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A FORMAL TREATMENT OF THE PRAGMATICS OF QUESTIONS AND ATTITUDES*

ABSTRACT. This article discusses pragmatic aspects of our interpretation of intensional constructions like questions and prepositional attitude reports. In the first part, it argues that our evaluation of these constructions may vary relative to the identification methods operative in the context of use. This insight is then given a precise formalization in a possible world semantics. In the second part, an account of actual evaluations of questions and attitudes is proposed in the framework of bi-directional optimality theory. Pragmatic meaning selections are explained as the result of specific rankings of potentially conflicting generation and interpretation constraints.

1. Introduction

Context plays a major part in the interpretation of natural language expressions. In this article, attention will be focused on contextual restrictions on quantificational domains in *intensional* constructions such as questions and propositional attitude reports. It has often been observed that our interpretation of these constructions may vary relative to the ways in which the objects under consideration are given to us (see in particular Hintikka 1969, and more recently Gerbrandy 2000). This article aims to give this insight a precise formalization and to propose an account of actual evaluations of these constructions across shifting contexts. The proposed analysis will

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shed some new light on a number of long standing philosophical problems arising in connection with the logical analysis of *de re* attitude reports and identity questions. Section 2 starts by reviewing these well-known problems and show how they can be clarified when we pay due attention to the crucial role of context in natural language use. Section 3 proposes an analysis of the pragmatics of attitudes and questions in the framework of bi-directional optimality theory. Actual evaluations of these constructions are explained as the result of optimization procedures, in which speakers and interpreters, whose preferences are determined by potentially conflicting generation and interpretation constraints, coordinate their choices by taking into account each other's efforts.

2. Attitudes, Questions and Context

Attitude reports and questions are typical examples of constructions the interpretation of which depends on what perspective is adopted over the individuals in the universe of discourse.[1] Classical semantic analyses of these constructions abstract from the way in which objects are identified and therefore have difficulties in accounting for this dependence. The analysis I propose in this section represents different methods of identification and is able to account for their impact on interpretation. Section 2.1 discusses propositional attitudes. Section 2.2 deals with questions.

2.1. *Propositional Attitudes*

Propositional attitude reports will be analyzed in the framework of modal predicate logic (see Hintikka 1969). A model M for a language of modal predicate logic is a quadruple $\langle W, R, D, I\rangle$ in which W is a set of worlds, R is an accessibility relation on W, D is a set of individuals and I is a function which assigns, for each world $w \in W$, an interpretation to the non-logical constants in the language. In the present context, the set $\{w' \in W \mid wRw'\}$ of worlds accessible from w represents the set of alternatives compatible with what the subject under discussion believes in w.

[1] Epistemic sentences like 'Anyone may be the culprit' are other examples of constructions that depend on conceptual perspectives over the universe of discourse. See Aloni (2000) for an account.

Sentences are interpreted in models M with respect to a world $w \in W$ and an assignment function g, mapping variables to individuals of D.

DEFINITION 1 (Standard modal predicate logic)

$$\begin{aligned}
M, w \models_g Pt_1, \ldots, t_n &\quad \text{iff } \langle [t_1]_{M,w,g}, \ldots, [t_n]_{M,w,g} \rangle \in I_w(P) \\
M, w \models_g t_1 = t_2 &\quad \text{iff } [t_1]_{M,w,g} = [t_2]_{M,w,g} \\
M, w \models_g \neg\phi &\quad \text{iff not } M, w \models_g \phi \\
M, w \models_g \phi \wedge \psi &\quad \text{iff } M, w \models_g \phi \text{ and } M, w \models_g \psi \\
M, w \models_g \exists x\phi &\quad \text{iff } \exists d \in D : M, w \models_{g[x/d]} \phi \\
M, w \models_g \Box\phi &\quad \text{iff } \forall w' : wRw' : M, w' \models_g \phi
\end{aligned}$$

In this framework, a sentence like (1) can receive the two logical forms in (a) and (b) corresponding to the traditional *de re* and *de dicto* readings of the example.

(1) Al believes that the boss is a spy.
a. $\exists x(x = \text{b} \wedge \Box Sx)$ (*de re*)
b. $\Box S\text{b}$ (*de dicto*)

On the *de re* and *de dicto* representations, the description "the boss" occurs outside and inside the scope of the belief operator, $\Box$, respectively. On the given interpretation of $\Box$ and $\exists$, (a) requires one and the same individual to be a spy in all worlds compatible with what Al believes, while (b) can be true with possibly different individuals being spies in different doxastic alternatives for Al.

It has often been observed that a number of difficulties arise for this classical analysis of propositional attitudes. The examples in the following section illustrate why.

2.1.1. *Puzzles about belief*

Consider the following well-known "double vision" example from Quine (see Quine 1953, 1956).

(2) a. Philip believes that Cicero denounced Catiline.
b. Philip does *not* believe that Tully denounced Catiline.
c. Philip believes that x denounced Catiline.

