-to-if-inference, because the invalidity of these particular two is often used as an argument against conditional assertion theories, see for instance Lycan (2006).

(23) a. Contraposition:
$\varphi \to \psi \equiv \neg\psi \to \neg\varphi$
b. Or-to-if-inference:
$\varphi \vee \psi \models \neg\varphi \to \psi$

Any world in which $\varphi \to \psi$ is true, is a world in which ψ is true, and therefore a world in which $\neg\psi \to \neg\varphi$ lacks a truth value. It is easy to see that the reverse direction doesn't hold either. Contraposition is thus ruled out. As for Or-to-if-inference, some worlds in which $\varphi \vee \psi$ is true will make φ is true. These worlds will clearly not make $\neg\varphi \to \psi$ true.[6][7]

This is a problem, for Contraposition and Or-to-if-inference do seem to hold for natural language indicative conditionals, as (24) and (25) respectively show:

(24) If it is raining, we won't play.
Therefore, if we play, it isn't raining.

(25) Either Oswald killed Kennedy, or someone else did.
Therefore, if Oswald didn't kill Kennedy, someone else did.

But if Contraposition and Or-to-if-inference are not valid, then why are (24) and (25) such compelling arguments? I submit that our judgments about the validity of (24) and (25) come about by the tacit assumption that the premise and conclusion have a truth value.

Strawson (1952) considers ways to make the inference from the Aristotelean A-form to the Aristotelean I-form valid:

(26) Every crow is black.
Therefore, some crows are black.

Traditionally, the inference in (26) is not justified, for its premise is true in models in which there are no crows, yet its conclusion is clearly false in such a model. However, most English speakers find (26) valid.

Strawson sought to solve this puzzle by (i) abandoning the assumption that all sentences necessarily have a truth value, and (ii) redefining the notion of entailment. He assumes that A-forms are neither true nor false in case their subject term is empty. In addition, Strawson assumes that cases in which the subject term is empty are irrelevant as far as entailment is concerned:

> The rule that A entails I states that, *if corresponding statements of these forms have truth values*, then if the statement of the A form is true, the statement of the I form must be true; and so on. (Strawson, 1952, 177)

[6] The reverse direction 'If-to-or-inference' of course does come out: any world in which $\neg\varphi \to \psi$ is true, is a world in which $\varphi \vee \psi$ is true in all worlds.

[7] All I am presuming here about the meaning of $\neg$ and $\vee$ is that $\neg\psi$ is not true if ψ is, and that $\varphi \vee \psi$ is true if φ is. I consider this uncontroversial. Yet the reader may wonder about the semantics of connectives other than $\to$, now that we are working in a partial system. The semantics that Belnap assumes comes down to strong Kleene, except of course his definitions for $\to$.

Let $\models_S$ be the kind of entailment that Strawson had in mind. This can be defined as follows:

> $\varphi \models_S \psi$ iff
> $\varphi, \chi \models \psi$ (i.e. φ, χ classically entails ψ)
> where χ is a premise stating that the definedness conditions of all statements involved are satisfied

It is easy to see that (26) is Strawson-valid. The premise presupposes that there are crows. Strawson thought of this as a precondition for the premise to have a truth value: only if there are crows, can 'Every crow is black' be true or false. It follows that provided that the premise of (26) has a truth value, we are justified to conclude that some crows are black.

Belnap (1973) himself refers to this notion of entailment as a useful one for conditional assertion. Indeed, both Or-to-if-inference and Contraposition turn out to be Strawson-valid:

(27) a. Contraposition:
$\varphi \rightarrow \psi \equiv_S \neg\psi \rightarrow \neg\varphi$
b. Or-to-if-inference:
$\varphi \vee \psi \models_S \neg\varphi \rightarrow \psi$

Contraposition follows, i.e. $\varphi \rightarrow \psi, \neg\psi \models \neg\psi \rightarrow \neg\varphi$ because there is no world which makes $\varphi \rightarrow \psi$ and $\neg\psi$ true. The same holds for the other direction. Clearly, Or-to-if-inference is also Strawson-valid: any worlds in which $\varphi \vee \psi$ is true and in which $\neg\varphi \rightarrow \psi$ has a truth value, is a world in which $\neg\varphi \rightarrow \psi$ is true. Thus, assuming that the statements are either true or false, we get the inferences we want.

What does this mean for our inferences in (24) and (25)? In as far as these are valid, they are enthymematic inferences, i.e. inferences that rely on an additional tacit premise: that the statements involved have a (classical) truth value. It could well be that Strawson-entailment describes the way that human reasoning naturally works. Moreover, it seems that other linguistic phenomena are also sensitive to Strawson-entailment: von Fintel (1999) argues that NPI licensing is sensitive to Strawson-downward entailment.

Note that it also follows that (28a) and (28b) are Strawson-valid (they are Strawson-entailed by any tautology):

(28) a. If it rains or snows tomorrow, then if it doesn't rain tomorrow, it will snow.
b. If it rains or snows tomorrow and it doesn't rain tomorrow, then it will snow.

If our intuitions are indeed guided by Strawson-entailment, it is thus explained why these sentences, even though they are strictly speaking not tautologies, nevertheless seem trivial.

6 Relation to presupposition

Truth value gaps have often been used to model presuppositions, but the partiality we have written into the semantics of *if* must obviously be distinguished from presupposition. This was already observed by Belnap:[8]

> Suppose we say that A S-"presupposes" B if whenever A is assertive$_w$, B is true$_w$. This is, I take it, a semantic rendering in the present context of Strawsonian presupposition, for then to say that A S-"presupposes" B is to say that the truth of B is a necessary condition for the assertiveness of A. But then it turns out for categorial A that (A/B) S-"presupposes" A, for the truth of the antecedent, A, is a necessary condition for the assertiveness of the conditional, (A/B), and indeed is the paradigm case of such. But it would be mad to suggest that "If Sam is a crow, then Sam is black" presupposes "Sam is a crow", a madness which accounts for the shudder quotes in 'S-"presupposes"'. For A to presuppose B in the pragmatic sense, it should be the case that one who utters A somehow commits himself to the truth of B. It should be that he has done something pragmatically unacceptable if he utters A when B is false. Something like this surely obtains when one utters "The present king of France is bald". But of course the whole point of conditional assertion is to be able to avoid any commitment whatsoever when the antecedent turns out false. Thus, although definable, S-"presupposition" should not be taken as a semantic analogue of pragmatic presupposition. (Belnap, 1973, 70)

Someone who utters 'All John's children are bald' in case John has no children, counts as having misled her audience. But this does not hold for a speaker who uttered a conditional with a false antecedent. In fact, if conditionals presupposed their antecedent, one would expect that natural language didn't contain any conditionals. On Gricean assumptions, if it were given that John has children, one shouldn't say 'If John has children, they are bald', but just 'His children are bald'.[9]

Perhaps we should assume that the presupposition of conditionals is of the kind that is never already given, but that always has to be accommodated? This won't work. Following Gazdar (1979), it is usually assumed that conditionals 'If φ, ψ' give rise to the clausal implicatures $\Diamond\varphi$ and $\Diamond\neg\varphi$, and that if a presupposition clashes with a clausal implicature, the implicature 'wins', i.e. the presupposition is canceled. It follows that if conditionals presupposed their antecedent, this presupposition would automatically be canceled.[10] To sum up, Belnap-partiality must be concluded to have nothing to do with presupposition.[11]

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[8]Note that Belnap uses the slash / as his conditional connective, whereas I use the arrow $\rightarrow$.

[9]Ordinarily, that is. In some situations, for instance in an argument via modus ponens it is allowed to assert a conditional whose antecedent is already given.

[10]See also Stalnaker (1975) and van der Sandt (1988), though these authors do not work in Gazdar's framework. For instance, in van der Sandt's system, the presupposition is canceled because it clashes with the fact that the conditional was uttered. Of course, the underlying intuition is similar to Gazdar's.

[11]Soames (1989) distinguishes so-called 'expressive presuppositions':

Given some presupposition theories, this is problematic. For instance, Heim's (1983) context change potentials are essentially based on a partial semantics. If we were to combine this theory with our Belnap-semantics, we would thus be assuming two distinct kinds of partiality. But this seems impossible in as far as undefinedness comes down to a lack of semantic value; how can we distinguish between two non-existing values? On the other hand, other presupposition theories, most notably the anaphoric binding theory of van der Sandt (1992); Geurts (1999), are fully independent of truth value gaps. Adopting Belnap's semantics thus does not automatically commit us to there being different kinds of undefinedness. At any rate, it is clear that Belnap-gaps just are not presupposition-gaps.[12]

7 Conclusion

In this paper I have argued in favor of a new way to avoid Gibbard's conclusion that the meaning of iterated *if*-clauses implies that the semantics of *if* cannot be stronger than material implication. The solution is to assign a partial semantics to indicative conditionals: a conditional only has a truth value in case its antecedent is true. And if the antecedent is true, the truth value of the entire conditional is the truth value of the consequent. I have argued that this semantics can be made to yield a plausible logic for conditionals, and I have explained why Belnap-partiality should be distinguished from the partiality that is often associated with presupposition failure.

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(i) Sentence S expressively presupposes proposition A relative to a context of utterance C iff the truth of A is necessary for S to semantically express a proposition in C.

So perhaps, had we opted for the less boring version of Belnap's semantics, we would have been able to link Belnap-partiality to (a very specific kind of) presupposition. But of course, we have good reason not to have opted for this semantics.

[12]Note that the difference between presupposition and conditional assertion just alluded to provides another reason why we shouldn't recruit Belnap's semantics for all kinds of domain restriction. Quantifiers are normally felt to presuppose their domain (Strawson, 1952; Geurts & van der Sandt, 1999), precisely because uttering "Every crow is black" in case there are no crows is misleading. But analyzing this sentence in terms of $\rightarrow$ would suggest that it is felicitous if there are no crows.

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Bridging Reference to Eventualities

Matthias Irmer
Dept. of Linguistics
University of Leipzig

mirmer@uni-leipzig.de

Abstract

Bridging anaphora can refer not only to previously introduced discourse entities, but also to abstract entities such as eventualities. The proposal made in this paper is to extend the current account of bridging in SDRT in a way that implicit reference to eventualities can be accounted for. We exploit the idea developed in Frame Semantics that world knowledge is organized in frames. With each eventuality introduced in a discourse, a corresponding frame is evoked in the discourse model. SDRT will be extended to include possibly underspecified representations of frame elements, which can give clues for finding suitable antecedents in bridging anaphora.

1 Introduction

Natural language discourses consisting of several utterances are more than merely stringing the utterances together. Discourses are structured and there are relationships between utterances at various levels. Basically, one can distinguish coherence and cohesion in a discourse. On the one hand, text segments are connected by discourse relations, yielding coherence of a discourse. On the other hand, there are many anaphoric relations within a single utterance as well as spanning bigger distances. They are responsible for cohesion in a text. Various types of anaphora can be distinguished - they can be either direct, e.g. if a pronoun is used, or more indirect, if there is some connection but no direct coreference between discourse entities. Clark (1977) called these cases of anaphora *bridging* anaphora. In a bridging anaphor, an entity introduced in a discourse *stands in a particular relation* to some previously mentioned discourse entity. This bridging relation is not explicitly stated. Yet it is an essential part of the discourse content because the knowledge of these relations is necessary for successfully interpreting a discourse.

Clark differentiated various kinds of bridging inferences. The most prominent type is indirect reference by association, where the antecedent is *closely associated* with a discourse entity mentioned before. There is some literature concerning these cases (cf. Asher and Lascarides, 1998a; Piwek and Krahmer, 2000). Another type of bridging is indirect reference by characterization, where the bridging relation *characterizes a role that* *something implicitly plays* in an eventuality[1] mentioned before. Roles can be optional or necessary agents, objects, or instruments. Less work is done on this topic. Koenig and Mauner (1999) deal with reference to thematic arguments, and Bos *et al.* (1995) propose a lexical account for bridging. In this paper, we want to investigate how extralinguistic information sources constrain bridging references to eventualities. We will take Clark's example (1) as a prototypical case.

(1) a. John was murdered yesterday.
 b. The knife lay nearby.

Utterance (1-a) describes a killing event which took place on the day preceding the utterance. The individual referred to by the proper name "John" is the victim of the event. Utterance (1-b) describes a state of the entity denoted by the definite noun phrase "the knife"[2]. This entity is new in the discourse, but stands in an implicit relation to the event described in utterance (1-a): the knife served probably as the instrument of the killing event. This relationship is not expressed by linguistic means. Instead, the hearer has to infer it using contextual knowledge. Apart from understanding the previous utterance, successful interpretation of (1-b) requires some world knowledge: in a murdering event, there must be a victim and a killer, and normally there is also an instrument used for performing the act.

Only by means of this additional knowledge, the hearer can successfully interpret the utterance and connect it to the preceding discourse. In this way, interpretation involves incrementally constructing a structured mental representation of the discourse. It is structured in the sense that rhetorical relations hold between discourse segments. In example (1), utterance (b) is subordinated to (a), providing background information. Neither these relations between utterances nor relations between discourse entities (including eventualities) have necessarily to be expressed directly by linguistic means. They often exist only implicitly, forcing the hearer to infer them using defeasible pragmatic inferences. In a successful interpretation, all information, not only directly expressed but also indirectly inferred, will be part of the discourse model constructed by the hearer in course of interpretation. The discourse model, as Cornish (1999) puts it, is "a constantly evolving representation of the entities, propositions, eventualities, properties, and states, as well as their interrelations, which are introduced into the discourse, or are assumed already to exist therein, at particular points". We adopt Segmented Discourse Representation Theory (SDRT, Asher and Lascarides, 2003) as theory of modelling discourse structure and processes, a theory that has already been formalized in considerable detail.

The remainder of this paper is organized as follows. In section 2, we will summarize the current account of bridging in the framework of SDRT and introduce the basic

[1] We use the term *eventuality* for uniformly referring to events, states, actions or circumstances.

[2] There are also cases of referring indefinite noun phrases which convey a bridging relation. In (i), "a knife" clearly refers to the probable instrument of murdering, almost identically as in example (1).

(i) John was murdered yesterday. A knife lay nearby.

As the literature on bridging mainly focuses on definite descriptions, we will concentrate on utterances involving definites. Different behaviour of indefinites is indicated whenever necessary.

ideas of Frame Semantics before we propose to integrate these two lines of research. Section 3 shows how bridging references can be solved using the proposed account. In section 4, we discuss related approaches, and we conclude in section 5.

2 Using Frame Semantics for Bridging in SDRT

2.1 Bridging in SDRT

We assume that the hearer is familiar with the basics of dynamic semantics (DRT, Kamp and Reyle, 1993). SDRT (Asher and Lascarides, 2003) is an extension of DRT with basically two new expressions: (i) speech act discourse referents, which label content of text segments and keep track of token utterances, and (ii) rhetorical relations, which relate speech act discourse referents. The resulting structures are segmented DRSs (SDRSs).

In SDRT, bridging inferences are seen as "a byproduct of computing how the current sentence connects to the previous ones in the discourse" (Asher and Lascarides, 1998a). Four meta-rules for bridging are stated:

1. **If possible use identity.**
2. **Bridges must be plausible.**
3. **Discourse structure determines bridging.**
4. **Maximize discourse coherence.**

The first rule reflects the empirical preference of resolving anaphora to an identical antecedent. This rule is the preferred rule; if resolution to identity is not possible, then the other rules apply in the indicated order. The second rule means that world knowledge "specifies certain plausible ways of filling the underspecified parameters in the presupposed material". Thus, plausibility relies on world knowledge, but is not precisely defined. We will try to refine this notion in a more constrained way. The third rule states that if a rhetorical relation between the involved discourse segments gives particular clues for resolving the anaphora, then this information is to be used. The fourth rule is one of the most basic principles assumed in SDRT. In discourse interpretation, there is a preference for resolving bridging anaphora in a way that maximizes discourse coherence.

To see more formally how bridging inferences a drawn in SDRT, we will concentrate on the meaning representation of definite descriptions triggering bridging inferences. In Russellian tradition, the denotation of a definite noun phrase can only be given if it fulfills the conditions on existence and uniqueness. This can be written in a short form using the iota operator ι which maps a set containing only one element to this element. An expression $\iota x.P(x)$, representing the core meaning of "the P", denotes x if $\exists x.P(x) \wedge \forall x'[P(x') \rightarrow x' = x]$ is true; if not, it is not defined. Chierchia (1995, p. 221) extends this notion and includes a contextual parameter B for a bridging relation. He claims that "the P" denotes a P that is related by B to an antecedent a to be specified by context. B restricts the domain and must be included in the uniqueness condition.

Building on that, Asher and Lascarides (1998a, p. 87) characterize the meaning of a definite noun phrase as $\lambda Q.Q(\iota x(B(x,a) \wedge P(x)))$. This expression applies a predicate Q (the verb meaning) to the entity x, for which P (the meaning of the NP) is true and that is related by a bridging relation B to some contextually given antecedent a.

This meaning characterization corresponds to the SDRT representation shown in (2). Note that the condition of uniqueness is now represented by the DRS condition consisting of the two small DRSs connected by $\Rightarrow$. The representation of an indefinite noun phrase would be very similar, in the sense that we just leave out the uniqueness condition and keep the rest of the conditions.

(2)
$$\lambda Q \begin{array}{|c|} \hline u,v,R \\ \hline u: \begin{array}{|c|} \hline e,x,a,B \\ \hline \begin{array}{c} Q(x,e),P(x), \\ B(a,x),B=?,a=? \end{array} \quad \begin{array}{|c|} \hline x' \\ \hline P(x') \\ B(a,x') \\ \hline \end{array} \Rightarrow \begin{array}{|c|} \hline \\ \hline x'=x \\ \hline \end{array} \\ \hline \end{array} \\ R(u,v),R=?,v=? \\ \hline \end{array}$$

There are two underspecifications to be specified by pragmatic inference: Firstly, a coherence relation $R(u,v)$ has to be established. According to Asher and Lascarides (1998b), a definite description triggers a coherence relation between the current utterance u and some previous utterance v. Secondly, in the bridging relation $B(a,x)$, the parameters B and a have to be specified (Asher and Lascarides, 1998a). For direct anaphora, B is *identity*. For indirect reference by association, B can be *part-of* or *member-of*. For indirect reference by characterization, B is a thematic role, e.g. *agent*, *theme*, or *instrument*. The question we want to go further into is what kind of information can we exploit to help us drawing these inferences.

2.2 Frame Semantics and FrameNet

To get clues for the resolution of this kind of bridging inferences, we propose to exploit an idea already mentioned in Gardent *et al.* (2003), but not further pursued. The idea is to use Frame Semantics, developed by Fillmore (1976), and subsequent work on FrameNet (Baker *et al.*, 1998; Fillmore *et al.*, 2003). This framework is based on the central assumption that world knowledge is organized in frames. Basic units are frames and lexical units. Frames are mental representations of stereotypical situations, whose elements can only be defined by relating one to another. A lexical unit is a pairing of a word with a meaning; polysemous words are represented by several lexical units. Every lexical unit **evokes** a particular frame and can only be understood in relation to that frame.

FrameNet (Baker *et al.*, 1998) is a lexical resource providing a body of annotated sentences based on frame semantics. The database contains around 10,000 lexical units, 800 semantic frames and over 120,000 example sentences. Frames are hierarchically organized: e.g. the frame *Killing* inherits the properties from the more general frame *Transitive_action*, which in turn inherits from the abstract frame *Event*. A frame consists of various **Frame Elements**, kinds of entities that can participate in a frame. They are defined in relation to a frame, and correspond roughly to thematic roles in an event. Sometimes, conceptually necessary Frame Elements do not show up in a sentence. This is the case of omitted agents in passive sentences (Constructional Null Instantiation, CNI), missing obligatory elements that can be inferred from the context (Definite Null Instantiation, DNI), or implicit arguments of certain transitive verbs that are used intransitively, e.g. verbs as *eat*, *bake* (Indefinite Null Instantiation, INI). For illustration, the *Killing* frame is described below in Fig. 1, and one of the lexical units evoking that frame, the verb *murder*, is characterized in Fig. 2.[3]

Definition: A Killer or Cause causes the death of the Victim.