Suppose sentences (2a) and (2b) are true. What is the truth value of (2c) under the assignment that maps x to the individual d which is

Cicero *and* Tully? As Quine observed, the ordinary notion of belief seems to require that although (2c) holds when x is specified in one way, namely as Cicero, it may yet fail when the same x is specified in some other way, namely as Tully. Classical modal predicate logic, in which variables are taken to range over plain individuals, fails to account for this ordinary sense of belief.

In the framework of possible world semantics, it is normal practice to represent these "ways of specifying objects" by means of the notion of an *individual concept*. An individual concept is a function from the set W of worlds to the set D of individuals. Many authors have observed that if we let variables range over concepts rather than plain individuals, we manage to account for Quine's intuition about example (2).[2]

In these proposals, sentences are interpreted with respect to an assignment function g mapping variables to concepts in D^W, rather than individuals in D. The denotation $[x]_{M,w,g}$ of a variable x with respect to a model M, a world w and an assignment g is the value $(g(x))\,(w)$ of concept $g(x)$ in world w. In the semantics, we only have to adjust the clause dealing with existential quantification.

DEFINITION 2 (Quantification over individual concepts)

$$M, w \models_g \exists x\phi \quad \text{iff } \exists c \in D^W : M, w \models_{g[x/c]} \phi$$

Let us see how Quine's puzzle can be analyzed in this version of modal predicate logic. In the example, "Cicero" and "Tully" actually refer to one and the same man, while not being believed to do so by Philip. Our semantics can capture this fact by letting the two terms refer to one and the same individual in the world of evaluation, but different individuals in the worlds conceived as possible by Philip.[3]

[2] Other non-classical views on trans-world identification, e.g. Lewis's counterpart theory, would also account for Quine's intuition (see Aloni 2001, chapter 4). These alternative analyses are also in need of the pragmatic theory I propose in the second part of this article.

[3] This analysis is not in contrast with Kripke's thesis that proper names are semantically rigid designators. It is important to notice that the phenomena which are typically considered in discussions of rigid designators (alethic modalities and counterfactuals) are of a different nature than the epistemic phenomena considered here. Many authors (e.g., Hintikka 1975) have distinguished semantically rigid designators from epistemically rigid designators – the former refer to specific individuals in counterfactual situations, the latter identify objects across possibilities in belief states len and concluded that proper names are rigid only in the first sense.

The two names express then different concepts, λw [Cicero]$_{M,w} \neq \lambda w$ [Tully]$_{M,w}$, and our sentence (2c) is true or false in the world of evaluation depending on the assumed assignment function.

Although this analysis of Quine's puzzle seems correct, an obvious problem arises if we let variables range over *all* concepts. The following classical example due to Kaplan illustrates why (see Kaplan 1969). Suppose Ralph believes there are spies, but does not believe of anyone that (s)he is a spy. Believing that spies differ in height, Ralph believes that one among them is shortest. Ortcutt happens to be the shortest spy. The *de re* interpretations of sentences (3a) and (4a) are intuitively false in this situation. But, if we let variables range over all concepts, their standard representations (3b) and (4b) are wrongly predicted to be true by our semantics.

(3) a. Ralph believes that someone is a spy.
b. $\exists x \Box Sx$

(4) a. Ralph believes that Ortcutt is a spy.
b. $\exists x(x = o \wedge \Box Sx)$

There is indeed a concept x such that (the actual value of x is Ortcutt and) Ralph believes that x is a spy, namely the concept λw[the shortest spy]$_{M,w}$.

What is needed, if we want to solve this problem, without automatically regenerating Quine's double vision difficulties, is not a return to quantification over individuals rather than representations, but 'a frankly inequalitarian attitude'[4] towards these representations. This is Quine's and Kaplan's diagnosis of these cases. According to this view, *de re* belief attributions do involve quantifications over representations, yet not over all representations. Which representations can count as a value of a variable is a function of the mental state of the relevant subject (see Kaplan 1969). *The shortest spy* in the example above is a typical instance of a representation which does not count as a "vivid" name for the subject, Ralph, of the object, Ortcutt. Therefore, such a representation cannot be part of our domain of quantification.

In our framework, this view can be formalized by adopting models which specify which sets of concepts are to count as the domain of quantification. These models will be quintuples $\langle W, R, D, S, I \rangle$ in

[4] The quotation is from the end of Quine (1961).

which W, R, D, I are as above and $S \subseteq D^W$. Assignments g map individual variables to concepts in S.

DEFINITION 3 (Quantification over suitable concepts)

$$M, w \models_g \exists x\phi \quad \text{iff } \exists c \in S : M, w \models_{g[x/c]} \phi$$

The following example, based on a situation described in Bonomi (1995), shows, however, that a solution of this kind, in which models (or mental states) determine what are the suitable representations, is not totally adequate.

Suppose that Swann knows that his wife Odette has a lover, but he has no idea who his rival is. He knows that this person is going to meet Odette the following day at the Opera. He decides to kill him there, and he tells his plan to his friend Leo. Unknown to Swann, Odette's lover is Leo's brother, Theo. Leo (who knows all the relevant details) immediately reports (5) to Theo.

(5) a. Swann wants to kill you and knows that you are going to the Opera tomorrow.
b. $\exists y(y = \textit{addressee} \wedge \Box_W\phi(y) \wedge \Box_K\chi(y))$

Theo goes to the police. Swann is arrested. A murder is avoided.

Consider now sentence (6) used by Leo in the same situation.

(6) a. Swann knows that you are Odette's lover.
b. $\exists y(y = \textit{addressee} \wedge \Box_K\psi(y))$

While sentence (5) was acceptable, (6) would be false in this situation. On Kaplan's account, the two *de re* sentences are true only if *Odette's lover* counts as a suitable representation for Swann of Theo. Only in this case the concept λw[Odette's lover]$_{M,w}$ can be part of our domain of quantification in our formalization. If we follow this strategy, however, we are faced with a dilemma: If in order to explain the inadequacy of (6), we rule out the concept *Odette's lover*, we are unable to account for the intuitive acceptability of (5). A natural way out of this *impasse* would be to accept that one and the same representation can be suitable on one occasion and not on another. But if the set of suitable representations is a function of the mental state of the subject, this solution is not available. As these examples show, what concepts can serve as a value for a variable depends on the circumstances of use. If we let the model determine what set of concepts is to count as the domain of quantification, we are unable to

account for this dependence. Many authors (among others van Fraassen 1979; Stalnaker 1988; Crimmins and Perry 1989; van Rooy 1997) have observed the crucial role played by context in the selection of the set of suitable representations. Not much however has been said about *how* context operates such a selection. This will be the topic of Section 3: how the context of use selects the set of suitable concepts on different occasions. Before addressing this question, however, let us make things formally precise.

2.1.2. *Quantification under conceptual covers*

I take variables to range over sets of *separated* concepts. Two concepts are separated if their values never coincide. For example, the two concepts *Tully* and *Cicero*, in Quine's example, are not separated, because their value in the actual world is one and the same individual. Therefore, I would like to propose, they cannot be part of one and the same quantificational domain. I assume that different sets of concepts can be selected on different occasions. Although variables always range over the same sort of individuals, these may be differently identified. This style of quantification is adopted in modal predicate logic.

I add a special index $n \in N$ to the variables in the language. These indices range over sets C of separated individual concepts, which satisfy the extra conditions that for each individual $d \in D$ and each world $w \in W$, C must contain one concept which identifies d in w (see Aloni 2001 for motivations). Sets satisfying such conditions will be called *conceptual covers*. Intuitively, in a conceptual cover, each individual in the universe of discourse is identified in a determinate way, and different conceptual covers represent different ways of conceiving one and the same domain. Our satisfaction relation is further relativized to a pragmatic parameter $\wp$ which assigns conceptual covers to the indices in N. As above, assignment functions map variables to individual concepts.[5]

DEFINITION 4 (Quantification over contextually selected conceptual covers)

$$M, w, \wp \models_g \exists x_n \phi \quad \text{iff } \exists c \in \wp(n) : M, w, \wp \models_{g[x_n/c]} \phi$$

[5] See Aloni (2001, chapter 2) for a sound and complete axiomatization of this semantics.

De re attitude reports are analyzed as quantified modal sentences $\exists x_n \Box \phi(x_n)$ which obtain the standard interpretation with the only exception that x_n is taken to range over the set of separated concepts pragmatically selected for n, rather than over the domain of individuals. In this way their interpretation is made dependent on the conceptualization of the universe of discourse which is contextually operative. Since different quantificational domains can be assigned to different occurrences of a quantifier, the dilemma posed by the example of Odette's lover disappears. In the described situation, if sentence (8) is false, sentence (7) can still be true, if the indices n and m are assigned two different values.

(7) a. Swann wants to kill you and knows that you are going to the Opera tomorrow.
b. $\exists y_n(y_n = \textit{addressee} \wedge \Box_W \phi(y_n) \wedge \Box_K \chi(y_n))$

(8) a. Swann knows that you are Odette's lover.
b. $\exists y_m(y_m = \textit{addressee} \wedge \Box_K \psi(y_m))$

Before addressing the crucial question of how the intended domain of quantification is selected in actual interpretations of *de re* sentences, let us provide further evidence for the presented view on quantification by looking at the other constructions we want to deal with in this article, namely interrogative sentences.

2.2. *Questions*

As many researchers have observed, our evaluation of direct and indirect uses of interrogative sentences may vary relative to various pragmatic factors (see, among others, Boër and Lycan 1985; Ginzburg 1995). The examples of question-answer pairs and *knowing-who* constructions discussed in this section illustrate one specific aspect of this context sensitivity.