Core Frame Elements :

FE	description	inherited FE	semantic type
Killer	The person or sentient entity that causes the death of the Victim	Agent	sentient
Victim	The living entity that dies as a result of the killing	Patient	sentient
Instrument	The device used by the Killer to bring about the death of the Victim	Instr.	physical entity
Cause	An inanimate entity or process that causes the death of the Victim	Cause	
Means	The method or action that the Killer or Cause performs resulting in the death of the Victim	Means	state of affairs

Non-Core Frame Elements: Beneficiary, Manner, Place, Purpose, Time, ...

Lexical Units: annihilate.v, annihilation.n, ..., murder.n, murder.v, murderer.n, ..., terminate.v

---

Figure 1: The *Killing* frame

As can be seen in Fig. 2, there are three cases among the 23 annotated sentences in the FrameNet database containing the lexical unit *murder.v* in which the *Killer* was not expressed at all (CNI), and the *Victim* showed up as external argument of the verb. This configuration is typical for passive sentences like (1).

An important question is whether a linguistic expression denoting an eventuality, e.g. a verb, evokes at most one frame, exactly one frame, or more than one frame[4]. As said above, in FrameNet, a *lexical unit* is defined as a pairing of a word with a sense. For a polysemous word, “the separate senses of the word correspond to the different (sets of) frames that the word can participate in. When a word’s sense is based on a

[3]Definitions are taken from the FrameNet Database, obtainable from the International Computer Science Institute, Berkeley, California (http://framenet.icsi.berkeley.edu/).

[4]I owe the examples to an anonymous reviewer who drew my attention to this point.

Lexical Entry: murder.v

- Frame elements and their syntactic realizations

Killer	CNI.– (3), NP.Ext (15), PP[by].Dep (5)
Victim	NP.Ext (8), INI.– (1), NP.Obj(14)

- Frame elements and valence patterns

frame element	realized as			
Killer	NP.Ext	NP.Ext	PP[by].Dep	CNI.–
Victim	NP.Obj	INI.–	NP.Ext	NP.Ext
(23)	(14)	(1)	(5)	(3)

Figure 2: Lexical entry *murder.v*

particular frame, the word evokes the frame" (Fillmore *et al.*, 2003). For example, the verb "break" can evoke, among others, the frame *Experience_bodily_harm* (e.g. in "I broke my leg") or the frame *Render_nonfunctional* (in "I guess I broke the doorknob"). Thus, interpretation of a text requires assumptions about which frame is relevant in the given context. Take the verb "eat": it could be associated with a set of frames, e.g. a restaurant frame, a family home frame, a wild-animals-in-the-open frame, etc. The question is how the right frame ends up being selected. We would suggest to choose the most general frame fitting in the given context. For "eating" this would be the frame *Ingestion*. Due to the hierarchical structure of FrameNet, any frame involving eating would inherit the properties and frame elements of this frame. Of course, in case that there are various very divergent senses of a word, the selected frame perhaps is too general to be helpful for our purposes. But still, FrameNet provides in many cases very useful information for discourse interpretation.

2.3 Proposal: Integrate FrameNet and SDRT

Each eventuality introduced in a discourse evokes a corresponding frame in the discourse model. Its frame elements correspond to all relevant (necessary or optional) thematic roles of the event. We propose to include for all core frame elements a representation in the discourse model, i.e. in the SDRS of the current utterance[5]. In case that some participant of a frame is not expressed linguistically, its representation remains underspecified. These elements can be further specified by subsequent information, provided that the discourse referent for the eventuality remains accessible for anaphoric reference. We will spell out in more detail how this works in section 3. Before that, we will discuss how frame elements can be represented in SDRT, and how they help to determine

[5]For expository purposes, we will ignore non-core frame elements, as well as the core frame elements *Cause* and *Means*, but surely a more sophisticated discourse model must contain additional representations of spatial and temporal coordinates. However, they do not add to the main points we want to make in this paper.

discourse relations.

In order to integrate FrameNet data in SDRT, we adopt a neo-Davidsonian style of event semantics (Parsons, 1990), assuming that lexical units expressing eventualities include an implicit event argument in their semantic representation. Thematic roles in an event are represented as conditions in form of predicates, whose first argument is this event argument. For instance, the sentence "John eats an apple" gets a semantic representation $\exists e \exists j \exists a[eat(e) \wedge agent(e,j) \wedge theme(e,a) \wedge john(j) \wedge apple(a)]$. Equipped in this way, we can express the underspecified semantic content of (1) as shown in (3).

According to FrameNet data (Baker *et al.*, 1998), in course of interpreting the utterance, the *Killing* frame is evoked by the verb "murder". Its core frame elements show up in the SDRS as $killer(e_1,x)$, $victim(e_1,j)$ and $instrument(e_1,y)$. Similarly, the verb "lie" (in its sense "lie nearby") evokes the frame *Being_located*, with only one core frame element $theme(e_2,k)$.

(3)

$$
\begin{array}{|c|}
\hline
u_1, u_2 \quad \mid \quad R, v \\
\hline
u_1 : \begin{array}{|c|} \hline e_1, j \quad \mid \quad x, y \\ \hline john(j), murder(e_1) \\ killer(e_1,x), victim(e_1,j), instrument(e_1,y), x=?, y=? \\ \hline \end{array} \\
u_2 : \begin{array}{|c|} \hline e_2, k \quad \mid \quad B, a \\ \hline \begin{array}{c} knife(k), lie.nearby(e_2), theme(e_2,k) \\ B(a,k), B=?, a=? \end{array} \begin{array}{|c|} \hline k' \\ \hline knife(k') \\ B(a,k') \\ \hline \end{array} \Rightarrow \begin{array}{|c|} \hline \\ \hline k' = k \\ \hline \end{array} \\ \hline \end{array} \\
R(v,u_2), R=?, v=? \\
\hline
\end{array}
$$

Thanks to the hierarchical structure of the FrameNet database, the *Killing* frame inherits the properties of the more general abstract frame *Transitive_action*, which in turn inherits from *Event*. The frame *Being_located* inherits the frame elements of the abstract frame *State*. As assumed in Asher and Lascarides (2003), the occurrence of an event followed by a state is a strong indicator for the presence of a BACKGROUND relation between the discourse segments containing the eventualities. This can be expressed by a default rule (4) [6] (cf. Asher and Lascarides, 2003, p. 207, Vieu and Prévot, 2004, p. 486). Thus, in example (1), a BACKGROUND relation R between u_1 and u_2 can be assumed.

(4) $u_1 : event(e_1) \wedge u_2 : state(e_2) > \text{BACKGROUND}(u_1, u_2)$

3 Resolving Bridging References

Resolving bridging anaphora requires two problems to be solved: (i) the correct antecedent to which the anaphor is to be connected has to be found, and (ii) the nature of the bridging relation itself must be identified. For solving (i), possible antecedents must be identified, and impossible ones must be ruled out. For solving (ii), it is helpful

[6] '>' is a nonmonotonic conditional operator. $A > B$ means: *if A then normally B*.

to restrict possible relations to conditions on discourse referents already present in the discourse model or at least evoked.

3.1 Constraints on Anaphoric Reference

Accessibility for anaphoric reference is constrained by general discourse principles such as the Right Frontier Constraint (RFC, Polanyi, 1988; Webber, 1988). Basically, this constraint draws a distinction between coordinating and subordinating discourse relations: a coordinating relation pushes the right frontier to the right, closing off its attachment point, and a subordinating relation extends the right frontier downwards, leaving open its attachment point. In SDRT, an antecedent for an anaphoric expression must be DRS-accessible on the right frontier (Asher and Lascarides, 2003). Asher & Lascarides' meta-rule "discourse structure determines bridging" (see section 2.1) is captured by this constraint. Recent work on SDRT (Vieu and Prévot, 2004) has revealed that BACKGROUND should be considered as subordinating by default. Accordingly, in (1), u_1 lies on the right frontier of the discourse, and e_1 is accessible for anaphoric reference in u_2. So the discourse structure tells us that, in principle, a bridging relation can be established. Now, the question remains of how to build the bridge between the knife and the killing event. As seen in the last section, FrameNet data can give important clues to establish discourse relations. But this knowledge is not always sufficient to resolve bridging references. In (1), the presence of a BACKGROUND relation alone is not enough to motivate the bridge. Which further information can we obtain from FrameNet?

The frame element *instrument* in the killing frame must have a semantic type (in the FrameNet sense) "physical_entity". It can be a weapon, but in principle any other physical entity could be used for killing, e.g. hands (5) or a lamp (6).

(5) John killed Mary. He strangled her.

(6) John killed Mary. He stunned her with a lamp.

On the other hand, the lexical unit "knife" evokes the frame *Weapon* bearing a semantic type "artifact", indicating the possibility that it could serve as an instrument in a killing event. But as noted in the informal FrameNet description, knives are not necessarily designed as weapons. So this knowledge does not really help us to resolve the bridging relation, at least in the present state of FrameNet. The only knowledge we can use is that there is no clash of semantic types: both knives and killing instruments are physical entities. As far as that we can capture the intuition behind Asher & Lascarides' meta-rule that "bridges must be plausible". It is little more than saying that interpretations must be consistent. In fact, as Zeevat (2006) suggests, selecting the most plausible interpretation given the context and the utterance entails a preference for consistent over inconsistent interpretations. Thus, using FrameNet data, we at least partly get an approximation to the plausibility constraint, which, nevertheless, is a probabilistic notion while consistency is either fulfilled or not. A full, gradual notion of plausibility is surely better captured by some kind of probabilistic system than by an all-or-nothing notion of consistency.

Looking again at the four meta-rules, we find as first rule "if possible use identity". This rule seems to be subsumed by a very general constraint in discourse interpretation, sometimes called DOAP "Don't overlook anaphoric possibilities". This principle is essentially stating that if there is an anaphoric trigger, we must try to find an antecedent. This preference can be captured by a general low ranked default saying that, unless otherwise indicated, (semantically compatible) discourse referents can be assumed to be equal. Formal details on how *Equality by Default* constrains anaphoric reference are described in Cohen (2007).

As noted above, with the presence of a discourse relation between u_1 and u_2, the discourse referents in u_1 are accessible for anaphoric reference in u_2. So, with Equality by Default, we can assume that a is equal to e_1. Thus, the bridging relation $B(a,k)$ can be specified as $instr(e_1,k)$. As a byproduct, the underspecified variable y in the condition $instr(e_1,y)$ in u_1 can be resolved to k, yielding that instrument and knife refer to the same entity. Although k is not accessible in u_1, it is accessible in the superordinated SDRS compromising both utterances, and therefore, after processing the second utterance, the underspecification can be resolved. Note that these inferences are defeasible and can be overridden by subsequent information. Nevertheless, if the bridging relation can be resolved, the discourse turns out to be more coherent. This captures the intuition behind Asher & Lascarides' fourth meta-rule "maximize discourse coherence" (MDC). Now consider discourse (7).

(7) a. John was murdered yesterday. b. # The book lay nearby.

This discourse is - in a neutral context - less coherent than (1), and we would like to explain why. In example (1), the knowledge that a knife is a kind of weapon that can serve as an instrument in a killing event licenses the bridging inference. In example (7), such a connection cannot be found. Again, a BACKGROUND relation can be inferred, but the role that "the book" could play in the killing event is less clear than that of a knife. Although there is no clear semantic connection between "the book" and any evoked core frame element, there is no clash of semantic types, and a bridging relation to the instrument could be plausible. Nevertheless, as no sense of "book" evokes a frame similar to *Weapon*, it remains unclear what nature has the bridging relation, and the discourse seems less coherent. Note again, if the context provides additional evidence that the book is a probable killing instrument, e.g. by being contaminated with poison, the bridging inference indeed can be drawn. To summarize the principles we need for bridging resolution, we remain with the following constraints on anaphoric reference:

- DOAP
- PLAUSIBLE or CONSISTENT
- RFC
- MDC

Note that they are not meant to be special meta-rules designed for bridging resolution, they rather seem to be more general constraints to be obeyed in discourse interpretation. They could be seen as constraints in optimality theoretic pragmatics, but we will not adopt a particular framework here, as we leave open the question whether the ranking of these constraints should be left as stated above. For a related discussion, see Zeevat (2006).

3.2 Weak Discourse Referents

For illustration, a pragmatically enriched SDRS for discourse (1) is shown in (8). Note that as the murderer is not mentioned at all, his referent could not be resolved and its representation remains underspecified.

(8)

$$
\begin{array}{|c|}
\hline
u_1, u_2 \\
\hline
u_1 : \begin{array}{|c|}
\hline
e_1, j \;\mid\; x, y \\
\hline
john(j), murder(e_1) \\
killer(e_1,x), victim(e_1,j), instrument(e_1,y) \\
x = ? \\
\hline
\end{array} \\
u_2 : \begin{array}{|cc|}
\hline
\multicolumn{2}{|c|}{e_2, k \;\mid\; B, a} \\
\hline
\begin{array}{c} knife(k), lie.nearby(e_2), theme(e_2,k) \\ B(a,k), B = instrument, a = e_1, k = y \end{array} &
\begin{array}{|c|} \hline k' \\ \hline knife(k') \\ B(a,k') \\ \hline \end{array} \Rightarrow \begin{array}{|c|} \hline \\ \hline k' = k \\ \hline \end{array} \\
\hline
\end{array} \\
\textsc{Background}(u_1, u_2) \\
\hline
\end{array}
$$

As suggested by the SDRT representations, we now have to deal with two different kinds of discourse entities: *regular* discourse referents introduced by linguistic expressions, and *weak* discourse referents which are not (yet) expressed linguistically. *Weak Discourse Referents* are abstract entities which are evoked or activated in course of the interpretation process. A linguistic expression does not introduce them directly, rather indirectly by virtue of the frame evoked by a lexical unit. They often remain underspecified, but can be specified by subsequent anaphoric reference. This is what happens with the killing instrument. Its identification with the knife helps to render the discourse more coherent. If the knife in the second sentence had nothing to do with the first sentence, the discourse would be rather incoherent, at least after uttering the second sentence.

The distinction between two types of discourse referents is not entirely new, e.g. Kamp and Rossdeutscher (1994) assume “schematic discourse referents”. Furthermore, this assumption could be generalized in the sense that all discourse referents are assigned finer-grained weights on a scale according to their salience, instead of distinguishing just two kinds of referents. We leave this point to further investigation.

Our proposal is to restrict the search space for suitable antecedents for bridging anaphora to take into account only accessible regular and weak discourse referents. In this way, the resolution of bridging inferences can be considerably constrained. In our model, new entities are (weakly) introduced with every eventuality that is talked about, with the potential to be strengthened, to remain in the background, or even to be dropped.

4 Related Approaches

4.1 Implicit Arguments as A-definites (Koenig and Mauner, 1999)

Important work on the discourse status of non-expressed event participants was presented by Koenig and Mauner (1999), who build upon results of psycholinguistic experiments concerning implicit verbal arguments. Reading times of sentences like (10) following one of the sentences in (9-a) were compared in an experiment carried out by Mauner *et al.* (1995)

(9) a. A ship was sunk
 b. A ship sank
 c. A ship was sunk by someone

(10) ... to collect settlement money from the insurance company.

Subjects take longer to process rationale clauses like (10) when they follow intransitive sentences like (9-b) than when they follow short passives (9-a) or agentive passives (9-c). Thus it seems that verbs like "sink" in (9-a) include an implicit actor argument as part of the representation of the lexical item, and the implicit anaphoric (PRO) subject of "collect" in (10) can be anchored more easily in the discourse model. Koenig and Mauner (1999) claim that implicit arguments, as well as words like the French subject clitic "on", the German "man", and indefinite uses of English "they" (*a-definites* in their terminology), cannot serve as antecedents of anaphora and do not introduce any discourse referent at all. Their DRT representation for sentence (9-a) is (11):

(11) $$\boxed{\begin{array}{c} y \\ \hline ship(y), sink(x,y) \end{array}}$$

In this representation, it remains unclear how the apparently free variable x, representing the actor, is model-theoretically interpreted. Moreover, as noted in their paper, bridging references to implicit arguments *are* indeed possible, e.g. consider example (12).

(12) a. They killed the president.
 b. The terrorists were merciless.

Koenig and Mauner (1999) do not give any details on how such an inference can be drawn according to their theory. The interpretational apparatus of DRT (Kamp and Reyle, 1993) would have to be changed in order to allow uninstantiated variables in final DRSs. Such an attempt is made by Farkas and Swart (2003). Here, we want to refrain from a major modification of truth conditions in DRT.

4.2 Bridging as Coercive Accommodation (Bos *et al.*, 1995)

Bos *et al.* (1995) presented an approach that is indeed very close to our proposal. Basically, they combine an extension of van der Sandt (1992)'s theory of presupposition with the *Generative Lexicon* (Pustejovsky, 1995), comparing bridging with Pustejovsky's *coercion*. This approach is based on a convincing formal definition of an extension of DRT. However, the treatment of bridging as a lexical phenomenon is not unproblematic. It is limited to lexically induced bridging inferences. Bos *et al.* (1995) show example (13) as a limitation case of their approach.

(13) Probably, if Jane takes a bath, Bill will be annoyed that there is no more hot water.

Interpreting this short discourse involves the inference that taking a bath involves using a hot water reservoir. This inference is difficult to explain in Bos *et al.* (1995)'s framework. Regarding FrameNet, in the present state of English FrameNet it is unclear whether phrasal verbs are lexical units and how they evoke frames, e.g. whether "take a bath" counts as a lexical unit, or just "take". However, in other versions of FrameNet, such knowledge is encoded; an equivalent sentence in Spanish using the verb "bañarse" (to take a bath) is analyzable in FrameNet terms[7]. There, it evokes the frame *Cause_to_be_wet* with a core frame element *Liquid*, which can be instantiated by "hot water". Still better is a suggestion made by the developers of Polish FrameNet[8], according to which both "wziąć kąpiel" (like in English) and "wykapać się" (like in Spanish) evoke the frame *Grooming*, where an *Agent* engages in personal body care. An *Instrument* can be used in this process as well as a *Medium*. Thus, if "take a bath" is treated as a lexical unit, we can draw the inference that the water in the second clause is used for the bath in the first clause.

(14) Yesterday, Chomsky analyzed a sentence on the blackboard, but I couldn't see the tree.

Moreover, as Piwek and Krahmer (2000) note, not all implied antecedents are lexical entailments; sometimes, non-lexical background knowledge is needed, as in (14). To correctly understand this utterance, the hearer has to rely on specific background knowledge, in particular on the knowledge that a generative syntactic analysis typically involves a tree-like representation of the sentence. It is questionable whether highly context-sensitive information of this kind is part of the lexicon. In any case, FrameNet provides us with additional secondary information which surely is beyond the lexicon but still has an influence on resolving bridging anaphora.

5 Conclusion

We have sketched how SDRT's account of bridging can be extended in order to cover reference to eventualities. SDRT and FrameNet are combined by assuming a neo-Davidsonian event representation and distinguishing two types of discourse referents. We could indicate that the meta-principles assumed for bridging can be put down to more general constraints to be obeyed in discourse interpretation. We have spelled out

[7] see http://gemini.uab.es/

[8] Magdalena Zawisławska, p.c.; see http://www.ramki.uw.edu.pl/

how world knowledge, represented in frames, contributes to the interpretation process, both for establishing discourse relations and for resolving indirect anaphora.

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Explaining Conjunction Systems: Russian, English, German

Katja Jasinskaja
University of Heidelberg & IMS, Stuttgart University

jasinsk@ims.uni-stuttgart.de

Henk Zeevat
ILLC
University of Amsterdam

henk.zeevat@uva.nl

Abstract

The paper analyses the Russian conjunctions *i*, *a* and *no*, the English conjunctions *and* and *but* and the German conjunctions *und*, *aber* and *sondern* in terms of specialised additivity: special cases of the relation between sentences expressed by *too* and *also*. The first section gives an overview of the analysis, the second section tries to give an explicit characterisation of additivity and its specialisations. The third section uses an OT-like framework to explain the complementary distribution of the conjunctions and the blocking effects that result.

1 Conjunctions

A much debated issue in Russian linguistics is the precise demarcation of the conjunctions *i*, *a* and *no*. *I* corresponds to the English *and*, *a* has to be translated sometimes as *and* and sometimes as *but*, where all the uses of *no* seem to correspond to English *but*. We refer to Jasinskaja and Zeevat (ms) for an attempt to do justice to the descriptive problems and the debate. In this paper, we try to look at the theoretical side of the proposal. That comes down to the semantical analysis of additivity and an account of the blocking of one conjunction by another that is needed to make the explanation work.