2.2.1. *Questions of identity*

Suppose that Al knows that Amadou Toure is the president of Mali, but he would not be able to point him out. Consider the following sentence:

(9) Al knows who the president of Mali is.

Is sentence (9) true or false in the given situation? On the one hand, since Al knows the name of the man, he knows who the president of

Mali is. On the other hand, since Al would not be able to point him out, he does not know who the president of Mali is. As in Quine's example considered above, our evaluation of (9) depends on the assumed method of identification. If identification by name is assumed, the sentence is true. If demonstrative identification is adopted, the sentence is false. In different contexts different methods seem to be operative. Consider the following two scenarios.

C1 At an exam on African politics.

(10) Q: Who is the president of Mali?
A: (?) This man [pointing at Amadou Toure].
B: Amadou Toure.

C2 At a party with many African leaders. Al wants to interview Amadou Toure.

(11) Q: Who is the president of Mali?
A: This man [pointing at Amadou Tour].
B: (?) Amadou Toure.

In context C1, identification by name is the operative method of identification. Indeed, reply B is a proper answer to question Q, while A is somehow out of place. Sentence (9) would be true if used here. In this context, knowing the name of the man constitutes enough evidence for knowing who the president of Mali is. Consider now context C2. Given Al's goal, demonstrative identification seems to be operative here rather than naming. Therefore, we would not use (9) to describe Al's belief in this situation and A is more appropriate than B as a reply to Q. Sentence (9) obtains then different truth values in contexts Cl and C2, where different methods of identification are operative, although the shift from one context to the other does not involve any change in Al's information state. It seems that the availability of different sets of concepts can help us in accounting for this variability. Let us have a closer look.

2.2.2. *Questions under cover*

To fix ideas, I will consider the partition theory of questions of Groenendijk and Stokhof (1984).[6] In this theory, the meaning of a

[6] For an application to other semantic theories of interrogatives see Aloni (2001, chapter 1).

question is identified with the set of meanings of all its possible complete answers. More formally, interrogative sentences are represented by formulae of predicate logic preceded by a question operator, ?, and a sequence $\vec{x}$ of k variables. Sentences are evaluated with respect to models $M = \langle D, W, I \rangle$ consisting of a set D of individuals, a set W of possible words and a world dependent interpretation function I for the non-logical fragment of the language.

A classical interpretation is assumed for indicative sentences. The denotation of an indicative in a model M, relative to a world w and an assignment function g is a truth value: $[\![\phi]\!]_{M,w,g} \in \{0, 1\}$.

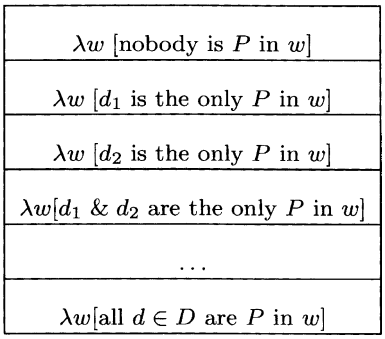
Interrogatives are analyzed in terms of their possible answers. The denotation of an interrogative in a given world is the proposition expressing the complete true answer to the question in that world.

DEFINITION 5 (Questions)

$$[\![?\vec{x}\phi]\!]_{M,w,g} = \{v \in W \mid \forall \vec{d} \in D^k : [\![\phi]\!]_{M,v,g[\vec{x}/\vec{d}]} = [\![\phi]\!]_{M,w,g[\vec{x}/\vec{d}]}\}$$

An interrogative $?\vec{x}\phi$ collects the worlds v in which the set of sequences of individuals satisfying ϕ is the same as in the evaluation world w. If $\vec{x}$ is empty, $?\vec{x}\phi$ denotes in w the set of the worlds v in which ϕ has the same truth value as in w. For example, a polar question $?p$ denotes in w the proposition *that p*, if p is true in w, and the proposition *that not p* otherwise. As for who-questions, suppose a and b are the only two individuals in the extension of P in w, then the proposition *that a and b are the only P* is the denotation of $?xPx$ in w, that is the set of worlds v such that $I_v(P) = \{a, b\}$.

While indicatives express propositions, interrogatives determine *partitions* of the logical space. I will write $[\![\phi]\!]_M$ to denote the meaning of a closed sentence ϕ with respect to M, identified with the set of all possible denotations of ϕ in M. While the meaning of an indicative corresponds to a set of worlds, i.e. a proposition, the meaning of an interrogative is identified with the set of meanings of all its possible complete answers. Since the latter is a set of mutually exclusive propositions the union of which exhausts the set of worlds, we say that questions partition the logical space. Partitions can be perspicuously visualized in diagrams.



In the first diagram, the polar question ?p divides the set of worlds in two alternatives, the alternative in which p is true and the alternative in which p is false. In the second diagram, the single-constituent question ?xPx divides the set of worlds in as many alternatives as there are possible denotations of the predicate P within M. Intuitively, two worlds belong to the same block in the partition determined by a question if their differences are irrelevant to the issue raised by the question. In this framework, our question (12a), represented as (12b), determines the set of propositions in (12c).

(12) a. Who is the president of Mali?
b. ?x $x = p$
c. {that d_1 is the president of Mali, that d_2 is the president of Mali, ...}

As we have observed above, intuitively, what counts as a good answer to this question depends on the adopted method of identification. Clearly, Groenendijk and Stokhof's standard treatment of (12a) fails to account for this dependence.

In order to improve on this, in Aloni (2002), I propose to modify Groenendijk and Stokhof's semantics by adopting the style of quantification introduced in Section 2.1.2. As above, I add indices $n \in N$ to the variables in the language. The interpretation of interrogative sentences is relativized to a contextual parameter $\wp$ which, as above, assigns conceptual covers to these indices. (By $\vec{x}_n$ I mean the sequence $x_{1_{n_1}}, \ldots, x_{k_{n_k}}$. By $\wp(\vec{n})$ I mean the product $\prod_{i \in k} (\wp(n_i))$. And by $\vec{c}(w)$ I mean the sequence $c_1(w), \ldots, c_k(w)$.)

DEFINITION 6 (Questions under Cover)

$$[\![?\vec{x}_n\phi]\!]^{\wp}_{w,g} = \{v \in W \mid \forall \vec{c} \in \wp(\vec{n}) : [\![\phi]\!]_{w,g[\vec{x}_n/\vec{c}(v)]} = [\![\phi]\!]_{v,g[\vec{x}_n/\vec{c}(v)]}\}$$

The idea formalized by this definition is that by interpreting an interrogative sentence one quantifies over tuples of elements of possibly distinct conceptual covers rather than directly over tuples of individuals in D. If analyzed in this way, a question like $?x_nPx_n$ groups together the worlds in which the denotation of P is identified by means of the same set of elements of the conceptual cover selected for n. A multi-constituent question like $?x_ny_mRx_ny_m$ groups together those worlds in which the pairs (d_1, d_2) in the denotation of R are identified by means of the same pairs of concepts (c_1, c_2), where c_1 and c_2 can be elements of two different conceptualizations. The following diagram visualizes the partition determined by $?x_nPx_n$ under a perspective $\wp$ such that $\wp(n) = \{c_1, c_2, \ldots\}$.

λw [no $c_i(w)$ is P in w]
λw [$c_1(w)$ is the only P in w]
λw [$c_2(w)$ is the only P in w]
λw [$c_1(w)$ & $c_2(w)$ are the only P in w]
...
λw[all $c_i(w)$ are P in w]

Due to the definition of conceptual covers, in the first block of this partition no individual in D is P; in the fourth block exactly two individuals in D are P; and in the last block all individuals in D are P.

Our question (13a) is now represented as in (13b) where the indexed variable x_n ranges over the set of separated concepts contextually selected as the value for n.

(13) a. Who is the president of Mali?
b. $?x_n\ x_n = p$
c′. {that Amadou Toure is the president of Mali, that Abdoulaye Wade is the president of Mali, ...}
c″. {that d_1 is the president of Mali, that d_2 is the president of Mali, ...}
...

Question (13b) can determine different partitions depending on the conceptual perspectives assumed. For example, it can determine the partition in (c′) in a context like Cl where identification by name is operative, and the partition (c″) in a context like C2 where demonstrative identification is required. Other partitions can be determined in other contexts where other identification methods are used – e.g., identification(s) by description.

It is easy to see that this analysis captures our intuitions about examples (9), (10) and (11) above. First of all, since partitions represent sets of possible answers, we correctly predict that the reply 'Amadou Toure is the president of Mali' counts as an answer to our question in context Cl, but not in C2. Furthermore, if, following Groenendijk and Stokhof, we analyze *know* as a relation between subjects and true complete answers to questions – roughly, a knows wh-ϕ iff a believes the true complete answer to wh-ϕ, sentence (9), restated below for ease of reference, results true in Cl and false in C2, in accordance with our intuitions.

(9) Al knows who the president of Mali is.

Finally, since in our analysis different occurances of variables can be assigned different conceptualizations as domains of quantification, we obtain an enlightening account of the following traditionally problematic sentences.

(14) a. Who is who?
b. $?x_n y_m\ x_n = y_m$

(15) a. Al does not know who is who.
b. $\neg K_a ?x_n y_m\ x_n = y_m$

In standard theories, (14) and (15) are wrongly predicted to be vacuous and to entail that Al's belief state is inconsistent, respectively. On our account, since different wh-phrases in a multi-constituent question can range over different sets of concepts, (14) can be significant and (15) can fail to entail inconsistence. In the following section we will return to these examples.