The theory can be recapitulated as follows.

The English *and* is a general marker of additivity. Additivity is a property of a clause to give a distinct answer to a question that was already addressed before. If the question contains a single *wh*-element, the additive clause and its antecedent must give distinct values to the *wh*-element. If the question has more than one *wh*-element, the additive clause and its antecedents give distinct values to each of the *wh*-elements—otherwise, it can still be additive, but with respect to the corresponding question with fewer *wh*-elements. The theory assumes that polar questions have *wh*-elements and are *wh*-questions that can take values from the set of truth-values. Accordingly they will be called *whether*-questions.

The conjunction *and* is indifferent to the number of *wh*-elements and the type of these *wh*-elements. But *and* competes with *but* that is a special case of additivity asking for questions with at least two *wh*-elements of which one must be *whether*. (1) gives an example of a *who-whether*-question, which can be split into two *whether*-subquestions: whether John likes football, answered by the first conjunct, and whether Bill does, answered by the second.

(1) Who "whether" likes football?
John does, but Bill doesn't.

The Russian system is more complex. The conjunction *i* requires a single *wh*-element in the question. The conjunction *a* can be taken as the generic additive marker (like *and*) that is blocked from single *wh*-questions by the presence of *i* and from the case covered by *no* by the presence of that marker[1]. *No* marks additivity with respect to a *why-whether* question. That means that the first conjunct gives a reason for some statement *C* and the second one a reason why *C* should not be adopted. This makes the argumentative function of *no* the basic one and constructs the *denial of expectation*-reading as the case that *C* is identical to the second conjunct.

(2) Why "whether" should we buy this ring?
It is beautiful, *but* (russ.: *no*) expensive.
Why "whether" didn't John make it?
He wanted to come, *but* (russ.: *no*) did not make it.

Whether-questions are special. Distinctness implies that there cannot be conjoined distinct answers to a single *whether*-question. They would have to answer *yes* and *no* to the same question and would be contradictory. But there can be conjoined answers to double *wh*-questions with one of the elements being whether.

A special case are correction markers like *sondern* in German (Spanish has a similar marker *sino*).

(3) Peter ist nicht in Berlin, *sondern/*aber* in Paris.
Peter is not in Berlin, *but* in Paris.
Peter ne v Berline, *a* v Pariže.

These are a special case of distinct answers to double *wh*-questions with one of the elements being *whether*, in (3) a *where-whether*-question: where whether is Peter? It provides the negative answer to whether Peter is in Berlin and a positive answer to

[1]In Jasinskaja and Zeevat (ms), *i* is taken to be the unmarked case, and *a* as the special case. It is however *i* that has the simpler semantics and it is hard to see how the property of marking for additivity with respect to multiple *wh*-questions can grammaticalise, while many additive particles allow only a single associate and provide a good source for conjunctions like *i*.

1wh	add	wh-whether	why-whether	correction
i	a		no	
	and	but		
	und	aber		sondern

Table 1: Correlations between the Russian, English, and German conjunction systems. (*1wh* stands for "single wh-element".)

whether Peter is Paris. *Sondern* marks *wh-whether*-questions with a correction presupposition: the first conjunct is presupposed (and denied by the second). Typically, in languages like Russian, where *a* has to do the job, the presupposition is not marked and the correction can be made in both orders.[2]

(4) Peter v Pariže, *a* ne v Berline.

Double *wh*-questions in Russian select *a* and not *no* because *no* requires both *why* and *whether*. This is not even satisfied in (5): John hits Peter in both conjuncts.

(5) John did not hit Peter because he was angry, but because he was drunk.

The conjunction answers: whether John hit Peter because of what? (a *whether-what*-question) by two doubly distinct answers. It would be *sondern* in German and *a* in Russian.

In providing different answers to the same questions, conjunctions belong to the class of additive markers, like *too* and *also*. Zeevat and Jasinskaja (2007) argue that some *and*-like conjunctions can be historically related to additive particles and need additivity for the proper understanding of their behaviour.

Blocking is the final ingredient of the explanation. If *no* or *i* can be used, *a* cannot. If *i* cannot, *a* must be used, if *but* can be used, *and* cannot.

Given these ingredients, it is possible to give a parsimonious description of the Russian system, the English system and the German system and correlate them as shown in table 1. It follows that *no* always translates to *but*. *A* translates as *but* and *aber* if one of its *wh*-elements is *whether*, unless one of the conjuncts is presupposed to be false (in the common ground or in the interlocutor's information state) in which case it is rendered by *sondern* and the presupposed conjunct is preposed. Otherwise, *a* translates as *and* and *und*. *I* always corresponds to *and* and *und*. *Sondern* always translates as *a* and *but*.

[2]The presupposition of the first conjunct is also missing in the English *but*, nevertheless *but* shows a slight preference for the negative-positive order of conjuncts under the correction reading, cf.: *Peter did not go to Paris, but to Berlin* vs. *Peter went to Berlin, but not to Paris*. Umbach (2004) claims that in the latter case the positive-negative order is only compatible with the non-corrective reading: Peter did not go to Paris in addition to (rather than instead of) going to Berlin, which in our theory results just from answering a *wh-whether*-question without any additional presupposition. The correction reading with the positive-negative order is conveyed better by using *and*: *Peter went to Berlin, and not to Paris*. This difference between the English *but* and the Russian *a* could be related to the asymmetry of the conjuncts of *but* that also shows up in its argumentative and denial of expectation uses like (2). An account of this asymmetry is presented in section 3.

Aber is always translated into English as *but*. Into Russian it translates as *a* unless it answers a *why-whether*-question in which case it becomes *no*. *And* translates as *i* if it marks *1wh* and as *a* otherwise and in German to *und*. These translation relations are illustrated below.

wh1:

(6) Vera prinimala vannu, *i* razgovarivala po telefonu.
Vera was taking a bath *and* talking on the phone.
Vera nam ein Bad *und* telefonierte.

(7) Idet sneg, *i* duet veter.
It is snowing *and* the wind is blowing.
Es schneit *und* der Wind weht.

wh>1:

(8) Vera prinimala vannu, *a* Lena razgovarivala po telefonu.
Vera was taking a bath *and* Lena was talking on the phone.
Vera nam ein Bad *und* Lena telefonierte.

(9) V Moskve idet sneg, *a* v Amsterdame duet veter.
It's snowing in Moscow *and* it's windy in Amsterdam.
In Moskau schneit es *und* in Amsterdam weht der Wind.

(10) Oleg ljubit futbol, *a* Roma basketbol.
Oleg likes football *and* Roma likes basketball.
Oleg spielt gern Fussbal *und* Roma Basketball.

wh-whether:

(11) Oleg ljubit futbol, *a* Roma ne ljubit.
Oleg likes football, *but* Roma doesn't.
Oleg spielt gern Fussball, *aber* Roma nicht.

why-whether:

(12) Èto kol'co krasivoe, *no* dorogoe.
This ring is beautiful, *but* expensive.
Dieser Ring is schön *aber* teuer.

wh-whether correction:

(13) Peter ne v Berline, *a* v Pariže.
Peter is not in Berlin, *but* in Paris.
Peter ist nicht in Berlin, *sondern* in Paris.

2 Additivity

The first formal semantics of additivity has been provided by theorists of presupposition like Gazdar (1978) and Karttunen and Peters (1979) who assigned to additive particles associating with a name the property that an object non-identical with the referent of the name also has the property that is expressed by the rest of the clause. This is too restrictive since additive particles also associate with other NPs and other constituents and even with sequences of NPs. Also the property of being non-identical seems too weak in two respects: for sequences there must be additivity at each coordinate and following Hendriks (2004), there should be more than just non-identity: the two elements should not overlap: John's hand cannot be in addition to John, a part of the content of a bottle of milk cannot be in addition to the content itself, an event cannot be additive with respect to a subevent. (14) is an illustration.

(14) John is coming. His whole family is coming (*too).

A third failure of these accounts is that they allow accommodation and satisfaction by common ground knowledge, something criticised by Kripke (ms) by the example (15).

(15) Tonight John is having dinner in New York too.

Kripke's point is that (15) is not acceptable out of the blue, even though everybody knows that there are millions who have dinner every evening in New York. *Too* seems to require an overt antecedent in the context and the property that allows and necessitates the occurrence of *too* would be that the clause readdresses a question that has already been addressed in the discourse. This gives the following definition.

(16) **Definition 1:**
$\varphi(a)$ and $\varphi(b)$ are **additive** to each other with respect to $?x\varphi$ in w iff
(1) both are true in w and answers to $?x\varphi$.
(2) and there is no c such that $c \leq a$ and $c \leq b$

This is one-place additivity. A more general definition is needed to capture additivity on pairs (and more generally, tuples) as in the examples below:

(17) A: I love you.
B: I love you too.

(18) Tim loves Louise and Sandra.
Sandra loves him too.

The tuples need to be distinct in each of the corresponding elements, that is why (19c) is infelicitous with *too*. It cannot be construed like (19a) as one-place additive (John is another person loving Sandra). While (19b) can be construed in terms of two-place additivity ($\langle$John, Monique$\rangle$ is another pair standing in a *love* relation whose every element is distinct from the corresponding element in $\langle$Tim, Louise and Sandra$\rangle$),[3] (19c) cannot because *Sandra and Monique* has a common part with *Louise and Sandra*.

[3] For some speakers *too* can only associate with a single constituent (Krifka, 1999, n. 7), however others accept (19b) with the reading where *too* associates with the pair of constituents *John* and *Monique*, giving rise to two-place additivity.

(19) Tim loves Louise and Sandra.
a. JOHN loves Sandra, too.
b. JOHN loves MONIQUE, too.
c. JOHN loves Sandra and MONIQUE, (*too).

A general definition of additivity uses questions of the form $?x_1 \dots x_n\varphi$ with $n \geq 1$.

(20) **Definition 2:**
$\varphi(a_1 \dots a_n)$ and $\varphi(b_1 \dots b_n)$ are **additive** to each other with respect to $?x_1 \dots x_n\varphi$ in w iff
(1) both are true in w and answers to $?x_1 \dots x_n\varphi$.
(2) for all $1 \leq j \leq n$ there is no c such that $c \leq a_j$ and $c \leq b_j$

This would be general additivity and correspond with markers like *and* and *und*, apart from blocking effects. If *a* is the default case, it is also just a general marker of additivity like *and* and *und*, but subject to more blocking. All the other markers discussed, including *too* are more restricted by putting more constraints on the number of *wh*-variables or on the type of these variables.

Some remarks on the definition: First of all, the definition appeals to a notion of $x \leq y$ which needs further motivation. Intuitively, distinctness between objects is about not sharing parts. There are a number of part-relations that are relevant. The following list seems to cover the most important cases.

1. objects and their constituent parts
2. set of objects and their subsets and elements
3. quantities of matter (some bread) and the subquantities that make them up
4. events and the subevents that constitute them
5. states and their component states
6. regions and their subregions
7. temporal intervals and their subintervals
8. truth values have no parts

This suffices for the *wh*-phrases considered here. *Why* takes events and states as values, *who* persons, *what* non-human objects, *when* and *where* spatial and temporal regions. The problems are mainly with abstract objects like habits, tendencies, dispositions, propositions and properties[4].

[4]A good deal of progress can be made by a reduction to their instances. If an instance of a property invariably or typically has another property that property could count as a part or a prototypical part of the property. If a proposition is true in virtue of events or states with invariable or prototypical subevents that make another proposition true, the other proposition is a part or prototypical part of the proposition. And the same would hold for habits, tendencies, and dispositions.

Second, the definition is about objects and not about generalised quantifiers, the general case of an NP meaning. The idea is that a linguistic answer with a generalised quantifier as a value for the *wh*-variable can always be witnessed in a world by an object answer.

This works as follows: If $\varphi(a)$ is true in w and $w \models N(a)$ (N is the meaning of a noun) then $\varphi(a)$ will witness a whole range of sentences of the form $(\neg)QN\varphi(x)$ (Q is a determiner meaning). Which determiners are witnessed (possibly under a negation) depends on the size of a and the size of the extension of N minus a and (sometimes) on contextual standards of comparison.

Let $\varphi(a)$ be true in w and a be in the extension of N in w.
Then

1. $\varphi(a)$ witnesses *some* N $\varphi(x)$ in w
2. $\varphi(a)$ witnesses *all* N $\varphi(x)$ in w iff a is the extension of N in w
3. $\varphi(a)$ witnesses 3 N $\varphi(x)$ in w iff a has size 3
4. $\varphi(a)$ witnesses *many* N $\varphi(x)$ in w iff a has a large size
5. $\varphi(a)$ witnesses *most* N $\varphi(x)$ in w iff a outsizes the set of members of the extension of N in w which do not satisfy $\varphi(x)$
6. $\varphi(a)$ witnesses few N $\neg\varphi(x)$ in w iff a is nearly all of the extension of N in w.

Given an information state $X \subseteq W$, the sentences with NP semantics are additive with respect to the question, if they can be witnessed by additive object answers to the question, in each world $w \in X$.

The definition also does not directly allow for pragmatic additivity, where the additivity holds not with respect to the common ground or the speaker's information state but with respect to the hearer's information state, as in (21).

(21) A: Did you invite the mayor and the doctor?
B: Well, the mayor is the doctor. So by inviting the mayor I invited the doctor too.

Thus in the most general terms, the conditions licensing additive marking can be characterised as follows[5]:

(22) The context must contain an answer A to a question $?x_1 \ldots x_n\varphi$ and the contribution B of the speaker must be witnessed by an additive answer with respect to the information state of the hearer as it is known to the speaker.

[5]Lexical —unlike the grammaticalised markers considered in this paper— expressions of additivity like "in addition" or "additionally" enforce additivity with respect to the common ground after the update: i.e. additivity is part of the truth-conditional content of the utterance. Another difference is that they do not need to have an additive antecedent, but can introduce it or accommodate it.

Additive conjunctions vs. additive particles: The additive conjunctions considered in this paper are special in that the antecedent is always the first conjunct and that the question is directly related to the goal of the speaker in producing the conjunction. This does not need to be the case for normal additive marking with *too* and *also*.

The speaker can answer a question with his contribution that is different from the question which makes his contribution additive as in (23).

(23) What did Susan do?
SUSAN had spaghetti TOO.

The speaker answers the question but in producing the answer also readdresses the question who ate spaghetti and marks the fact that he is readdressing it with the additive marker.

Specialisations of additivity: The first kind of specialisation is simplex vs. duplex (multiplex) questions. *I* marks single *wh*-questions, *no* the particular case of double questions with *why* and *whether* as the two *wh*-elements. The Russian *a* does not impose any restriction on the number of *wh*-elements *per se*, but because of blocking by *i* it is only possible with multiplex questions. All the other conjunctions do not have a restriction on the number of *wh*-elements with or without blocking.

The second kind is typing. The *wh*-variable in a question can allow only values of a certain type, like object, event, truth-value, region, quantity etc., corresponding to wh-words like *who*, *why*, *whether*, and *which*, *whether*, *where*, *how much* and others. Polar questions are treated as normal *wh*-questions. This is not problematic, *whether p* gets the logical representation: $?x_t\ ext(p) = x_t$.

Whether-questions are a special case: the only way to be a distinct truth-value is to be the other truth value. This makes it impossible to have simplex additivity of type truth-value: one would affirm and deny the same statement. But duplex and multiplex questions can include a type truth-value: it is possible that P holds of x but does not hold of y.

There is a similar problem with *why-whether*-questions. If *A but B* addresses *Why whether p?* and A addresses the positive side, i.e. A gives a reason for p, and B a reason for $\neg p$, then the answer does not decide the *whether*-question. Markers like *but* are however implicating that B is the decisive part. So if B gives a reason for $\neg p$, the speaker implies that $\neg p$ is true or should be the decision that has to be taken.

3 Blocking

As described in section 1 the various specialised additive markers block each other when their condition of application is more specific: *but* is preferred to *and* when the conditions for *wh-whether* hold, even though *wh-whether* is also compatible with the weaker conditions imposed by the generalised additive marker *and*. Similarly, *i* and *no* block *a* in Russian. In German, *sondern* blocks *aber*, which is otherwise very similar to English *but* or Dutch *maar*.

and/und/a	
but/aber	WHETHER, 2ND
sondern	CORRECTION
i	SINGLE
no	WHY, WHETHER, 2ND

Table 2: Conjunctions and the features they realise

How does this happen? It is not a general property of natural language that what is more specific in semantics is preferred. It is not necessary to refrain from calling Bill a man, if he is an actor and a bachelor. Blocking is known from morphology (the more specific rule that makes the plural of *goose geese* wins from the more general rule that would make *gooses* out of *goose*). But the system of conjunctive markers is not normally seen as a paradigm.

It could however be compared to a paradigm. The present of the verb *to be* is the paradigm *am*, *is* and *are*. For the negation, the form *amn't* is missing and gives way to *aren't* in *Aren't I clever?*. This makes *are* and *aren't* into the unmarked form and lets the special forms *am* and *is* come out of a constraint that tries to realise the input features of number and person on the output form, when this is possible. Bresnan (2000) employs a constraint AGR for this purpose.

We could do the same, by assuming that AGR tries to realise a special category of features on conjunctions. Candidates for such features would be WHETHER, 2ND (second), SINGLE, WHY and CORRECTION with our conjunctions realising these features as in the following table 2. WHETHER requires that one of the *wh*-elements be typed as truth value, 2ND makes the second conjunct resolve the *whether*-issue, WHY types one of the *wh*-elements as a proposition giving an argument for ϕ, SINGLE restricts the number of *wh*-elements to one, and CORRECTION introduces the presupposition of the first conjunct characteristic of corrections.

Unfortunately, conjunctions are not obligatory as such. Quite systematically, conjunctions of any type can be replaced by two adjacent unmarked sentences.

(24) John came and Mary left.
John came. Mary left.
John is tall but Bill is small.
John is tall. Bill is small.
Johann ist nicht in Paris, sondern er ist in Berlin.
Johann ist nicht in Paris. Er ist in Berlin.

This makes the problem different from agreement marking. There is nothing optional about agreement, at least in English, while additive conjunctions can be left out if distinctness is obvious from the context or signalled by other means, e.g. by additive particles like *too* and *also*, or adjectival markers like *another*, *a different*.

The paradigmatic approach also does not explain why the system emerged. For the verbal agreement system, it is generally accepted that the agreement morphemes come from fusion of the verb with pronouns and would be remains of clitic doubling. It needs to be explained of course why such remains are stable, but there is a general explanation that applies here: the agreement morphemes mark finiteness and their presence increases semantic redundancy and therefore supports understanding. It seems wrong to consider the conjunction systems to be atavistic remains of any other paradigm, even though they do make understanding more robust.

Another approach is to assume a maximisation constraint MAX(OTHER) that checks that the items that are distinct in the input are also distinct in interpretations of the output (see Zeevat, 2003). The check can be understood as part of the self-monitoring of the speaker and is here directed to checking that objects are not identified in interpretation when this is not intended. The constraint is closely related to the fact that perception is strongly oriented towards identification: identify when there is no reason not to. Pragmatic formulations of that principle are *NEW (Zeevat, 2008), DO NOT ACCOMMODATE (Blutner, 2000) and DOAP (Williams, 1997; Hendriks and de Hoop, 2001). The approach by MAX(OTHER) however also runs into a number of problems.

Distinct objects can be associated with different descriptions, but if they share descriptions, it is necessary to use a marker of distinctness like *other* or *different*. If the same predicate applies to a different object, it is necessary to employ an additive marker. It is important to realise that in these cases there can be plenty of other cues to infer that the objects are different. In (25), the two men need to be different because one cannot non-metaphorically meet oneself, because a full NP cannot be coreferential with another NP in the same clause and because indefinites introduce new referents.

(25) A man met another man.

The interpretation of the phenomenon as a max-constraint does not work in these cases precisely because of the fact that distinctness can be completely clear and the marker is still needed. The rule seems to be that *other* (or an equivalent marker) needs to be used if there is another object with the same description.

The same point can be made about additive marking by particles. In (26), the different names are sufficient to guarantee that John and Bill are distinct people.

(26) John went to the party. Bill went too.