2.2.3. *Conclusion*

To summarize the content of this part, we first observed that our evaluation of *de re* attitude reports and wh-questions may vary

relative to the method of identification which is operative in the specific circumstances of use. We then proposed to account for this context dependence in terms of quantification over sets of contextually selected individual concepts. We are now ready to address the question of how the interpreter selects the intended domain of quantification while evaluating these constructions. The following section addresses this issue in the framework of optimality theory.

3. Pragmatics in Optimality Theory

In the previous section we have argued that a number of seeming paradoxes emerging from logical analyses of attitudes and questions can be explained in terms of shifts in perspective over the universe of discourse. In this section we want to address the issue of how different perspectives are selected on different occasions. Shifts in perspective have a cost and, therefore, are generally avoided. However, on certain occasions, like in the 'who is who' constructions discussed in the previous section, we seem to be compelled to make such shifts by the requirement to comply with general principles of rational conversation, which, for example, disallow vacuous or inconsistent interpretations. The pragmatic selection of a conceptual perspective seems then to be ruled by principles which are not absolute, but may be crucially violated in order to prevent the violation of more stringent ones. This suggests a formulation of a perspective selection procedure in the framework of optimality theory.

3.1. *Optimality Theory*

Optimality Theory, henceforth OT, is a branch of research in linguistics which stems from work on connectionism in artificial intelligence (see Prince and Smolensky 1997). OT makes use of a number of possibly conflicting constraints ranked according to their different degrees of violability. Ranked constraints are used to select a set of optimal candidates from a larger set of candidates. A given candidate can be optimal even if it violates a constraint provided all alternative candidates lead to more severe constraint violations. A single violation of a higher ranked constraint overrides in severity multiple violations of lower ranked constraints. The following example illustrates a typical optimization procedure.

Snackbar wisdom. Consider the following real life example of conflicting constraints (from a board in a snackbar in Amsterdam):

> If it's fast and cheap, it can't be good.
> If it's good and fast, it can't be cheap.
> If it's good and cheap, it can't be fast.

Suppose you want to go out for dinner tonight and you can choose between a fast food chain (cheap, fast, but not good), a sushi bar (good, fast, but not cheap) and a French restaurant (good, but neither cheap nor fast). Which candidate will be optimal depends on your priorities. Consider the following possible different rankings on the constraints.

(a) CHEAP > FAST > GOOD
(b) FAST > GOOD > CHEAP
(c) GOOD > CHEAP > FAST

If you assume the ranking in (a), the optimal choice is the fast food chain. If your priorities are as in (b), then you should choose the sushi bar. The same goes if your ranking is (c). Let us have a closer look at how the optimal candidate for the latter case is selected. If we assume the ranking in (c), the sushi bar is optimal although it violates one constraint – it is not cheap, because the alternative candidates lead to more severe constraint violations. The fast food option violates the stronger constraint GOOD; and the French restaurant violates both CHEAP and FAST. Although FAST is low, its violation is crucial in this case. The following diagram summarizes the optimization procedure for this example. (*) is used to indicate that the candidate violates the corresponding constraint, and !(*) to indicate a crucial violation. Optimal interpretations are those which do not involve any crucial violation.

	GOOD	**CHEAP**	**FAST**
fast food	!(*)		
sushi bar		(*)	
French cuisine		(*)	!(*)

Let us go back to linguistics.

3.2. *OT Analyses of Interpretation*

On the account defended in the first part of this article, *de re* attitude reports and wh-questions can express different contents on different occasions. In what follows, we will focus on the selection procedures of the intended interpretation for these constructions in a given context. These pragmatic processes will be characterized as optimization procedures with respect to a set of ranked constraints. Actual interpretations in contexts are selected as optimal candidates with respect to these constraints.

In OT analyses of interpretation a distinction is made between a uni-directional and a bi-directional notion of optimality. In *uni-directional* OT analyses of interpretation, the set of candidates are potential meanings of a single syntactic form (de Hoop and Hendriks 2001). In *bi-directional* OT interpretation, the set of candidates are potential form-meaning pairs (Blutner 2000). We start by assuming a uni-directional notion of optimal interpretation (Section 3.3). Interpreters choose from sets of possible meanings the ones which optimally satisfy a set of ranked constraints. Uni-directional optimality has, however, a problem: it fails to account for the dynamic multi-agent character of communication. Section 3.4 discusses a number of examples which cannot be explained by a purely interpreter-oriented theory and motivates the adoption of a bi-directional analysis, in which the speaker's perspective is also taken into account. Finally, Section 3.5 formalizes the pragmatics of questions and attitudes in terms of bi-directional optimization procedures in which speaker and interpreter – whose preferences are determined by generation and interpretation constraints – coordinate their choice towards optimal form-meaning pairs.

3.3. *Interpretation Constraints*

I propose the following constraints as principles that guide our interpretations of (quantified intensional) sentences in a context:

CONVERSATIONAL MAXIMS

CONSISTENCY Be consistent.
INFORMATIVITY Be informative.
RELEVANCE Be relevant.