So it is best to see other-marking and additive-marking as production constraints along the following lines.

(27) **OTHER:** mark the re-use of the same description for a different object

(28) **ADD:** mark the application of the same predicate to a different object

That does not mean that MAX(OTHER) is not involved. The existence of lexical markers together with MAX(OTHER) would be responsible for the formation of the grammaticalised markers and the production constraints as partial grammaticalisations of MAX(OTHER). The pattern would presumably be that the markers appeared sufficiently often in response to MAX(OTHER) that their absence started being a signal that there is no OTHER. This forces the emergence of these production constraints, since the

English:

and		¬ (WHETHER, 2ND)
but	WHETHER, 2ND	

German:

und		¬ (WHETHER, 2ND)
aber	WHETHER, 2ND	¬ CORRECTION
sondern	CORRECTION	

Russian:

i	SINGLE	
a		¬ SINGLE, ¬ (WHY, WHETHER, 2ND)
no	WHY, WHETHER, 2ND	

Table 3: Blocking in the conjunction systems of English, German, and Russian

probability of misunderstanding increases with the signalling function of the absence of the marker.

The same would be applicable in the case of conjunctions: conjunctions grammaticalise in response to MAX(OTHER) as additive markers. Specialised additive markers can grammaticalise because they mark distinctness even better (type, number) and MAX(OTHER) is then responsible for a pragmatic preference for the specialised marker in favour of the less specialised marker when they are in competition.

For the choice to leave out any conjunction, one has to assume that there is no other principles than MAX(OTHER) involved in conjunction (unlike the additive particles and adjectives discussed above). Not marking is then possible, if the distinctness is sufficiently clear from other cues (which may include additive and contrastive particles, intonation, choice of lexical items, overtness of the question addressed etc.). MAX(OTHER) by itself would allow the use of the less specialised conjunction when more specialised conjunctions can be used, if there are enough cues to infer the distinctions.

The way out is to assume that the non-specialised markers have become signals that the more specialised markers do not apply. This will happen if in fact MAX(OTHER) would make the specialised marker dominant over the general marker in the cases where the specialised marker can apply. There is a legitimate probabilistic inference from not using the more specialised marker to the assumption that the conditions for its use do not hold.

This would turn our earlier table 2 into the schemata shown in table 3.

There is some evidence for setting it up in this way in the interpretations that arise when *and* is used in situations that seem to require *but*, or *a* in situations that seem to require *no*, or *aber* in the situations that seem to require *sondern*.

An empirical observation about *why-whether*-conjunctions (expressed by *but*, *no* or *aber*) is that the second conjunct decides the issue, in the sense that the speaker indicates that the second argument is better than the first (Anscombre and Ducrot, 1977). This is illustrated in (29). This observation is not a consequence of the theory presented in this paper and may perhaps be explained by the fact that if one of the two conjuncts is old, it should be the first. In that case, the speaker adds a new argument for consideration in the second conjunct, presumably because she deems it important enough to be considered. The preference of the speaker for the course of action advocated in the second conjunct can therefore be inferred and the standard ways of expressing *why-whether*-conjunction can become signals of this conclusion. In the schema, this corresponds with the feature 2ND.

(29) The ring is beautiful, but expensive. (Let's not buy it)
The ring is expensive, but beautiful. (Let's buy it)

If one assumes that the conventional markers of *why-whether*-conjunction indeed signal the decisiveness of the second argument for the speaker, replacing the marker by a less specific one would cancel the effect, as in (30) under the assumption that the question of buying the ring or not is at issue.

(30) The ring is beautiful and expensive. (I don't know what to do)

This may give the explanation of the mirative uses of *and* and *a*.

(31) Max can't read *and* he's a linguist.
Her husband is in hospital *and* she is seeing other men.
Leto, *a* idet sneg.
It's summer *and* it's snowing.

In all these cases, *but* (*no*) is possible with a *why-whether*-reading: Why whether Max can read?: he should because he is a linguist, he does not because (it is known that) he cannot. The point is to establish the second conjunct and protect it from the expectation arising from the first conjunct.

It can be argued that this is the proper content of the feature 2ND: it makes the conjunction marked by *no*, *but* or *aber* a contribution to the issue *whether C?* given by the *why-whether*-question *Why whether C?* and lets the second conjunct resolve that issue. In the cases at hand, C is identical to the second conjunct B. The negation of 2ND will then in general stop the conjunction from being a contribution to the issue *whether C* and thereby remove the special role of the second conjunct. In the examples of (31), this means that the issue addressed by the whole conjunction is not *whether B?* but something else. (32) provides some possible alternative issues. The examples all seem to be of the kind that denies a rule: linguists can read, wives behave when their husband is in hospital, it doesn't snow in summer. These rules are precisely the ones evoked in the first conjunct by interpreting the conjunctions, just like their variants with *no*, *but* and *aber* as giving distinct answers to *why whether B?* and relate directly to the wider issues assumed in (32).

(32) Are linguists any good?
Is she a good person?
Is the weather as it used to be?

While we think that this is an attractive option and the alternative of postulating that *a* lexically codes for a mirative reading is unappealing, there is reason for doubt. A variant of an example by Blakemore and Carston (2005, p. 571) is (33).

(33) A: Loose rugs are pretty harmless.
B: Well, John slipped on a Persian rug and he broke his leg.

Mirative uses of *and/a* like those in (31) usually can be paraphrased with *but/no* with the loss of mirativity, but (33) cannot be paraphrased by (34), which means that it cannot be addressing a *why-whether* question. It is not clear though that (33) is an instance of a mirative use of *and*.[6]

(34) (???) John slipped on a Persian rug, but he broke his leg.

How about the other cases? Does *and* mean ¬(WHETHER, 2ND)? Does *aber* mean ¬CORRECTION? Does *a* mean *multiple*? The prediction that they do have these additional effects is confirmed. Assigning *a* the meaning of DOUBLE is the most frequent line taken by the tradition on *a*, often next to other readings (Jasinskaja and Zeevat, ms). Apart from the mirative uses which were analysed above as avoiding the feature *2ND*, *and* is not used for arguing in different directions. For *aber*, consider example (35).

(35) Johann is nicht in Paris, sondern/aber bei seiner Frau.
John is not in Paris, but (he is) with his wife.

With *sondern*, John is with his wife instead of being in Paris. In particular, the sentence implies that John's wife is not in Paris. With *aber*, there is an expectation that John would be both in Paris and with his wife (because his wife lives in Paris), but contrary to this expectation, John is with his wife outside Paris. The fact that such non-correcting interpretations arise is predicted by the assumption that *aber* signals the absence of correction.

It is consistent to assume that these three effects of blocking arise by reasoning about alternatives, as e.g. in scalar implicatures, but if that is so one would expect similar effects: extra processing costs and the possibility of cancellation. It seems unlikely that there are such effects, but we are not aware of any empirical studies in this area.

4 Conclusion

This paper tried to show that additivity can be seen as a common "semantics" for the conjunctions under consideration. For this purpose it is necessary to define additivity as the property of giving an answer that is distinct on each dimension corresponding to a *wh*-element x_j of a question $?x_1 \ldots x_n\varphi$.

While there seems to be no other way to deal with the problem given by the example "I love you too" and the conjunctions discussed in this paper, it is a bit of a mystery why this is the crucial notion and not the simpler one: distinct answer to the same *wh*-question. It can be argued that blocking is again at work: for a good representation of the relations involved, it may be mandatory to construct answers constituted by distinct

[6] *I* is quite possible in Russian for this example. This suggests that this is probably not a mirative use, which would require *a* in Russian.

tuples that coincide on one of their elements (e.g. $\langle \text{John}, \text{Mary} \rangle$ and $\langle \text{John}, \text{Susan} \rangle$) to be additive with respect to the question with one *wh*-element removed. This makes the distinctness marking that is the most probable functional advantage of additive marking unoperative for markers that do not have a fixed arity, such as *and*, *und* and *a*, while at the same time providing a functional motivation for the markers with a fixed arity (*i*, *no*, *aber*, *but* and *sondern*).

The account of blocking by means of extra meaning being generated by the same process that generates complementary distribution patterns needs further explanation. The departure point is the situation that the default marker of additivity competes with the specialised marker and that pragmatics decides whether the specialised marker is used: the speaker judges that he will be misunderstood without the special marker. This in turn turns the generic marker into a stochastic signal that the specialised meaning is not intended. The stochastic signal pushes up the probability of misunderstandings arising with the use of the generic marker for the special case. This will increase the frequency with which the speakers will judge that they will be misunderstood in that particular case. The end result is a complementary distribution and the generic sign being a categorial signal that the specialised meaning does not obtain. The argument is identical to the model of grammaticalisation proposed in Zeevat (2006).

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One More Step and You'll get Pseudo-Imperatives Right

Jacques Jayez
Université de Lyon, ENS-LSH and L2C2, CNRS

jjayez@isc.cnrs.fr

Mathilde Dargnat
Université de Nancy, France and ATILF, CNRS

mathilde.dargnat@univ-nancy2.fr

Abstract

We consider *pseudo-imperatives* like *Come near (and) I'll show you*, which have a conditional interpretation ('if you come near, I'll show you'). We show that they have basically the same semantics as Sufficiency Modal Constructions studied by von Fintel and Iatridou (2007). We provide a detailed analysis of 'sufficiency' in Lewis's counterfactual framework, extending the analysis to pseudo-declaratives. We discuss the possible origins of the construction and offer a characterisation of the syntax-semantics interface.

1 Introduction

Pseudo-imperatives (P-imperatives) are structures of the form A-IMP B or A-IMP *and* B, where a conditional interpretation is possible, as in (1).

(1) a. Come near (and) I'll show you
 b. If you come near, I'll show you

It has been proposed that the morphologically imperative constituent does not convey a separate speech act of command, permission, etc., but combines with the second constituent to form a conditional unit, see Franke (2008) and Russel (2007) for recent references. This is specially useful to deal with contrasts noted by van der Auwera (1986) between A *and* B and A *or* B structures.

Unfortunately, it turns out that there are other, unexpected restrictions on the semantic relation between A and B in P-imperatives. Roughly speaking, A (*and*) B sounds strange whenever the causal relation between A and B is perceived as 'weak', in a sense to be clarified in section 4.2. Yet, the relevant examples allow for conditional paraphrases, a fact which is potentially problematic for the mentioned approaches. One

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could assume that P-imperatives are just conditional structures in disguise. One must then explain why the semantic relation between A and B does not coincide with that observed between the antecedent and consequent of conditional sentences. Alternatively, one could describe P-imperatives as 'special' conditionals, which, when compared to the standard ones, obey additional constraints. In that case, the question arises whether there is a connection of some kind between the imperative morphology and these specific constraints.

In this paper, we follow the second route and show that P-imperatives are special conditional structures that most probably inherit their semantic features from an interaction between modal subordination and the basic semantics of imperative. In section 2, we present the data we consider in the paper. In section 3, we focus on certain problematic observations, which are not accounted for by current analyses. In section 4, we characterise the semantic constraint we propose in Lewis's counterfactual framework, motivating the pseudo-imperative construction in section 4.3. Finally, in section 5, we discuss briefly some aspects of the syntax-semantics interface.

2 Basic observations

In this section, we provide a short description of the relevant structures in English and in French. In addition to P-imperatives, one finds P-declaratives (2a-b), where A is a declarative clause, P-optatives in French (2-c) and P-interrogatives (2d-e), where the $\nearrow$ marks rising intonation. We will be mostly concerned here with P-imperatives and P-declaratives.

(2) a. You come near (and) I show you
b. Tu t'approches (et) je te montre
c. Qu' il vienne et je lui montrerai
that he come-SUBJ and I him show-FUT
d. You have any $\overset{\nearrow}{\text{problem}}$ (and) they come
e. Tu as un $\overset{\nearrow}{\text{problème}}$ (et) ils viennent

AB structures, where A is imperative and declarative, exist independently, without any conditional interpretation. They realize two speech acts, a command (advice, invitation) in A, followed by the expression in B of a consequence of the eventuality that A's speech act targets, through *modal subordination* (Roberts, 1989). For instance, (3) might be interpreted as "I want you to come near. Then, I'll show you". It seems that the future is preferred, but the present tense is not impossible.

(3) (You) come near. I'll show you

Several factors interact in facilitating or preventing a conditional interpretation for P-X (where X may be imperative, declarative, etc.). First, prosodic cues play a role in discourse attachment. Dargnat and Jayez (2008) show that, if a discourse segment A, occurring at the end of a sequence of segments Σ, is immediately followed by a segment B, the absence (or shortness) of pause between A and B and the presence of a continuative contour on A, favours a direct attachment of B to A, rather than to a previous segment of Σ.[1] The nature of the discourse relation is largely unspecified. For instance, (4a) features a justification and (4b) a temporal relation. If, other things being equal, a conditional interpretation is possible, the combination of a short/null pause and a continuative rise favours the integration of A and B into a unique conditional discourse relation holding between A and B.

(4) a. Hurry up we are late
  b. Il est arrivé il était huit heures
  'He came it was eight'

Two remarks are necessary at this point. First, it is important to keep in mind that prosody does not *create* the possible discourse relation(s). It only makes the attachment of B to A most plausible and natural. The preferred attachment itself needs a discourse relation to gain substance. Therefore, the mentioned prosody-driven approach does *not* in itself account for P-X interpretations (where 'X' covers at least imperatives and declarative cases and possibly others). It would have this power only if one could show that, for instance, imperatives and declaratives can convey some hypothetical meaning by themselves. This is unlikely for imperatives[2] and calls for further discussion in the case of declaratives. Second, from the fact that A and B can be connected by a discourse relation, it does *not* follow that the result forms a unique speech act. This might be the case for P-imperatives, as proposed by Franke (2008), but it is more debatable for examples such as (4) or (5) (Dargnat, 2008, ex. 10), where the question about the title remains separate and the global speech act, if any, does not consist in questioning the conditional relation.

(5) Tu écris tes mémoires, tu leur donnes quel titre?
  'You write your memoirs, what title do you choose?'
  $\approx$ If you write your memoirs, what title do you choose?

However, in all cases, prosodic cues favour an 'integrated' interpretation. Either there is a unique speech act or one of the acts is 'focal' or 'foregrounded', that is, it constitutes a potential answer to a question under discussion or introduces such a question. For example, in French, (4b) can be an answer to the question *A quelle heure est-il arrivé?* ('When did he come?') and (5) introduces a question about the title. We group these two possibilities (speech act merging and foregrounding) under the generic label of *(discourse) integration*.

A second type of factor is the semantic relation between A and B. In the most clear-cut cases, B expresses a consequence of A. Consequences can be divided into cases of *triggering* and *generation*. Intuitively, an eventuality e_1 is a trigger of an eventuality e_2 whenever e_1 makes the occurrence of e_2 more probable (or certain) according to general social, physical or logical laws. e_1 generates e_2 whenever the occurrence of e_1 physically coincides with the occurrence of e_2. For instance, one can open a door (e_2) by turning the key into the keyhole (e_1). Pollack (1986, 1990) distinguishes between generation and *enablement*: an action A_1 enables A_2 if A_1 contributes to executing A_2

[1]See (Mithun, 1988, p. 335) for a similar remark on the absence of an intonation break between conjoined clauses.

[2]We disagree with Corminbœuf (2008) on this point.

but, in addition to executing A_1, it is necessary to do something else in order to achieve the result of A_2. Note that (1) is a triggering case, not an enablement one. In addition to the consequence vs. enablement distinction, one must consider the type of the terms of the discourse relation, or in Sweetser's (1990) terms the *domains* that are related. For instance, in (5), one may discern a relation between the fact of writing one's memoirs (content domain) and the speaker's question (speech act domain), which is prompted or at least made relevant by the writing. A content-based relation between writing one's memoirs and choosing a title for them is also possible. As shown by Sweetser (1990) and Dancygier (1998), there is a rich array of possibilities in *if*-conditionals. P-X are more restricted. For instance Austinian conditionals, a.k.a *biscuit-conditionals*, are infelicitous with P-imperatives and P-optatives (6). The corresponding imperatives and optatives are not impossible in P-X in general (7). These contrasts can be explained by assuming that certain P-X require that there be a triggering or generation relation (causation type) between the content of A and that of B (domain type). Franke (2008) imposes an analogous constraint on P-imperatives. As shown by (7), P-imperatives and P-optatives do not require that the A part describe an action.

(6) a. ?? Be hungry (and) there are biscuits in the cupboard
b. ?? Qu' il ait faim (et) il y a des biscuits dans le buffet
That he have-SUBJ hunger (and) there are biscuits in the cupboard

(7) a. Be hungry (and) you'll realize how hard it is to control your bodily reactions
b. Qu' il ait faim (et)
That he has-SUBJ hunger (and)
il verra comme c'est dur de contrôler ses réactions corporelles
'he'll see how hard it is to control one's bodily reactions'

A third family of parameters is the choice of tense and mood. We won't go into detail here, but we note that, in line with a similar observation by Culicover and Jackendoff (1997), *and* is not compatible with a conditional interpretation when A is in the conditional. So, *and* is not sufficient to determine a conditional interpretation.

(8) a. You'd come near, I'd show you ('If you come near ...')
b. You'd come near and I'd show you ($\neq$ 'If you come near ...')

3 The problem

In this section, we make clear what the relevant data are and why they are problematic. In the literature on P-imperatives, one finds the view that they are not genuine imperatives but rather elements of a conditional construction (van der Auwera, 1986; Han, 1998; Takahashi, 2004; Russel, 2007; Franke, 2008). Whatever the details and the differences between them, these proposals have two benefits. First, they provide a simple solution to van der Auwera's asymmetry. van der Auwera (1986) observed that, in families of example like (9), whereas the first three forms are appropriate in opposite contexts, like cold/hot weather, the last one is more difficult to interpret in *both* contexts. If one assumes that the *and* sentences are conditional structures in disguise whereas the disjunctive structures associate two speech acts through modal subordination ('Do that, otherwise ...'), the first three sentences are predicted to be pragmatically appropriate. More importantly, the last one is predictably odd in both contexts since the two speech act interpretation is implausible and the conditional one is not available. A similar distribution exists for P-declaratives.

(9) a. Open the window and I'll kill you [Context: it's cold]
b. Open the window or I'll kill you [Context: it's hot]
c. Open the window and I'll kiss you [Context: it's hot]
d. #Open the window or I'll kiss you

Second, if A is hypothetical, we have an explanation of why it externally behaves as an NPI-licenser environment (Culicover, 1972).

(10) a. Make any serious attempt to understand string theory and it'll ruin your scientific life
b. Fais la moindre tentative sérieuse pour comprendre la théorie des cordes et ça ruinera ta vie scientifique

In view of it ability to account for two major observations, the conditional approach seems to be on the right track. However, there are some unexpected contrasts, which exhibit three features.

1. A conditional resultative interpretation is available. So, there is no question of a 'hidden' Austinian interpretation.
2. Only paratactic (= non-coordinated) P-declaratives are natural.
3. The contrast is unstable and seems to depend on the consequent.

Suppose for instance that the addressee has just bought a new computer and is very nervous about possible breakdowns. The speaker tries to make him relax by pointing out that he has signed in for a hot-line service. Although the four variants in (11) aim at conveying the very same conditional meaning ('If you breakdown, you call the hot-line'), only the first is really natural.

(11) a. You break down, you call the hot-line
b. #You break down and you call the hot-line
c. #Break down, you call the hot-line
d. #Break down and you call the hot-line

One might hypothesise that the 'you call the hot-line' actually carries a directive speech act, a fact which, for some reason, would hinder the interpretation of the last three examples. But the contrast persists with P-optatives, which pattern like P-imperatives.

(12) #Qu' il tombe en panne (et) il appelle la hot-line
That he break down-SUBJ (and) he calls the hot-line

The contrast is also to be found with non-directive consequents. The directive interpretation may be absent from (13) if the speaker is taken to simply describe what is going to happen.

(13) a. You have a headache, I give you some aspirin
b. #Have a headache (and) I give you some aspirin
c. #You have a headache and I give you some aspirin

In the conditional paraphrases of (11) and (13), a result interpretation is available, since calling the hot-line (getting aspirin) results from breaking down (having a headache): 'If you break down, then you call the hot-line' (description), 'If you break down, then you may/must call the hot-line' (directive), 'If you have a headache, then I give you some aspirin'.

The instability of the contrast is evidenced by (14). Suppose a context of car-pursuit, where a bunch of gangsters is running after the speaker and the driver, who is the addressee. (14c) extends the paradigm in the direction of (13).

(14) a. You break down (and) we are dead
b. Break down (and) we are dead
c. Have another fit (and) you are going to get an operation

At this point, the problem we face is the following. To what extent can we account for the observed contrasts without endangering the assimilation of P-imperatives and similar structures to integrated semantic objects, in which only one speech act is executed?

4 The automaticity condition

4.1 The basic automaticity constraint

The term 'automaticity' is reminiscent of Bolinger's (1977) remark that in A *and* B P-imperatives, given A, B is 'automatically' true. A consonant suggestion has been made by von Fintel and Iatridou (2007) for Sufficiency Modal Constructions (SMC) of the general form 'If you want to get A you only have to do B'. In essence, von Fintel and Iatridou propose that a SMC (i) presupposes that in every world where A obtains, the addressee does something and (ii) asserts that in at least one world where B obtains, the addresses does not do anything else than A. If we assume that P-imperatives correspond to SMC, we can account for (11c-d): there is no world reasonably similar to the actual world in which it is sufficient to break down to call the hot-line, since the call itself is a mandatory action, which is not triggered/generated by the breakdown independently of the agent (the addressee). The proposal has to be slightly relaxed, to allow for the possibility of (14)-type example. In the formulation given in (15), we leave open the possibility that a does or *undergoes* e.

(15) Given an agent a and a couple of eventualities e, e', in which a participates, we say that e' is an automatic consequence of e with respect to a, if e causes e' and e' is not an action by a.

In view of examples like (16), we do not need to describe a presupposed component. B reacts to A's P-imperative by denying that breaking down would lead automatically to death. It is usually assumed that direct rejections ('you are wrong', 'It's false', 'You are lying', etc.) cannot target the presupposed or implicated part of an assertion.[3]

[3]Actually, this is not that simple. In some cases, one can construct natural examples where a discourse participant attacks a presupposition or a conventional implicature. However, in (16) and analogous examples, it seems difficult to find a presupposition or conventional implicature trigger and to articulate a main content fundamentally different from 'B automatically follows from A'.

(16) A – Break down (and) we are dead
B – You're wrong, we have guns, remember?

This shows that the constraint for P-imperatives must put the automaticity condition at the level of the main content. We treat P-optatives along the same lines since they pattern with P-imperatives. Only conjunctive P-declaratives must obey the same constraint.

(17) **Automaticity condition**
A P-imperative or P-optative of the form A (*and*) B is appropriate only under an interpretation where the eventuality described by B is an automatic consequence of the eventuality described by A with respect to the addressee. P-declaratives of the form A *and* B are subject to the same constraint.

Examples like (13) raise a problem, since having a headache might be a sufficient condition for getting aspirin if the aspirin is provided by someone else than the relevant agent (by default, the addressee in P-imperatives). Although they may sound odd out of the blue, they improve in appropriate contexts. For instance, (13) fits well in a situation where the addressee is craving for aspirin. Generally speaking, communicating the fact that B is an automatic consequence of A makes better sense when automaticity is relevant to the addressee's goals and concerns, that is, whenever comparing A to other non-automatic triggers of B or B to other non-automatic consequences of A can help the addressee to reach her goals or to update/revise her expectations, given her current concerns. When it is difficult to abduce plausible contexts for *using* constructions that convey automaticity, they will be felt as anomalous, even if is *not* difficult to abduce contexts that satisfy their basic semantic requirement, i.e. the automaticity condition. This is just one more illustration of the fact that the *Gedanke experiment* of interpreting sentences in isolation combines understanding the meaning of the sentences *and* motivating their use. As an additional symptom of the difference, note that the following variant of (11) is perfect in a context where the addressee is seeking a reason for calling the hot-line.

(18) a. You break down (and) you can call the hot-line
b. Break down (and) you can call the hot-line

4.2 A Lewis-style causal analysis

So, pseudo-imperatives and coordinated P-declaratives demand that there be a causal relation between the eventualities described by A and by B. It is apparent from the discussion of causation type in section 2 that sufficient conditions correspond to triggering or generation, but never to enablement. At this stage, we have to make precise at least one notion of consequence, in order to provide a framework in which we can express the sufficiency requirement that characterises the pseudo-X we consider.

We resort to Lewis's (1973a; 1973b; 2004) analysis of causation. Although some subtle aspects of causation might not be captured by Lewis's approach (see the papers in Collins et al. (2004) for various illustrations), we consider that it covers all the main cases we need to take into account.

(19) **Lewis's causal dependency**
1. For a given similarity ordering $\prec$ between worlds, $w, \prec \models A \,\Box\!\!\rightarrow B =_{\mathrm{df}}$ at every w-closest world where A, B
2. B causally depends on A at w ($w, \prec \models A \Rrightarrow B$) $=_{\mathrm{df}}$ $w, \prec \models (A \,\Box\!\!\rightarrow B \,\&\, \neg A \,\Box\!\!\rightarrow \neg B)$.

One must keep in mind that the intuition for 'A being a sufficient condition for B' in a counterfactual analysis may convey a tension. On the one hand, to establish the truth of $A \,\Box\!\!\rightarrow B$ at w, only the *minimal* revisions of w with A are considered. This entails that all that is necessary to derive B from A is already present in w or is a consequence of adopting A in w and making as few changes as possible. In this respect, A is 'sufficient' to ensure B. On the other hand, events posterior to A in w might play a role; so, in that respect, A is not really 'sufficient' to trigger B. Consider (14): if an unfortunate breakdown occurs, the B event (the murder) cannot take place if the gangsters change their plan for some reason and decide to abandon the pursuit. For B to take place, an action by the gangsters is required, which means that the murder is not really 'automatic' in a strictly causal and deterministic sense. However, in the situation at hand, the murderous intentions of the gangsters are part of the initial conditions. Therefore, in order to obtain an acceptable definition for 'B is an automatic consequence of A at w', we need to make sure that (i) A causes B, that (ii) no eventuality of w posterior to or simultaneous with A and which would not be caused only by eventualities preceding A is necessary for obtaining B and that (iii) actions of the relevant agent (e.g. the addressee for P-imperatives) may be suppressed without changing the result B.

We construct our definition for automaticity in two major steps. First, we define a notion of sufficient condition; then, we define automaticity proper. We abbreviate (19.2) as $A \Rrightarrow_{w,\prec} B$. Worlds are seen as sets of eventualities. The set of worlds, W, contains every consistent subset of eventualities. In particular, if $w \in W$, $w' \subseteq w$ and w' is consistent, $w' \in W$.

(20) For a set of eventualities $\mathcal{E}$ in w, $CAUSE_{w,\prec}(\mathcal{E}) = \{e \in w : \exists e' \in \mathcal{E}(e' \Rrightarrow_{w,\prec} e)\}$

$CAUSE_{w,\prec}(\mathcal{E})$ stands for the set of causes of eventualities in $\mathcal{E}$. We can now 'slice up' worlds into temporal regions with respect to A. $X <_w Y$ notes that the starting point of Y is posterior to that of X in w.

(21) 1. $w_{\lll A} =_{\mathrm{df}} w - \{e : A \leq_w e\}$.
2. $w_{\not\lessdot A} = w_{\lll A} \cup \{e \in w : CAUSE_{w,\prec}(\{e\}) \subseteq w_{\lll A}\} \cup$ $\{e \in w : \forall e'((e' \in CAUSE_{w,\prec}(\{e\}) \,\&\, e' \geq_w A) \Rightarrow$ $\exists e''(e'' \in CAUSE_{w,\prec}(\{e\}) \,\&\, e'' <_w A))\}$

$w_{\lll A}$ is the set of eventualities that precede A. $w_{\not\lessdot A}$ is the set of eventualities that (i) precede A or (ii) have at least one causal precursor that precedes A. The notion of sufficient condition (22) corresponds to a causal dependence between a precursor A and a consequence B where the world ordering is sensitive only to those eventualities that precede A or have precursors that precede A.

(22) Let $W_{\not\lessdot A}$ be $\{w \in W : \exists w' \in W(w = w'_{\not\lessdot A})\}$. A is a sufficient condition for B at $(w, \prec)$ whenever $w_{\not\lessdot A}, \prec \restriction W_{\not\lessdot A} \models A \,\Box\!\!\rightarrow B$ and $w, \prec \models \neg A \,\Box\!\!\rightarrow \neg B$.

In prose, A is a sufficient condition for B at w if, (i) when we compare only worlds where no eventuality not preceding A or causally dependent only on eventualities not preceding A takes place, at every closest world, if A then B, and (ii) $\neg A \,\Box\!\!\rightarrow \neg B$ holds at w in the original model $(W, \prec)$. In contrast with $A \,\Box\!\!\rightarrow B$, we do not require that worlds be modified for $\neg A \,\Box\!\!\rightarrow \neg B$. Consider the gangsters' case. If the fugitives do not break down and the police has enough time to rescue them, we don't want to suppress the rescuing event because it occurs after the breakdown, since doing so might falsify $\neg$*breakdown* $\Box\!\!\rightarrow \neg$*killing*.

Under the simple deterministic view we have adopted, 'A is a sufficient condition of B' means that the causal link from A to B does not involve any eventuality that would be independent of every event preceding A. In the gangsters' case, given the initial setting (the physical circumstances and intentions of the agents) the killing is unavoidable once the breakdown has occurred. Thus, the breakdown is a sufficient condition of the killing since all the eventualities that have a part in the result are triggered or generated by eventualities that precede the breakdown. With (11), the breakdown is also a sufficient condition of the call if calling the hot-line is the consequence of a plan existing before the breakdown. In order to reflect von Fintel and Iatridou's idea, we need an extra constraint in the definition of sufficient condition. If a is the relevant agent, the general idea is to 'ignore' the actions of a that do not precede A, even if they play a causal role in bringing about B and are caused by eventualities that precede A. We define a new shrinking method, $w^a_{\not\prec A}$, which consists in subtracting from $w_{\not\prec A}$ the actions by a that do not precede A. α_x ranges over actions by x.

(23) $w^a_{\not\prec A} = w_{\not\prec A} - \{\alpha_a : \alpha_a \geq_{w_{\not\prec A}} A\}$

Finally, A entails B automatically if (i) B causally depends on A in a model where we keep only the worlds where eventualities irrelevant to the causal connection between A and B and actions not preceding A have been suppressed and (ii) $\neg B$ causally depends on $\neg A$ in the initial model.

(24) **Automatic consequence**
B is an automatic consequence of A in w w.r.t. an agent a whenever:
$w^a_{\not\prec A}, \prec \restriction W^a_{\not\prec A} \models A \,\Box\!\!\rightarrow B$ and $w, \prec \models \neg A \,\Box\!\!\rightarrow \neg B$.

When applied to (11), (24) predicts that the action of calling the hot-line will be removed from any relevant world, which conflicts with the possibility of characterising the call as a consequence of the breakdown. The analysis offered here deliberately ignore the issue of causal *preemption*, that is, roughly speaking, the fact that several conflicting causes may produce the same effect. It does not seem to be crucial for the type of simple examples we have commented. However it is an open problem whether preemption can be accommodated in a counterfactual framework like Lewis's (see Hall and Paul (2003); Spohn (2006)).

4.3 How come?

As noted in section 2, modal subordination plays a role in the conjunction of an imperative clause and a clause expressing one of its consequences (Jayez, 2002; Jayez and

Rossari, 1999). Imperatives propose to or impose on the addressee *a* some course of action α. If the result of α depends on further actions of *a*, they should be mentioned as recommended or compulsory. It would be uncooperative to mention only α and to count on some other action which does not necessarily follow from the context and is not a default action by the addressee. So, in general, in a structure A-IMP B, where B expresses the result of A, this result is an automatic consequence. In such modally subordinated structures, automaticity is a conversational implicature. It is not infrequent to see pragmatically preferred interpretations of linguistic structures acquire a conventional meaning, although there is probably no agreement about what factors are (ir)relevant (frequency, saliency, etc.), as evidenced by the discussion in Ariel (2008, chap. 5). We conjecture that automaticity has become the prominent conventional meaning of A-IMP B structures whenever prosody (short/null pause + continuative rise) favoured an integrative interpretation, as explained in section 2. In addition to this combination of a conditional reading (integration) with automaticity ('frozen pragmatics'[4]), P-imperatives exhibit a sort of bleaching on the imperative itself. The A part may use non-controlled predicates, as in (25).

(25) a. Be a blonde and every man will start fantasising about you
b. #Be a blonde

What is the role of *and*? Normally, *and* introduces the last term in an enumeration. So A *and* B suggests that B is the last term in a sequence of eventualities. Consider paratactic (= non-coordinated) P-declaratives AB. The conditional interpretation corresponds to the view that the eventuality e_A expressed by A leads to a point where e_B is normally true or bound to be true. But other eventualities might play a role. The relation between e_A and e_B may be paraphrased by 'given A, normally B', which means that, in certain cases, for e_B to obtain, e_A should be supplemented by other eventualities, which are expected to happen ('normal') in general or in the particular circumstances under consideration. With coordinated P-declaratives, B is marked as final. Why would a speaker choose to emphasise that a result is final, rather than just a result? A plausible reason is that e_A leads directly to the result (e_B), without it being necessary to mention any intervening eventuality. So, the speaker is convinced that, given A, the whole process will run to its term, this belief being itself motivated by the fact e_A leads automatically to e_B without any agent intervention (blind causality) or with respect to some agent, whose action is irrelevant to the result. We conjecture that the latter inferential motivation has been internalised as a grammatical construction, which would explain the difference between the paratactic and *and*-coordinated forms for P-declaratives.

5 Interface problems

In this section, we discuss briefly the representation of P-structures in an extension of the HPSG framework (Pollard and Sag, 1994), designed to accommodate *constructions* in the sense of Goldberg. Strictly compositional structures preserve the contribution of their constituents in isolation. In P-structures, A (*and*) B, A has not the meaning it has

[4] A term we borrow from Levinson (1987), see also Hyman (1984).

in isolation, e.g. imperatives are not semantically imperative. Moreover, the prosodic integration of A and B cannot be attributed to A or B separately. The rising contour itself seems to be ambiguous between continuation and interrogation (Dargnat and Jayez, 2008). This shows that P-structures should be analysed as constructions. It is well-known that Construction Grammars exploit feature structures of the type used in HPSG, in particular because they provide facilities for accessing different parts of information simultaneously (multidimensionality). The default mechanism of HPSG (Lascarides and Copestake, 1999) can also be imported. The following feature structure summarises the most important aspects of the representation for French. / notes a default value.

The *decl-hd-su-cl* type corresponds to declarative headed clauses with a subject and demands indicative or conditional mood. Imperative clauses demand imperative mood. The initial string X (et) Y is split into two constituents consA and consB. consA hosts preferentially a rising contour and is preferentially saturated (/{ }). The pause is preferentially short or null. Two discourse moves A' and B' with a common speaker are associated with A and B. *attach* type objects describe the attachment of a discourse move to a subset (list) of discourse moves through a discourse relation (value of DR). B' must be attached to A' through an automatic consequence relation. $\leftrightarrows$ notes the replacement of a value. The original illocutionary force of A' is switched to a hypothetical value. The whole construction inherits its illocutionary force (assertion) from B'. The net result amounts to asserting the proposition (C) that an automatic consequence relation holds between a hypothetical discourse move (A') and an assertive discourse move (B') attached to it.

(I) *decl-hd-su-cl*: $\begin{bmatrix}\text{HEAD} & \begin{bmatrix}\text{MOOD} & ind \vee cond\end{bmatrix}\end{bmatrix}$ **(II)** *imp-hd-cl*: $\begin{bmatrix}\text{HEAD} & \begin{bmatrix}\text{MOOD} & imp\end{bmatrix}\end{bmatrix}$

(III) *P-imp/decl*:

$$\begin{bmatrix}
\text{STRING} & \left\langle \boxed{X}\ .\ (et)\ .\ \boxed{Y} \right\rangle \\
\text{CONSA} & \begin{bmatrix} \multicolumn{2}{l}{decl\text{-}hd\text{-}su\text{-}cl \vee imp\text{-}hd\text{-}cl} \\ \text{MORPH} & \boxed{X} \\ \text{SLASH} & /\{\} \\ \text{END-CONTOUR} & /rising \\ \text{DISC-MV} & \begin{bmatrix} dmv & \\ \text{SPEAKER} & \boxed{1} \\ \text{ILLOC-FORCE} & \boxed{F1} \end{bmatrix} \boxed{A'} \end{bmatrix} \boxed{A} \\
\text{PAUSE} & /(\text{short} \vee \text{null}) \\
\text{CONSB} & \begin{bmatrix} decl\text{-}hd\text{-}su\text{-}cl & \\ \text{MORPH} & (et)\ \boxed{Y} \\ \text{SLASH} & /\{\} \\ \text{DISC-MV} & \begin{bmatrix} dmv & \\ \text{SPEAKER} & \boxed{1} \\ \text{ILLOC-FORCE} & \boxed{F2} \end{bmatrix} \boxed{B'} \end{bmatrix} \boxed{B} \\
\text{DISC-MV} & \begin{bmatrix} dmv & \\ \text{SPEAKER} & \boxed{1} \\ \text{ILLOC-FORCE} & \boxed{F2} \\ \text{PROP} & \boxed{C} \end{bmatrix} \\
\text{CNTXT} & \begin{bmatrix} \text{DISC-MVS} & list\text{-}of(disc\text{-}mv)\boxed{2} \\ \text{DISC-RELS} & list\text{-}of(\begin{bmatrix} attach & \\ \text{DR} & dr \\ \text{DISCMV1} & sub\text{-}list\text{-}of(\boxed{2}) \\ \text{DISCMV2} & el\text{-}of(\boxed{2}) \end{bmatrix}) \oplus \begin{bmatrix} attach & \\ \text{DR} & automatic\ consequence\ \boxed{C} \\ \text{DISCMV1} & \boxed{A'} \leftrightarrows (\boxed{F1} = hyp) \\ \text{DISCMV2} & \boxed{B'} \end{bmatrix} \end{bmatrix}
\end{bmatrix}$$

This basic feature structure has to be supplemented with constraints that handle more specific details, such as the presence of *et* or mood/tense agreement. E.g., P-declaratives require the presence of *et* under the automatic consequence interpretation (1), when *A* is in the conditional, *B* also must be in the conditional (2), *A* may not be in the plus-que-parfait (≈ pluperfect) (3), etc., see Dargnat (2008) for other examples.

1. CONSA : *decl-hd-su-cl* ⇒ STRING : $\langle X\,.\,et\,.\,Y \rangle$
2. CONSA : HEAD|MOOD : *cond* ⇒ CONSB : HEAD|MOOD : *cond*
3. CONSA : TENSE : ¬*plus-que-parfait*

6 Conclusion

In further work, we will apply the present approach to a larger spectrum of paratactic structures, involving for instance optative and interrogative clauses as well as NPs (see Culicover's (1972) OM-sentences). Ideally, the relationship between coordination and conditional interpretation would have to be studied in a broader typological and diachronic setting. In particular, the fact that *and* is semantically distinctive for P-declaratives should be compared with the idea that, typologically, conjunctive coordination is less marked than, for instance, disjunctive coordination (Ohori, 2004). While the contrast between *and* and *or* P-declaratives (one vs. two speech acts) goes in the same direction, the role of *and* in P-declaratives is, in this respect, in need of further clarification.

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Focus Alternatives and Contextual Domain Restriction: A Visual World Eye-tracking Study on the Interpretation of 'Only'

Christina Kim
ckim@bcs.rochester.edu

Christine Gunlogson
gunlog@ling.rochester.edu

Michael Tanenhaus
mtan@bcs.rochester.edu

Jeffrey Runner
runner@ling.rochester.edu

Dept. of Brain & Cognitive Sciences
Dept. of Linguistics
University of Rochester

Abstract

The interpretation of sentences with focus-sensitive elements like 'only' depends on context to restrict the domain of relevant alternatives for evaluating the focused expression. But what kinds of contextually available information do listeners actually use to restrict interpretive domains? Three visual world eye-tracking experiments show that listeners use at least previous mention (Experiment 1), real-world knowledge about specific scenarios (Experiment 2), and conceptual similarity to recently mentioned items (Experiment 3).