***ACC** Do not accommodate.

None of these principles are new and they all find independent motivation in the literature. The first three principles express a general preference for consistent, informative and relevant interpretations, and correspond to Grice's maxims of rational conversation. The last principle, *ACC, prohibits accommodation, in particular, of new domains of quantification. Originally from van der Sandt (1992), *ACC has been adopted by Blutner (2000) and Zeevat (2000) in an OT setting and is closely related to the principle "Do not Overlook Anaphoric Possibilities" (DOAP) from Williams (1997) (also used by de Hoop and de Swart 2000; de Hoop and Hendriks 2001). We can think of *ACC as an economy principle. Accommodating (a new domain) has a cost and you do not do it unless you are forced to. As we will see, to avoid violations of the conversational maxims is enough reason to violate *ACC. This suggests the following ranking between our principles:

CONVERSATIONAL MAXIMS > *ACC

As an illustration of the constraints, let us consider the following examples.

The workshop. Suppose you are attending a workshop. In front of you lies the list of names of all participants. Around you the participants are sitting in flesh and blood. You do not know who is who. Consider now the following multi-constituent question:

(16) a. Who chaired whom?
b. $?x_n y_m C x_n, y_m$

On our semantic analysis, different wh-phrases can range over different domains. In this case, however, although the context makes salient two domains of quantification, namely the sets of concepts representing identification by name and by ostension respectively, there is a clear preference for a uniform interpretation for domain indices n and m. Indeed, in such a situation, where it is not known which person is called what, replies like (17) or (18) are intuitively more acceptable answers to (16), than reply (19):

(17) Dylan Dog chaired Nathan Never. Ken Parker chaired Dylan Dog ...

(18) This woman chaired that man. The man in the first row chaired that woman over there ...

(19) This woman chaired Nathan Never. That man chaired Ken Parker ...

Our analysis allows us to account for this intuition in a straightforward way. As it is illustrated in the following diagram, our constraints select for (16) two optimal interpretations, namely the first two candidates, which do not involve accommodation of new domains. All other candidates are ruled out because they involve some violation of *ACC.

(16)	**CONV MAX**	***ACC**
$n = m$ (naming)		
$n = m$ (ostension)		
$n = m$ (others)		!(*)
$n \neq m$ (name & ostens)		!(*)
$n \neq m$ (others)		!(*)(*)

Let us consider now two examples in which *ACC is crucially overruled.

(20) a. Who is who?
b. $?x_n y_m\ x_n = y_m$

(21) a. Al does not know who is who.
b. $\neg K_a ?x_n y_m\ x_n = y_m$

Each of these examples contains two wh-phrases which, intuitively, should range over different domains. A typical answer to (20) is one which specifies a mapping from the set of names to the set of people in the room. Answers like 'Dylan Dog is Dylan Dog, ...' or 'this woman is this woman, ...' would be out of place. Let us see what are the predictions of our OT analysis.

In both examples we have a conflict between two constraints. On the one hand, we have *ACC which suggests to interpret m as n. On the other, the fulfillment of the conversational maxims prevents this resolution, because assuming one and the same domain for the two wh-expressions would render example (20) a vacuous question and example (21) an inconsistent statement.[7] Since INFORMATIVITY and CONSISTENCY rank higher than *ACC, the analysis correctly

[7] We are assuming that it is common knowledge that Al has consistent beliefs.

predicts that we shift the domain of quantification when evaluating these sentences, as illustrated in the following diagrams:

(20)	**INF**	***ACC**
$n = m$ (naming)	!(*)	
$n = m$ (ostension)	!(*)	
$n = m$ (others)	!(*)	(*)
$n \neq m$ (name & ostens)		(*)
$n \neq m$ (others)		!(*)(*)

(21)	**CON**	***ACC**
$n = m$ (naming)	!(*)	
$n = m$ (ostension)	!(*)	
$n = m$ (others)	!(*)	(*)
$n \neq m$ (name & ostens)		(*)
$n \neq m$ (others)		!(*)(*)

We turn now to an example of propositional attitude reports, in which relevance plays a crucial role.

Ann and Bea. The following case has been inspired by an example in van Rooy (2003). In front of Ralph stand two women. Ralph believes that the woman on the left, who is smiling, is Bea and the woman on the right, who is frowning, is Ann. As a matter of fact, exactly the opposite is the case. Bea is frowning on the right and Ann is smiling on the left. Suppose all of a sudden Ralph starts chasing the woman on the left to bring her to a mental institution. Asked for an explanation of this surprising fact, you answer:

(22) Ralph believes that Ann is insane.