1 Introduction

The semantic contribution of the focus particle 'only' in sentences like (1-a)-(2-a) has two components, under standard assumptions: (i) the proposition expressed by the sentence without 'only'[1]—e.g., Matt's acing the exam in (1-a); and (ii) the claim that no alternative to the focus value associated with 'only' makes the sentence true. The focus value and its alternatives are understood to be drawn from some appropriately restricted domain, as suggested in (1-b)-(2-b).

(1) a. Only Matt got a perfect score on the exam.
    b. students in some class

[1]This proposition is often referred to as the *prejacent*; there has been a lot of debate about its status, which we do not address here.

(2) a. I only had a crush on Jared Leto.
b. cast of mid-90s teen TV drama *'My So-called Life'*

A likely context for (1-a), for instance, is a discussion of a specific class in a specific term. In other cases, like (2), the alternatives that the sentence is interpreted against seem to vary easily with the particular discourse context the sentence appears in.

Our concern in this paper is how this contextual narrowing of alternatives takes place. The work of spelling out the role of context generally falls to pragmatics, as von Fintel (1998) suggests in connection with similar issues of domain restriction for generalized quantifiers:

> The idea is to (temporarily) restrict the domain of evaluation for the whole sentence or even the whole discourse. The pragmatics will help in choosing a suitable universe for the evaluation of a particular sentence, but the semantics can just operate abstracting away from any such choice of a universe.

Rooth (1996) similarly characterizes the domain variable posited for interpretation of focus as pragmatically determined. How exactly the pragmatics accomplishes the task of suitably restricting the domain remains largely unarticulated. Our approach in the present study is to investigate experimentally potential sources of relevant contextual information by considering their effects on processing of sentences with 'only'.

We examine three factors, starting with preceding mention, cited by Rooth (1996) as one pragmatic factor affecting interpretation of 'only' sentences. With reference to (3) (Rooth's 24), he observes that "the domain of quantification is understood as consisting of just three propositions, rather than the full set of propositions of the form 'John introduced y to Sue' ".

(3) John brought Tom, Bill, and Harry to the party, but he only introduced Bill$_F$ to Sue. *(Rooth 1996, example 24)*

That is, the domain is restricted to the set of propositions featuring the individuals just mentioned. In Experiment 1, we manipulate the factor of previous mention, as in Rooth's example.

Experiment 2 varies, in addition to linguistic mention, 'how much' context there is—that is, how much the nature of the scene described by the context-setting sentences constrains likely alternatives. To illustrate this, consider a shopper described as being at a farmers market vs. one who is at a shopping mall. Potential purchases for the first shopper are most likely confined to produce and other food items, whereas the mall shopper could be buying just about anything. Relative to the shopping mall, the farmers market context is more restrictive and hence more informative, in a sense, about the kinds of things available for purchase.

Finally, Experiment 3 introduces the factor of conceptual similarity with previously mentioned items. In principle, the pair of sentences (4-a)-(4-b) can be interpreted with respect to the alternatives in (4-c), but we most easily construe this as meaning 'strawberries, but not other types of fruit' (4-d).

(4) a. Jill likes apples and nectarines.
b. Abby only likes [strawberries].
c. {strawberries, apples, nectarines, grapes, peas, socks, fountain pens,...}
d. {strawberries, apples, nectarines, grapes,..}

The remainder of this paper is structured as follows. First, in Section 1, we review some relevant previous psycholinguistic work on domain restriction. Section 2 introduces the Visual World paradigm in general, and describes specifically how eye movements can be used to probe comprehenders' expectations about focus alternatives. Sections 3-5 present three eye-tracking experiments examining effects on focus alternatives of previous mention, informativity of the context, and conceptual similarity, respectively. Section 6 concludes with directions for future research.

2 Using eye-tracking to investigate domain restriction

Our methodology involves monitoring of participants' eye movements in a 'visual world' paradigm. In a typical visual world eye-tracking study, participants move or click on objects in a visual display as they are listening to a sentence that indicates what item in the display is the target. Eye-movements have been shown to be closely time-locked to salient linguistic events in auditorily presented stimuli (Tanenhaus et al., 1995), and therefore provide a means to track listeners' expectations about upcoming linguistic input given the visual context and what they have heard so far. By manipulating the availability of different information types available in the visual or linguistic context, one can ask to what extent each of these potential information sources helps the listener restrict the referential domain to the point that the single intended referent can be picked out.

Previous experimental work has shown that language comprehenders rapidly integrate multiple sources of information for the purpose of referential disambiguation. Tanenhaus et al. (1995) showed that reference resolution can be guided by what we know about the meanings of definite descriptions, in conjunction with properties of the visual context. Participants' eye movements were tracked as they followed instructions to manipulate items in a display. For example, they would hear *'Put the apple on the napkin in the box'*, while viewing a display containing one apple on a napkin, an empty napkin, an unrelated item, and a box. They found that whether the PP *'on the napkin'* was interpreted as a modifier or as a goal depended on properties of the visual display. When the display contained only one referent that matched the description *'apple'*, at the point when participants had heard *'the apple'*, they had all the information they needed to pick out the intended unique referent in the scene. As a result, *'on the napkin'* was not construed as a modifier but as a goal: participants looked at the empty napkin and sometimes even started to put the apple on the empty napkin. However in a display containing two apples, after hearing *'Put the apple'*, listeners interpreted *'on the napkin'* as a restrictive modifier picking out one of the two apples, not a goal.

These findings demonstrate that reference resolution is an incremental process that is sensitive to the visual context—in fact small changes to the visual context can bias comprehenders in favor of one parse over another. Moment to moment biases are reflected in participants' anticipatory eye movements as they are interpreting a sentence

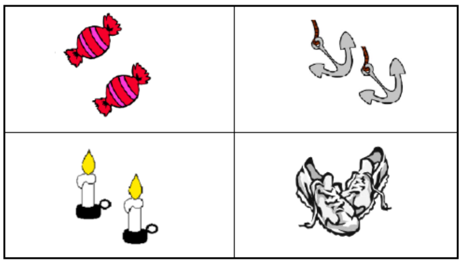


Figure 1: Example display. *target* = candy; *cohort* = candles; *unrelated* = anchors, sneakers.

in a particular visual context. Subsequent studies have established language comprehenders' sensitivity to a variety of information sources during online processing: selectional properties of lexical items (Altmann & Kamide, 1999), the presence of contrast (Sedivy et al., 1999), information about the preceding linguistic discourse (Chambers et al., 2002), and knowledge about possible eventualities in the world (Chambers et al., 2004).

The current study take the same methodological approach to investigating what factors determine what is included in the set of focus alternatives that a sentence like (5) is interpreted with respect to.

(5) Jane only has some candy.

Under our standard assumptions, (5) conveys that Jane has some candy and that she has nothing other than candy. What is included in this 'nothing else'? Since the eventual target word (*'candy'*) must be included among the focus values, having an expectation about what that word will be amounts to having stronger or weaker expectations about what will be a possible alternative.

For each trial, we record continuously what item the participant is fixating in a display like Fig. 1, as they are hearing the target sentence. After averaging this information over many trials (for a number of subjects), we can look at the proportion of fixations to a particular display item (for example, fixations to the target item) over time. Once we have the proportion of fixations to the target, the cohort competitor,[2] and the distractors, we can look at a particular time interval and ask whether there is a difference between the proportion of looks to each display item.

3 Experiment 1: Focus alternatives are constrained by previous mention

Even out of the blue, one might expect (5) to be interpreted with respect to just the *relevant* alternatives (6-a).

(6) a. {candy, cupcakes, apples, sandwiches, gum, dry erase markers, refrigerators, pickup trucks ...}

[2]The cohort competitor shares initial phonology with the target word; see Section 3.1.

b. {candy, cupcakes, apples, sandwiches, gum, ...}

(7) Mark has some candy and some apples.

But in the context of a sentence like (7), the mentioned subset of the focus alternatives seem much more salient (6-b): the mentioned alternatives are somehow 'preferred'. Is the set of alternatives considered in interpreting a sentence like (5) constrained by the set of things just mentioned in the discourse?

3.1 Design, Procedure

The same basic paradigm is used (with variations) in all four experiments. The prerecorded stimuli each consist of one or more *context sentences*, the last one of which includes references to particular types of objects such as boots or candy. The *target sentence* follows, as exemplified in (8).

(8) a. [*Context*] Mark has some candy and some apples.
b. [*Target*] Jane (only) has some . . .
(i) candy
(ii) candles

What Jane is described as having varies by experimental condition, e.g., the mentioned *candy* above vs. unmentioned *pencils*. The presence vs. absence of *only* is systematically varied as well. The task required of subjects is simply to click on the item(s) identified in the target sentence.

We manipulated (i) whether the target word was mentioned in the context sentence (Mention), and (ii) whether 'only' appears in the target sentence. Examples of the four resulting conditions are in Table 1; target sentences are to be interpreted with respect to the four-item display in Fig. 1.

On each trial, participants heard a pair of sentences like (7) (context sentence) and (5) (target sentence). At the onset of the target sentence, four pictures appeared (Fig. 1), one in each quadrant of the computer screen. Participants were instructed to click on the items in the target sentence (i.e. the things Jane had). 28 University of Rochester students who were native speakers of American English participated in the experiment.

Context	*No Mention*	*Mention*
Mark has...	...some gloves and some pencils.	...some candy and some pencils.
Target	*No Only*	*Only*
Jane...	...has some candy.	...only has some candy.

Table 1: Experiment 1 design and example stimuli.

In experimental trials, two of the four pictures were members of the same phonological cohort (*'candy'-'candles'*). In the absence of biasing factors, participants will begin to shift fixation to words that match the acoustic input about 200 ms after the onset of the word (Allopenna et al., 1998). Therefore we expect participants to look equiprobably at the target item and the cohort competitor at the point in the target sentence when they've heard just the beginning of the direct object (*'can...'*). As the unfolding auditory input disambiguates the target referent (*'...ndy'*)—the point of disambiguation—the proportion of fixations to the target item should rise as fixations to the competitor drop off. This means that if looks to the target item increase earlier than the point of disambiguation, there is a bias toward the target item due to some other property of the stimulus.

If recent mention of a particular type of object makes that kind of object more salient, as seems plausible, then we expect earlier identification of the target *candy* just in the Mention conditions. Since the target item in critical trials is always either an item mentioned in the Context sentence, or a phonological competitor of a mentioned item, using previous mention as a cue would effectively allow participants to identify the target early, despite the fact that the initial syllables of the target and competitor are identical.

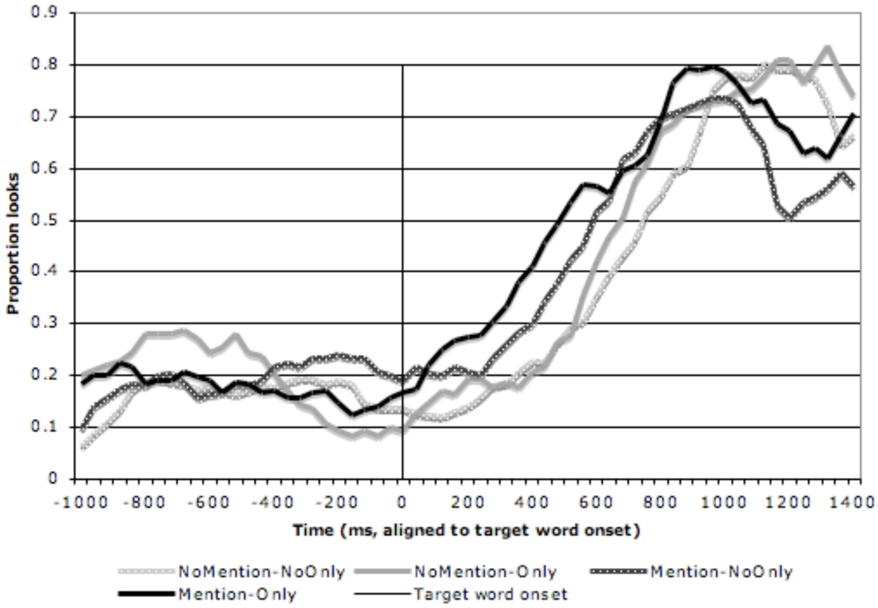
Whether the presence of 'only' by itself can be expected to facilitate identification of the target is not clear. A more interesting question is whether 'only' interacts with the mention factor. If the presence of 'only' strengthens the mention effect, we will see fastest identification of the target in Mention Only conditions—faster than can be expected on the basis of Mention NoOnly and NoMention Only conditions.

3.2 Results

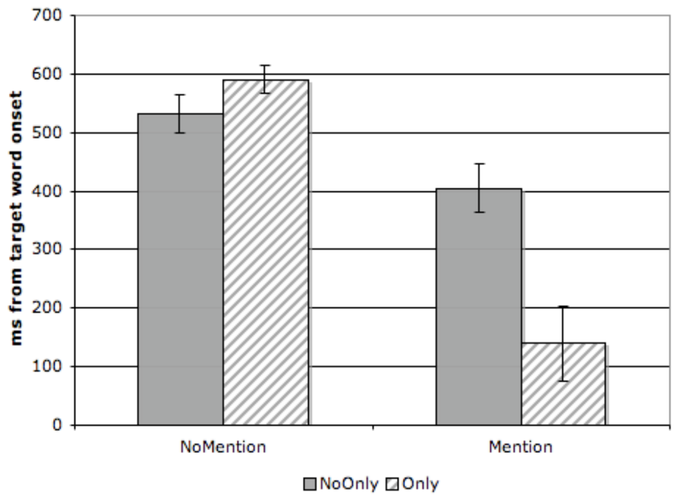
In order to examine the time course of fixations, we calculated the proportion of fixations to the target at every 33 ms time slice, aggregating trials for each condition first within a participant and then across participants. Fig. 2.a shows proportion of fixation curves plotted as a function of time. The average time to convergence on the target referent (where target looks reliably exceed looks to the competitor) for each condition is shown in Fig. 2.b. For example, the 'Mention-Only' curve in Fig. 2.a corresponds to the average proportion of looks to the quadrant containing the target referent, *candy*, in Fig. 1, as listeners hear the sentence *'Jane only has some candy'*. In this condition, the target word will have been mentioned in the preceding context sentence. The corresponding bar in Fig. 2.b (rightmost) represents the average time for fixations to converge on *candy*—that is, diverge from fixations to the competitor, *candles*.

There were main effects of Mention ($F1(1,24) = 46.8$, $p < .0001$) and Only ($F1(1,24) = 6.2$, $p < .05$), as well as a Mention-Only interaction ($F1(1,24) = 14.8$, $p < .0005$). On No Mention trials, listeners were able to disambiguate the target referent from the phonological competitor only after hearing the entire word, on average 560 ms after the onset of the target word (left-hand bars in Fig. 2.b). Thus in the absence of Mention, listeners had no preference for *candy* over *candles*. There was no advantage for the Only condition over the No Only condition ($t = 1.4$, $p = .15$).

The Mention-No Only trials (right-hand bars, Fig. 2.b) showed an effect of Mention independent of any effect of Only: fixations converged on the target referent 404 ms after target word onset. Thus when a previously mentioned item appeared as part of the visual context, listeners had a preference for the mentioned item. When 'only' was present, fixations converged on the target referent 139 ms after target word onset, well



a.



b.

Figure 2: Experiment 1: a. Proportion target fixations over time, b. Mean point of disambiguation (error bars are Standard Error).

before the input disambiguated the target and the cohort competitor. In the 200-400 ms post-target onset interval, fixations to the target in Mention-Only trials exceeded those in Mention-No Only trials ($t = 10.4$, $p < .001$), while No Mention trials did not differ as a function of Only ($t = .9$, $p = .35$). Thus, after hearing only the initial part of the target word, listeners strongly expected the possible referents to be constrained by the set of just mentioned items. When this expectation is violated, as in the No Mention-Only condition, the point of disambiguation is late (in fact, later in absolute terms than in the No Mention-No Only condition).

These results suggest that upon hearing 'only', listeners have a strong expectation that the upcoming focus will be a recently mentioned item. We might think of 'only' as functioning as a cue that increases listeners' sensitivity to aspects of the preceding discourse context.

4 Experiment 2: Informativity contributes to restricting alternatives

Presumably the manipulation of Mention in Experiment 1 has the effect of making some set of things salient in the context. We might then expect to observe the same restrictive effect just by enriching the information in the context (i.e. making the context more 'restrictive'). Experiment 2 tests this hypothesis, asking whether having richer information in the context contributes to restricting focus alternatives in sentences like (9). Compare (10-a) and (10-b).

(9) Peter only wants to buy [some magazines].

(10) a. Jill and Peter are at the drugstore.
b. Jill and Peter are at the newsstand.

Intuitively, (10-b) provides more information, since our knowledge about the world tells us that the range of items that can be purchased is relatively narrow compared to a drugstore, where a wider set of items can be purchased. In addition to repeating the experimental conditions from Experiment 1 (Mention x Only), Experiment 2 varied the informativity of the discourse context.

4.1 Design, Procedure

Experiment 2 crossed three factors: Context Informativity (Informative, Underinformative), Mention, and Only; the resulting eight conditions are given in Table 2. The corresponding visual display is in Fig. 3.

The procedure was as in Experiment 1, except that two context sentences (Context 1 and 2 in Table 2) preceded the target sentences. As participants heard the target sentence, they were shown a visual display like Fig. 3, with a target item (*magazines*), a cohort competitor (*magnets*), and two unrelated distractor items (*scissors, lamps*). Notice these are all items consistent with the Underinformative Context (here, 'drugstore'),

Context 1	*Underinformative*	*Informative*
Jill and Peter are...	...at the drugstore.	...at the newsstand.
Context 2	*No Mention*	*Mention*
Jill is getting...	...some comic books and some cigarettes.	...some magazines and some cigarettes.
Target	*No Only*	*Only*
Peter is...	...getting some magazines.	...only getting some magazines.

Table 2: Experiment 2 design and example stimuli.

Figure 3: Experiment 2 example display.

while only the target item is compatible with the Informative Context ('newsstand'). 24 native English speakers participated in the experiment.

If more informative contexts function in the same way as mention, they could restrict the domain of interpretation specifically when 'only' is present. We might then expect faster convergence on the target item only in Only conditions (on top of the Only-Mention effect from Experiment 1). On the other hand, we might find that enriching the context has a restrictive effect on subsequent interpretation, but in a general way that isnt specific to the presence of 'only'. In that case, we would expect across-the-board faster convergence on the target item in Informative conditions, irrespective of the presence of 'only'.

4.2 Results

Fig. 4 shows the average time to convergence on the target referent (Underinformative conditions on the left, Informative conditions on the right).

4.2.1 Underinformative contexts

There were main effects of Informativity ($F(1,20) = 34.0$, $p < .0001$), Mention ($F(1,20) = 11.5$, $p < .001$), and Only ($F(1,20) = 9.8$, $p < .005$), and no interactions.

Underinformative contexts patterned much like Experiment 1. This is expected: the most underinformative thing to say is nothing at all, and in this case the four Underinformative conditions reduce to the conditions in Experiment 1. The target referent was disambiguated latest in the No Mention-No Only and Mention-No Only conditions,

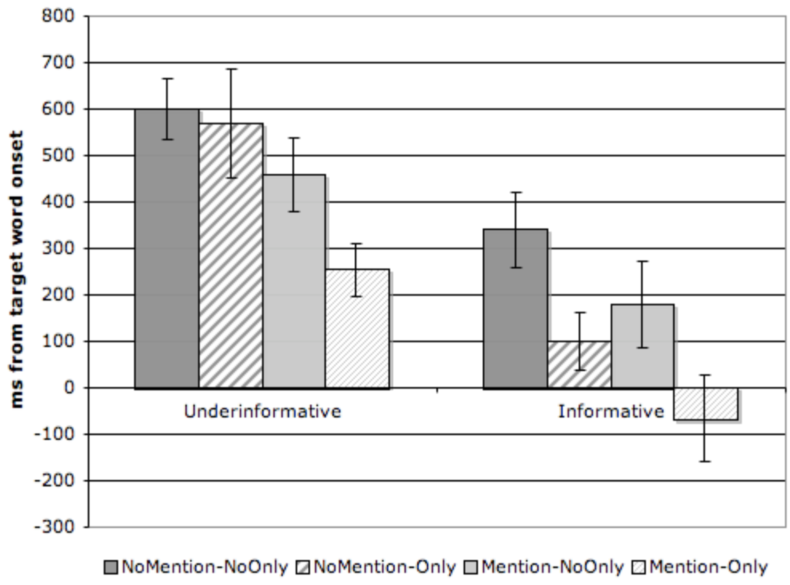


Figure 4: Experiment 2. Mean point of disambiguation.

earlier in the No Mention-Only condition, and earliest in the Mention-Only condition (Fig. 4, left-hand bars). As in Experiment 1, 'only' seems to increase sensitivity to information in the preceding linguistic context, creating a bias in favor of discourse-old items.

4.2.2 Informative contexts

First, there was a general restrictive effect of context informativity: Informative context conditions had on average a 335 ms earlier convergence on the target referent relative to the corresponding Underinformative context conditions.

In addition, the benefit due to informativity was strengthened in the presence of 'only': there was a 399 ms advantage due to Informative context in Only conditions, compared to a 271 ms advantage for No Only conditions. In Mention-Only trials, target fixations start rising well before the onset of the target word, soon after the onset of 'only'. The largest advantage occured in the Mention-Only condition, where listeners were able to disambiguate the target referent after hearing 'only', but well before the onset of the target word.

5 Experiment 3: Generating expectations about likely alternatives

In Experiment 3, we asked whether conceptually similar alternatives are preferred over conceptually unrelated ones: after hearing *'Jane likes apples and nectarines'*, a continuation like *'Mark only likes oranges'* seems more expected than one like *'Mark only likes pickup trucks'*. If this contrast is real, we might be able to use it to ask a question about

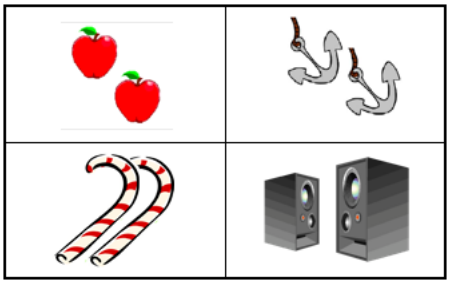


Figure 5: Experiment 3 example display.

the nature of the expectations comprehenders have about the members of the alternative set.

What might listeners be doing to produce the results of Experiments 1-2? At least two explanations seem possible. First, maybe given the items in the visual display, listeners are ruling out certain referents as unlikely (based on the previous discourse context, etc.). This could explain the pattern of results we observe in both experiments. But another possibility is that listeners use the information from the discourse context to start generating hypotheses about what items are likely to be in the alternative set. If listeners are actively generating candidate alternatives, they might do this on the basis of something like conceptual similarity; this would predict earlier target disambiguation for same-category over different-category items, even without previous mention.

5.1 Design, Procedure

The structure of Experiment 3 is virtually identical to Experiment 1. Participants heard sequences consisting of a context sentence and a target sentence (Table 3; the corresponding visual display is shown in Fig. 5.

Context	*Mention*	*Novel-Same category*	*Novel-Different cat.*
Mark has...	...some apples and some oranges.	...some pears and some oranges.	...some boots and some sandals.
Target	Jane only has some apples.		

Table 3: Experiment 3 design and example stimuli.

At the onset of the target sentence, a display containing a target item (*apples*), a cohort competitor (*anchors*), and two unrelated distractors (*candycanes, speakers*) appeared. Based on Experiments 1-2, we expect a Mention preference. The question of interest is whether there is an advantage for Same-category over Different-category Novel items. 16 native English speakers participated in the experiment.

5.2 Results

Average points of disambiguation are in Fig. 6. Fixations converged on the target referent earlier in the Mention condition than in the Novel conditions ($t = 3.7$, $p < .0001$),

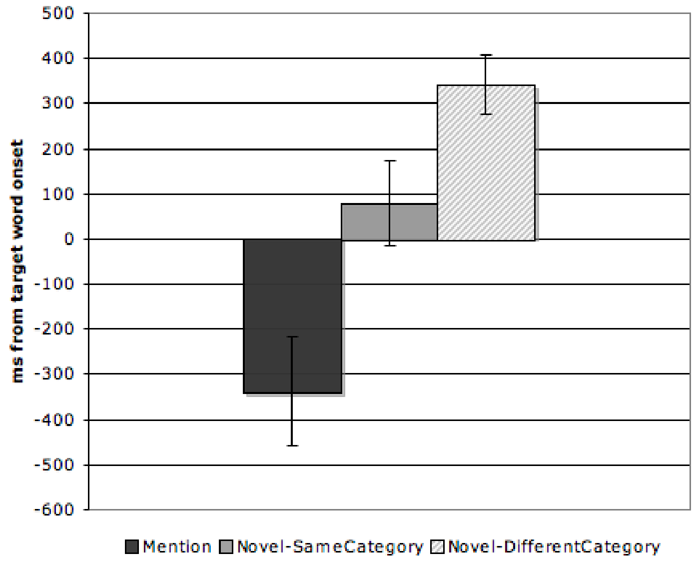


Figure 6: Experiment 3: Mean point of disambiguation.

consistent with the results of Experiments 1-2.

Interestingly, within Novel conditions, the target was disambiguated earlier when the target word was in the same category as recently mentioned items (*'some pears and some oranges ... some apples'*) than when it was in a different category (*'some boots and some sandals ... some apples'*) ($t = 2.4$, $p < .05$). This advantage cannot be due to explicit mention, since Same and Different category conditions both contained novel target words. Instead, it suggests that previous mention of *'pears'* and *'oranges'* activates not only the meanings of those particular words and their corresponding conceptual representations, but also the conceptual category they are members of; this in turn makes other category members (like *'apples'*) more salient as possible members of the alternative set.

6 General discussion

In the current study, we address the question of how alternative sets are established for the purpose of interpreting sentences containing focus operators, looking specifically at sentences with adverbial 'only'. We use comprehenders' eye movements in a visual scene as a measure of their changing expectations about possible referents; in critical cases, the presence of 'only' earlier in the sentence served as a cue to attend to aspects of the linguistic context.

In three eye-tracking experiments, we show that recent mention (Experiment 1), the informativity of the linguistic context (Experiment 2), and conceptual similarity (Experiment 3) are among the factors that contribute to the restriction of focus alternatives in the context of 'only'. These factors speed recognition of targets for sentences without 'only' as well, suggesting they have a general role in comprehension. Their enhanced effect in the presence of 'only' is striking, raising the possibility that 'only' has a general function of directing attention to contextual cues about the relevant domain for interpretation. The results of Experiment 3 further suggest that listeners' expectations about likely alternatives underly the contrasts observed in Experiments 1-2: given the linguistic context, comprehenders immediately begin generating hypotheses about likely focus alternatives.

These findings for 'only' raise interesting questions about the behavior of other focus operators. Future work comparing 'only' with other alternative-sensitive operators like 'also' will help pull apart the specific contributions of these lexical items from general aspects of focus interpretation. In particular, our conclusions about 'only' lead us to specific predictions about how the behavior of 'also' will diverge from 'only', allowing us to substantiate the hypothesis that comprehenders actively generate candidate alternatives. Even more generally, we have been treating focus alternatives as analogous to quantifier domains, but whether the same factors influence domain restriction is an empirical question. We anticipate addressing this question by comparing 'only' with quantifiers like 'every' or quantificational adverbs like 'always', which share with 'only' the general problem of domain restriction, but also differ along other dimensions (for instance, the presuppositions carried by an 'only' sentence versus an 'every' sentence) that may influence the types of information comprehenders take into consideration.

A very general problem to be addressed from the point of understanding language comprehension has to do with cue combination; that is, how do prosody, discourse parallelism, discourse old-new status, and other potentially relevant factors combine with each other? Once we can adequately characterize how different kinds of information interact in various instances of contextual domain restriction, we will be in a position to ask how the linguistic properties of particular lexical items predict what contextual information they will draw on, given general facts about how different information types are integrated during interpretation.

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Norm-Relatedness in Degree Constructions

Sveta Krasikova
English Department
University of Tübingen

contact@svetakrasikova.eu

Abstract

We consider the distribution of norm-related readings with dimensional adjectives across various degree construction in Russian and English and argue that the observed pattern as well as some well-known asymmetries in the use of antonyms in English follow from the assumption that gradable adjectives are ambiguous between the scalar and the vague predicate meaning.

1 Introduction

Bierwisch (1989) introduced the term norm-relatedness to refer to the comparison with a contextually determined standard of the relevant gradable property. This kind of comparison is inherent in positive sentences like (1a) where Jimmy's height is said to lie above the given standard of tallness. It is not obligatory in comparatives like (1b) that normally express direct comparison between two points referred to in the sentence.

(1) a. Jimmy is tall.
    b. Tony is taller than Jimmy.

Kennedy (2001) observes that the norm-related comparison in contrast to the direct comparison is a freely available interpretative option and surfaces as the comparison of deviation reading. Bierwisch also concludes that comparison with the norm can be part of the meaning of any degree construction and under certain circumstances it must be. In the latter account, norm-relatedness is treated as a re-interpretation strategy applied in the environments in which the direct comparison reading is impossible, e.g. a cross-polar anomaly example in (2) can only receive a norm-related interpretation.

(2) ??Tony is taller than Gemma is short.
    'Tony is further above the standard of tallness than Gemma is below the standard of shortness.'

Recently, Rett (2008) investigated the link between norm-relatedness[1] and the polarity of the gradable predicate. In the equative, negative polar adjectives (A–) obligatorily trigger the norm-related reading, see (3a), whereas positive polar ones (A+) do not, see (3b). However, from a broader cross-linguistic perspective, the two phenomena are not always related. In Russian, the equative as well as some other degree constructions are norm-related regardless of the polarity of the adjective, compare (3b) and (4).

(3) a. Gemma is as short as Judy.
    b. Tony is as tall as Pat.

(4) Катя такая же высокая, как и Лариса.
    Katja that emph. tall as also Larissa
    'Katja and Larissa are equally tall.'

It is this distribution of norm-relatedness in English and Russian that we will consider in this study. Our findings will reveal some crucial properties of degree constructions in these languages that may shed light on the long-standing puzzles related to the semantics of antonyms and measurement.
The paper is structured as follows: section 2 compares the norm-relatedness patterns in English and Russian and elaborates on the norm-related reading in English to highlight the link between the polarity and norm-relatedness; section 3 compares different approaches to norm-relatedness and sets the stage for the new proposal that is presented in section 4; in section 5 we discuss the consequences and conclude.

2 Data

2.1 Two Patterns of Norm-Relatedness

According to Rett (2008), who adopts a degree-based approach to the semantics of gradation, the cancellability of norm-related inferences in English, except in the positive construction (1a), depends on the polarity of the adjective and the properties of the involved degree operator. She observes that along with the equative, that we considered above, 'how' questions are norm-related too if they feature an A–. For example, the answer to (5a) must make reference to the narrowness norm for desks in the given context, while (5b) is normally a neutral request for the width of the desk.

(5) a. How narrow is the desk?
    b. How wide is the desk?

Comparatives, including the 'too' and 'enough' constructions, do not usually display such a switch in the meaning if the polarity of the predicate is reversed. However, as

[1] Rett uses the term evaluativity that is also employed to refer to the properties of non-dimensional adjectives, such as 'happy'. We stick to Bierwish's norm-relatedness to avoid confusion.

observed by Bierwisch (1989) for German in certain subdeletion comparatives only the norm-related reading is available. If the embedded clause of a subdeletion comparative contains an A–, the direct comparison is impossible, regardless of what is in the main clause, see (6a–b). The A– in the subdeletion equatives, be it in the main or in the embedded clause, forces a norm-related interpretation, see (6c–d). The complete pattern is summarised in the table in (6) where the shaded cells represent the unavailability of the direct comparison. According to Bierwisch, if the insertion of a differential measure phrase or a ratio modifier makes a sentence unacceptable, the direct comparison reading is not available and the sentence gets a norm-related interpretation, as illustrated in (6). Note that Bierwisch's measure phrase test is effective for degree questions as well. If (5a) were not norm-related, (7) would be an acceptable answer to it.

(6) a. ??The door is (*2 cm) higher than it is narrow.
b. ?The door is (*2 cm) lower than it is narrow.
c. ?The door is (*twice) as high as it is narrow.
d. The door is (*twice) as low as it is narrow.
e. ?The door is (*twice) as low as it is wide.

A+ er than A+	**as A+ as A+**
A+ er than A–	**as A+ as A–**
A– er than A+	**as A– as A+**
A– er than A–	**as A– as A–**

(7) *The desk is 70 cm narrow.

In Russian, we observe a contrast between the synthetic and the analytical form of the comparative (also reported in Pancheva (2006) among others). The analytical comparative is judged unacceptable in contexts containing the negation of the positive form of the relevant adjective or its antonym, compare (8a) and (8b). Thus, Russian has a different distribution of norm-relatedness: the comparative morpheme on a gradable adjective makes the norm-related inference cancellable. The equatives, too/enough comparatives and superlatives support the observation that the norm related interpretation in Russian is triggered by the lack of degree morphology on an adjective, see (9)–(12).

(8)	a.	Катя	не	высокая,	но	она	выше,	чем	Сергей.
		Katja	neg	tall	but	she	tall-er	than	Sergej
	b.	Катя	не	высокая,	*но	она	более	высокая,	чем	Сергей.
		Katja	neg	tall	but	she	more	tall	than	Sergej

‘Katja is not tall, but she is taller than Sergej.’

(9) a. * Катя низкая, она такая/настолько же высокая,
Katja short she that/by that much emph. tall
как/насколько и Лариса.
as/by how much also Larissa
lit.: ‘Katja is short, she is as tall as Larissa.’
b. * Катя высокая, она такая/настолько же низкая,
Katja tall she that/by that much emph. short
как/насколько и Лариса.
as/by how much also Larissa
lit.: ‘Katja is tall, she is as short as Larissa.’

(10)	a.	??	Катя	низкая,	но	достаточно	высокая,
			Katja	short	but	enough	tall
			чтоб	дотянуться	до	полки.	
			to	reach	to	shelf	

lit.:‘Katja is short but she is tall enough to reach the shelf.’

	b.	??	Катя	высокая,	но	достаточно	низкая,
			Katja	tall	but	enough	short
			чтоб	носить	это	платье.	
			to	wear	this	dress	

lit.: ‘Katja is tall but she is short enough to wear this dress.’

(11)	a.	??	Катя	низкая,	но	слишком	высокая,
			Katja	short	but	too	tall
			чтоб	уместиться	на	диване.	
			to	fit	on	sofa	

lit.: ‘Katja is short but she is too tall to fit on the sofa.’

	b.	??	Катя	высокая,	но	слишком	низкая,
			Katja	tall	but	too	short
			чтоб	носить	это	платье.	
			to	wear	this	dress	

lit.: ‘Katja is tall but she is too short to wear this dress.’

(12)	a.	??	Все	три	брата	низкие.	
			all	three	brothers	short	
			Коля	самый	высокий	из	них.
			Kolja	most	tall	from	them

lit.: ‘The three brothers are short. Kolja is the tallest among them.’

	b.	??	Все	три	брата	высокие.	
			all	three	brothers	tall	
			Коля	самый	низкий	из	них.
			Kola	most	short	from	them

lit.: ‘The three brothers are tall. Kolja is the shortest among them.’

(13)	a.	Насколько	стол	широкий?
		by how much	desk	wide
	b.	Насколько	стол	узкий?
		by how much	desk	narrow

lit.: ‘How wide/narrow is the desk?’

The degree questions in (13) require a norm-related proposition as an answer, similarly to (5a). Neither (13b) nor (13a) can be used as a request for the width of the desk, they rather inquire about the comparison class or the relation to the contextual norm. Thus, an appropriate answer to (13a) would be ‘It is fairly wide’ or ‘It is wide for the desks in our department.’

Considering what we saw above, subdeletion examples that contain a morphologically unmarked form of the adjective in the embedded clause are expected to express comparison of deviation only. Indeed, the subdeletion equative in (14) does not compare the width and the length of the bed directly. It can be true if the bed is longer than it is wide, but, say, looks out of place due to its extreme wideness rather than its length.

(14)	Эта	кровать	не	настолько	длинная,
	this	bed	neg	by that much	long
	насколько	широкая.			
	by how much	wide			

‘This bed is not as long as it is wide.’

In compliance with Bierwisch’s test, measure phrases can occur only in the synthetic comparative in Russian since it does not require the norm-related interpretation in contrast to the analytical comparative, compare (15a) and (15b). Bierwisch’s test also correctly rules out the cases of the measure phrase modification of non-comparative adjectives in Russian, see (16).

(15)	a.	Кровать	на	4 см/	в 2 раза	шире,	чем	диван.	
		bed	by	4 cm	twice	wide-ER	than	sofa	
	b. *	Кровать	на	4 см/	в 2 раза	более	широкая,	чем	диван.
		bed	by	4 cm	twice	more	wide	than	sofa

‘The bed is 4 cm wider than the sofa./The bed is twice as wide as the sofa.’

(16)	Кровать	80 см	*широкая/	*узкая/	шириной.
	bed	80 cm	wide	narrow	width-instr

‘The bed is 80 cm wide.’

To conclude, two factors are responsible for whether a degree construction has a direct comparison interpretation or must be re-interpreted and make reference to the relevant contextual norm. First, in English, this is partly determined by the polarity of the predicate. In comparatives the overt instances of A– in the embedded clause trigger re-interpretation. In the equatives the direct comparison is incompatible with the overt A– in general. A– in the ‘how’ questions also lead to norm-related readings. The second factor is at work in Russian where the norm-related interpretation is triggered by the lack of degree morphology on an adjective.

2.2 Norm-Relatedness and Antonymy

The constructions that we discussed in the previous section in connection with the norm-relatedness in English are often argued to show that A– are marked with respect to their A+ counterparts. Measure phrase constructions, ‘how’ questions, equatives with ratio modifiers and embedded clauses of subdeletion comparatives are the environments in which A+ and A– show a different behaviour. In these cases negative polar adjectives result in deviancy, see (17a) and (17c), unless the sentences can receive a norm-related interpretation as in (17b) and (17d).

(17) a. The desk is 70 cm wide/*narrow.
b. How wide/narrow is the desk?
c. The desk is twice as wide/*narrow as the doorway.
d. The doorway is higher/lower than the desk is wide/??narrow.

Rullmann (1995) notes that this asymmetry is hard to explain in a degree-based theory if one makes the common sense assumption that the degrees of an A– are identical to the degrees of its antonymous A+. Since degrees are standardly defined as equivalence classes of individuals, see Cresswell (1976), the equivalence of antonymous degrees means that they refer to the same equivalence classes. This assumption is crucial for deriving the equivalence in (18), which Rullmann speaks of as the minimal adequacy requirement for any theory of antonymy.

(18) Katja is taller than Larissa. ⇔Larissa is shorter than Katja.

The task of deriving (18) while accounting for the markedness of A– demonstrated in (17) drove Kennedy (1997) to introduce a sortal distinction between the two types of degrees. He suggests that antonymous degrees (extents) refer to different segments of the same scale. An A+ maps an entity to an initial interval on the relevant scale called the positive extent. The corresponding A– returns the final interval whose lower bound is shared by the positive extent. By adopting this distinction one can indeed come up with satisfactory explanations for the restricted distribution of A–, see Kennedy (2001), von Stechow (1984a). However, this kind of approach faces difficulties with the cases where one cannot appeal to the asymmetry of the poles on the one hand, see (19), and where this asymmetry does not lead to unacceptability on the other, see (20).

(19) a. The desk is (*4 cm) lower than it is narrow.
b. The desk is as narrow as the doorway.
c. How narrow is the desk?

(20) The doorway is lower than the desk is wide.

By denying any link between polarity and norm-relatedness, extent-based theories fail to predict that (19a)–(19c) are impossible on the direct comparison interpretation and that the differential measure phrases are bad in subdeletion comparatives like (19a). Those analyses therefore have to resort to ad hoc stipulations to account for the norm-related inference, see Kennedy (2001, pp. 44–51). No less stipulatory are the existing explanations of the cross-polar nomaly in (20), see Büring (2007), Heim (2008).
We suggest a switch in the perspective in the hope of getting around some loose ends: we claim that the restricted distribution of A– is due to the norm-related inference. Before discussing this claim in more detail, let us consider the different approaches to analysing norm-relatedness.

3 Sources of Norm-Relatedness

Depending on the ontological assumptions, we can distinguish two approaches to analysing norm-relatedness. To derive the meaning of (1a), scalar theories usually need to assume a silent operator that performs the comparison to the contextual standard in the form of a free variable over degrees, von Stechow (1984b). In the "vague predicate" theories norm-relatedness stems from the meaning of gradable adjectives, Klein (1980). In this section, we will consider the two strategies and see that both have difficulties accounting for the data that we discussed above. Section 4 will be a synthesis of the two points of view.

3.1 Vague Predicates

According to Klein (1980) and other "vague predicate" analyses of comparative constructions, gradable adjectives denote partial functions from individuals to truth values. Applied to a context, they partition their domain into the positive extension, the negative extension and the extension gap. Thus, in a simple case, like (1a), the relation of Jimmy's height to the standard of tallness in a given context is determined by 'tall' that specifies who counts as tall in the context.

(21) $[\![\text{tall}]\!] = \lambda c\ \lambda x\ 1$ if $x \in pos_{tall}(c)$, 0 if $x \in neg_{tall}(c)$ and undefined otherwise,
where $pos_{tall}(c) = \{u\text{: u is tall in c}\}$ and $neg_{tall}(c) = \{u\text{: u is not tall in c}\}$

Gradable adjectives can be modified by various degree adverbs that denote a family of degree functions specifying how exactly partitioning is to be done. Thus, measure modifiers make vague predicates precise in that they turn them into properties holding of entities of the particular size, e.g. 'six foot' maps 'tall' to a set of entities that are equal in length to 6 foot (the sixth element of the standard sequence based on foot), see Klein (1980, p. 28). Other modifiers, such as 'very', 'fairly', 'extremely', do not eliminate the extension gap as numerical modifiers but shift the boundary of the positive extension in a lexically specified way. For example, 'very' turns 'tall' into a new vague predicate that is like the original one except for the contextual comparison class with respect to which it is evaluated. The comparison class is set to the positive extension of 'tall' in the given context, see (22).

(22) a. For any context *c*: *c*[*X*] is that context *c′* just like *c* except that the comparison class in *c′* is *X*.
b. $[\![\text{very}]\!] = \lambda c\ \lambda K_{c(et)}\ \lambda x\ K(c[X])(x)$, where $X = \{u: K(c)(u) = 1\}$
Klein (1980, p. 42)

The comparative and the equative introduce quantification over degree functions and like numerical modifiers remove reference to the norm in the given context. For example, the comparative maps the vague predicate 'tall' in (1b) to a new predicate that is

true of Tony iff there is at least one degree function that makes ‘tall’ true of Tony and false of Jimmy. The equative is a universal quantifier over degree functions.
Though successful and simple in accounting for the meaning of positive sentences and sentences with vague degree adverbs, this approach as it stands does not explain the norm-related readings of the comparative or the equative. However, the theory is technically equipped enough to offer us a means for deriving such readings. One such way is mentioned by van Rooij (2008, fn. 9), where he proposes to introduce a new class of operators that quantify over a restricted set of degree functions. For example, (1b) can be analysed as in (23a), according to which both Tony and Jimmy are tall in *c*.

(23) a. $\square f \square F^* [f(⟦ tall⟧)(c)(Tony) \wedge ((NEG(f)(⟦ tall⟧))(c)(Jimmy)]$
b. $F^* = \{f: (f(⟦ tall⟧))(c) \subseteq ⟦ tall⟧ (c)\}$
c. $NEG = \lambda f\, \lambda P\, \lambda c\, (⟦ tall⟧ (c) - (f(⟦ tall⟧))(c))$

However, this proposal does not address the distribution of the norm-related readings. In general, a vague predicate analysis as developed in Klein neither can explain why the polarity of an adjective may be decisive in this respect nor can it offer any explanation for the contrast between Russian and English with respect to norm-relatedness. Another problem is the ban on numerical modifiers under the norm-related interpretation. If differential measure phrases can be integrated into this kind of analysis, see Klein (1991), there is nothing in the theory that would prevent their occurrence in the norm-related cases. The same can be said about the ratio modifiers in the equative and the contrast in (17a).

3.2 Degrees

Degree theories assume that gradable adjectives make use of scales formed from abstract entities called degrees. Degrees are usually defined in the style of Cresswell (1976) as equivalence classes of individuals, see (24). The ontology is enriched to include the semantic type of degrees and the denotation domain of this type, (25a-b).

(24) a. Let $\succ_{tall}$ be the empirically given relation “taller than” and $F(\succ_{tall})$ its field.
$x_e, y_e \square F(\succ_{tall})$: $y =_{tall} x$ iff
$z_e \square F(\succ_{tall})$: $[y \succ_{tall} z \text{ iff } x \succ_{tall} z] \wedge [z \succ_{tall} y \text{ iff } z \succ_{tall} x]$
b. A ‘tallness’ degree:
$[u]_{tall} \subseteq D_e =: \{x_e:\ \ y_e \neq x \wedge y \square [u]_{tall} \rightarrow y =_{tall} x\}$
c. Ordering on ‘tallness’ degrees:
Let D_{tall} be the set of tallness degrees.
$d, d' \square D_{tall} : d \succ_{tall} d' \text{ iff } \ x \square d,\ \ y \square d'\ x \succ_{tall} y$

(25) a. Let *d* be the semantic type of degrees.
b. Let D_d consist of disjoint sets of degrees of various sorts.
c. Call each pair $\langle X, \succ \rangle$, s.t. $X \subseteq D_d$ and $\succ$ is the ordering on X, a scale.

One of the ways to conceive predicates like 'tall' and 'short' in a degree approach is as relations between individuals and degrees that use measure functions of the respective sort. A measure function maps an individual to its equivalence class based on some property, e.g. HEIGHT defined in (26c) maps an individual to its height.

(26) a. $[\![\text{tall}]\!] = \lambda d_d \square F(>_{tall})\ \lambda x_e\ \text{HEIGHT}(x) = d$

b. $[\![\text{short}]\!] = \lambda d_d \square F(>_{short})\ \lambda x_e\ \text{HEIGHT}(x) = d$[2]

c. $\text{HEIGHT} = \lambda x.\ \iota d{:}\ d \square D_{tall} \wedge x \square d$

In this setup, in the LFs of (1a-b) it is assumed that the degree morphemes bind the degree argument of 'tall' and express the relevant type of comparison. The comparative turns the gradable predicate A into a relation that maps a degree *d* to a property that holds of *x* if *x*'s degree of A-ness exceeds *d*, see (27a). The positive does not take a degree argument but receives the standard-of-comparison value from the context, (27b). The analysis of (1b) is sketched in (28a-b). The embedded clause is assumed to express a definite degree description.

(27) a. $[\![\text{COMP}]\!] = \lambda A_{d(et)}\ \lambda d_d \square F(>_R)\ \lambda x_e\ \ \iota d'(A(d')(x)) >_R d$

b. $[\![\text{POS}_C]\!] = \lambda A_{d(et)}\ \lambda x_e\ \ \iota d'(A(d')(x)) >_R g(C)$

(28) a. Tony [[COMP taller] [DEF λd Jimmy d tall]]

b. $\text{HEIGHT}(\text{Tony}) >_{tall} \text{HEIGHT}(\text{Jimmy})$

If we pursue this approach to comparatives, the interpretation of subdeletion examples like (29a) is not so straightforward. The two degrees that are to be compared here form different scales and cannot be directly related to each other. This kind of comparatives could be analysed as involving an additional step, namely, that of mapping the resulting degrees to real numbers. Let NUM be a function that maps a unit of measurement and a degree to the real number that corresponds to the number of times the unit must be concatenated with itself to form the abstract object representing the degree. We can now define a number-relating comparative morpheme that is applied if the conventional one in (27) fails to compare the two degrees, see (29c-e).

(29) a. The desk is higher than the door is wide.

b. $\text{HEIGHT}(\text{the desk}) >_{?} \text{WIDTH}(\text{the door})$ (undefined!)

c. $[\![\text{COMP}^{num}]\!] = \lambda A\ \lambda n\ \lambda x\ \text{NUM}(u)(\iota d' A(d')(x)) >_R n$,
where $>_R$ is '>' or '<' ordering on real numbers[3].

d. the desk [[COMP^{num} higher] [NUM λd the door d wide]]

e. $\text{NUM}(u)(\text{HEIGHT}(\text{the desk})) > \text{NUM}(u)(\text{WIDTH}(\text{the door}))$

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[2] We presuppose that the equivalence classes base on the relations $\succ_{tall}$ and $\succ_{short}$ are identical and therefore the degrees of tallness are not distinguishable from the degrees of shortness, hence the use of the same measure function in the defintion of 'tall' and 'short'.

[3] We make the assumption that '<' is employed to compare two numbers if the adjective argument of the number-relating comparative operator is an A–.

NUM would then also be at work in the interpretation of measure phrases. Differential measure phrases like ‘by 5 cm’ in (30a) specify the distance between the numbers that NUM maps each of the compared degrees and the measure unit to, see (30b-c). The measure phrase ‘1.80 m’ in (31a) has a different function. It points to a degree of the appropriate type that is directly fed into the adjective meaning to yield a statement about Jimmy’s height. Let us assume that the mapping of a number and a unit to a degree is performed by the operator EQ as shown in (31b-c).

(30) a. Tony is taller than Jimmy by 5 cm.
b. $[\![$ by 5 cm$]\!] = \lambda R\ \lambda A_{d(et)}\ \lambda d_d\ \lambda x_e\ R(A)(d)(x) \wedge \textsc{diff}(d,\ \iota d'(A(d')(x)), cm) = 5$
c. $d, d' \in D_d, : \textsc{diff}(d, d', u) = |\textsc{num}(u)(d) - \textsc{num}(u)(d')|$

(31) a. Jimmy is 1.80 m tall.
b. Jimmy [[EQ 1.80 m] tall]
c. $[\![$ EQ 1.80 meter$]\!] = \iota d(\textsc{num}(\text{meter})(d) = 1.80)$

The equative sentence in (32) can be assumed to have the same structure as the measure phrase construction in (31a) except that the degree argument of ‘tall’ is not created by the EQ operator from a number and a unit but is referentially linked to the correlative phrase. In many languages, including Russian, the correlate in the main clause may surface as a pronoun, e.g. in (4).

(32) Tony is as tall as Pat.

Interestingly, this analysis when applied to the English data we discussed in section 2 makes the obligatorily norm-related environments look distinct from the ones where this inference can be cancelled. Their distinct characteristic is that in they do not distinguish truth-conditionally between the sentences with A+ and A–. This observation was first made in Rett (2008) for ‘how’ questions and equatives. Indeed, under the assumption that antonymous degrees refer to the same equivalence classes, see footnote 2, the equative in (33) and the ‘how’ question in (34) end up having the same extension in the A+ and the A– case.

(33) a. The desk is as wide/narrow as the doorway.
b. $\textsc{width}(\text{the desk}) = \textsc{width}(\text{the doorway})$

(34) a. How wide/narrow is the desk?
b. $\{p: \exists d\ p = \lambda w\ \textsc{width}(\text{the desk}) = d\}$

Note that the measure phrase construction and the subdeletion comparatives, repeated in (35) and (36), reveal this property too. In the subdeletion case, we are forced to apply the number-relating comparative. This renders the pairs in (36a) and (36c) differing only in the polarity of the embedded predicate truth-conditionally equivalent.

(35) a. The desk is 70 cm wide/*narrow.
b. $\textsc{width}(\text{the desk}) = \iota d(\textsc{num}(cm)(d) = 70)$

(36) a. The doorway is higher than the desk is wide/??narrow.
b. NUM(u)(HEIGHT(the doorway)) > NUM(u)(WIDTH(the desk))
c. The doorway is lower than the desk is wide/narrow.
d. NUM(u)(HEIGHT(the doorway)) < NUM(u)(WIDTH(the desk))

One can follow the strategy developed in Rett (2008) and assume that the process of semantic competition between the marked A– and unmarked A+ forces us in these cases to parse the sentences with A– as involving a positive morpheme that she calls EVAL and defines as an optional degree modifier. For example, in (37) EVAL would restrict the degree set it attaches to include only degrees that exceed the contextual standard for narrowness. As a result, the answer to (37a) has to be norm-related.

(37) a. How narrow is the desk?
b. how ? [EVAL [λd the dest d narrow]]
c. {p: □d p = λw WIDTH(the desk) = d & d > g(C)}

However, this approach does not attempt and, for that matter, cannot give us an answer to the question why measure phrases are incompatible with the norm-related interpretation. What is worse it makes an absurd prediction that the measure phrase construction is optionally norm-related and therefore (31a) can be false if Jimmy's height, 1.80 m, does not exceed the contextual standard of tallness, cf. (38).

(38) HEIGHT(Jimmy) = ι d(NUM(meter)(d) = 1.80) & d > g(C)

In general, degree based theories are inept to handle the norm-related comparison. According to the standard approach, pursued in Bierwisch (1989) and taken up in Kennedy (1997), norm-related comparatives or comparatives of deviation relate the degrees of deviation from the contextual norm(s). It is clear that such deviation degrees can be only obtained by applying the distance function to two numbers, which is exactly what we want to avoid in order to account for the ban on numerical expressions in the norm-related contexts.

4 Proposal

We want to make use of the obvious advantage of the degree analysis outlined in section 3.2, namely its ability to distinguish the obligatorily norm-related environments from the others. At the same time, we do not want to inherit its problems in dealing with measure modifiers in the norm-related contexts. This brings us to the lexical ambiguity hypothesis. Let us assume that gradable adjectives are ambiguous between the vague predicate and the scalar meaning. The vague predicate meaning is responsible for the norm-relatedness. The analysis of numerical expressions is based on degrees as proposed in 3.2 and so they are allowed to occur only in the scalar meaning contexts. It remains to spell out the factors that determine when which meaning is selected.

4.1 Degree Morphology: The Case of Russian

The empirical pattern that we observe in Russian, see section 2.1, suggests that the choice of the scalar meaning for a gradable adjective is triggered by the comparative morphology. We propose the following rule for Russian:

(39) The scalar meaning of a gradable predicate must be licensed by the degree morphology.

The consequence of (39) is that all comparative constructions in Russian, except for the synthetic comparative, employ the vague predicate meanings of gradable adjectives. We are faced with deriving the norm-related interpretations in the vague predicate approach. We propose that the correlate ‘такая’/‘that’ in the main clause of a Russian equative construction, e.g. in (4), does not refer to a degree but to a degree function, see (40b). Recall that the expressions denoting degree functions now exclude the numerical modifiers that neutralise norm-relatedness. Since the role of degree functions is to fix the comparison class parameter in a given context, (40a) can serve as a paraphrase for the meaning of (4) under this analysis.

(40) a. Katja is tall with respect to the same comparison class with respect to which Larissa is tall.
b. $\iota f\,(f(\llbracket \text{tall} \rrbracket)(c)(\text{Katja})) = \iota f\,(f(\llbracket \text{tall} \rrbracket)(c)(\text{Larissa}))$

One prediction of the analysis in (40) is that (4) can be truthfully uttered in a situation in which Katja’s and Larissa’s heights are not equal. (4) is predicted to only convey that Katja and Larissa are both tall with respect to the same standard of tallness. The inappropriateness of B’s remark in (41) indicates that this is indeed the case.

(41)	A:	Катя	довольно	высокая.	Она	еще	выше	Ларисы.
		Katja	rather	tall	she	even	tall-er	Larissa
	B:	*Она	не	выше,	а	такая	же	высокая.
		she	neg	tall-er	but	that	emph.	tall

‘A: Katja is rather tall. She is even taller than Larissa.
B: She is not taller but as tall as Larissa.’

While the equative construction involves a reference to a degree function, the analytic comparative expresses comparison of degree functions. To implement this idea we need to define an ordering on degree functions. Assume that vague degree adverbs form a natural scale of the kind shown in (42). The comparative in (8b) repeated below as (43a) does not compare the degrees of tallness as its synthetic counterpart in (8a) but the degree functions that specify the comparison class with respect to which the subject and the object are asserted to be tall (43b-c).

(42) somewhat < … < very < … < extremely

(43) a. Катя более высокая, чем Сергей.
Katja more tall than Sergej
b. Katja [[COMP tall] [DEF λf Sergej f tall]]
c. ι f(f(⟦ tall⟧ (c)(Katja)) > ι f(f(⟦ tall⟧ (c)(Katja))

For other norm-related constructions like the superlative in (12) and the intensional comparison constructions in (10)–(11) we need to specify the interpretation of their degree adverbs. Roughly, the superlative 'самый'/'most' that also uses the lexical scale in (42) requires that the degree function that makes the adjective true of the subject is ranked higher than the degree functions that make other individual in the given comparison class true of the adjective. The intensional adverbs 'слишком'/'too' and 'достаточно'/'enough' restricts the comparison class to include only those individuals that make the modalised statement of the embedded clause false and true respectively. In (10a), the extension of 'достаточно высокая'/'tall enough' in the given context is the set of individuals who are tall and can reach the shelf.
To sum up, Russian does not exploit the scalar meaning of gradable adjectives unless they are morphologically marked for comparison. We proposed to pursue a Klein's style approach to interpret the indirect comparison constructions and showed that their meaning can be derived by manipulating the comparison classes.

4.2 Semantic Competition: The Case of English

In contrast to Russian, resolving the ambiguity of an English adjective does not depend on the degree morphology but on its polarity. We believe that the markedness of A– with respect to their A+ counterparts and the process of semantic competition are at stake here. If assume that A– are marked[4] the process of semantic competition can be described as follows:

(44) $\boxed{\text{If two degree constructions X(A–) and X(A+) are truth-conditionally equivalent and the speaker utters the marked X(A–) then she had a reason to do so, namely to employ the meaning of A– that renders X(A–) and X(A+) non-synonymous.}}$

This line of reasoning as well as the fact that NUM is defined on degrees and cannot be applied to vague predicates accounts for the subdeletion paradigm we considered above. Recall that the comparative fails to relate two degrees if they are the values of different measure functions. The number-relating comparative can remove the problem by mapping the resulting degrees to the real numbers. This is what happens in (45a) and (45c). If the embedded clause features a marked A– as in (45b) and (45d) the rea-

[4] This assumption can most probably get independent empirical support from language acquisition or processing.

soning in (44) can be applied since these two examples come out equivalent with (45a) and (45c) respectively as we showed in (36). As a result, the vague predicate meaning is selected and only the indirect comparison analysis along the lines we outlined in the previous section is possible. The reduced acceptability of these examples, as noted in Bierwisch (1989), corresponds to the fact that the assignment of the norm-related reading is a kind of re-interpretation strategy.

(45) a. The doorway is higher than the desk is wide.
b. ??The doorway is higher than the desk is narrow.
c. ?The doorway is lower than the desk is wide.
d. ?The doorway is lower than the desk is narrow.

Another welcome prediction of our proposal is the unacceptability of ratio modifiers with A– equatives and the A– measure phrase construction in (35). Assuming 'twice' has the semantics in (46), it cannot apply in (33) where the scalar meaning of A– is banned. For the same reason, EQ is undefined in the A– variant of (35). The subdeletion equatives in (47) require the accommodation to numbers step. Obviously, the insertion of NUM is blocked in the process of semantic competition if one of the adjectives is A–.

(46) $[\![\text{ twice}]\!] = \lambda d\ \iota d'\ (2\ {}^{*}\text{NUM}(u)(d) = d')$

(47) The desk is twice as wide/*narrow as the doorway is high/*low.

To conclude, the assumption that A– are marked and enter the process of semantic competition with their positive pole counterparts correctly predicts the distribution of direct comparison readings and measure phrases in English.

5 Conclusion

We propose that gradable predicates are lexically ambiguous. Norm-relatedness is the result of preferring the vague predicate meaning of a gradable predicate to the scalar one. In English, the polarity of the adjective and the process of semantic competition govern the selection of the meaning. In Russian, only degree morphology can license the scalar meaning. This strategy has proved successful in explaining some puzzling and so far unresolved asymmetries in the distribution of antonyms and handling the cross-linguistic variation in the distribution of norm-relatedness. The two patterns that we observe in Russian and English do not have to be exhaustive. We would expect languages to vary in how often and under which conditions they employ the scalar meaning.

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