There are three possible ways of interpreting this sentence in the described situation: (a) an interpretation *de re*, in which Ann is identified in Ralph's state as the woman on the left; (b) an interpretation *de re*, in which Ann is identified by name; (c) the *de dicto* interpretation. All three interpretations are informative and consistent with the background. Interpretation (a) involves a violation of *ACC. Indeed, it requires the accommodation of the concept *the woman on the left*. Interpretation (b) and (c) do not involve such a violation. Still, intuitively, we prefer interpretation (a) for (22) in such a situation. I would like to suggest that the reason is that it is only under such an interpretation that the sentence is relevant. Indeed, whether sentence (22) is contributing to an explanation of Ralph's

behaviour depends on how Ann is identified in Ralph's belief state. Whether or not Ralph believed that Ann – who is, according to him, the woman on the right – is insane does not help explain why he is chasing the woman on the left, whereas the fact that he believes that the woman on the left is insane does contribute to an explanation. Thus, it is only under interpretation (a) that the belief attribution constitutes a proper answer to my question and hence is relevant.[8] This is why people select a domain containing the concept the *woman on the left* in such a situation, although this involves a violation of *ACC.

(22)	**REL**	***ACC**
(a)		(*)
(b)	!(*)	
(c)	!(*)	

At last, let us see what our OT analysis predicts regarding Quine's double vision puzzle.

Double vision. Consider Quine's question rewritten here in (23c).

(23) a. Philip believes that Cicero denounced Catiline.
b. Philip does *not* believe that Tully denounced Catiline.
c. Does Philip believe that x_n denounced Catiline?

We have two possible interpretations for question (23c), either (i) concept *Cicero* is in the set of concepts selected by index *n* or (ii) concept *Tully* is. The two concepts cannot be both in *n* because they are not separated. In the first case, *yes* would be the true answer to the question, in the second case, *no* would be. Our principles do not select a unique optimal candidate for this example. If (23a) alone had been mentioned, or (23b), then our principles would have selected possibility (i) or (ii) respectively, since the alternative interpretation would have violated principle *ACC. But after (23a) and (23b) both concepts *Cicero* and *Tully* are equally salient, and so both options (i) or (ii) are equally available. This explains the never ending puzzling effect of Quine's example.

[8] Formal characterizations of this notion of relevance according to which a sentence is relevant iff it addresses the question under discussion, have been recently attempted by a number of authors, e.g., Roberts (1996), Groenendijk (1999), and in particular van Rooy (2003).

3.4. *Generation Constraints*

In the previous section, we have introduced four ranked interpretation constraints and discussed a number of examples of questions and attitudes that these constraints can explain. The examples discussed in this section will show, however, that a fully adequate account of the pragmatics of these phenomena does require a more complex analysis, in which generation principles are also taken into account. The first example is a variation of Kaplan's example of the shortest spy.

The shortest spy. Assume as part of the common ground the information that Ortcutt is the shortest spy, that Ralph does not believe of anyone that (s)he is a spy, and that Ralph would not assent to 'Ortcutt is a spy' or to 'Ortcutt is fat'. Consider the following sentences:

(24) Ralph believes that Ortcutt is a spy.

(25) Ralph believes that Ortcutt is fat.

Intuitively, these sentences are deviant in this context. This means that their actual interpretation in this situation is the one represented in (26), let us call it *ort*, which corresponds to the *de dicto* reading of the sentence or the *de re* reading with the 'unnatural' concept *the shortest spy* not included in our domain of quantification.

(26) $\Box\phi(ort) \Leftrightarrow \exists x_n(ort = x_n \wedge \Box\phi(x_n))$ if $\lambda w[ort]_w \in \wp(n)$

This reading can be paraphrased as '(Ortcutt is Ortcutt and) Ralph would assent to *Ortcutt is a spy*' for example (24), or '(Ortcutt is Ortcutt and) Ralph would assent to *Ortcutt is fat'* for example (25).

However, our semantics allows another possible interpretation for these sentences, namely the content represented in (27). Let us call this *spy*. It corresponds to the *de re* reading of the sentence in which the concept *the shortest spy* is taken to be part of our domain of quantification.

(27) $\exists x_n(ort = x_n \wedge \Box\phi(x_n))$ and $\lambda w[spy]_w \in \wp(n)$

This second reading can be paraphrased as '(Ortcutt is the shortest spy and) Ralph would assent to *the shortest spy is a spy*' for example

(24), or '(Ortcutt is the shortest spy and) Ralph would assent to *the shortest spy is fat*' for example (25). We expect our OT analysis to rule out these unnatural interpretations. Under this reading, the two sentences would be acceptable in this situation and this clashes with our intuitions.

For sentence (24), our constraints do their job, as illustrated in the following diagram.

(24)	**INF, CON**	***ACC**
ort	(*)	
spy	(*)	!(*)

Interpretation *ort* is optimal for sentence (24), because, although it violates one constraint, namely CONSISTENCY, the alternative candidate leads to more severe constraint violations. Indeed, content *spy* violates INFORMATIVITY – the sentence would be trivialized, and the weaker principle *ACC – the non-rigid concept *the shortest spy* must be accommodated. Since CONSISTENCY and INFORMATIVITY are assumed not to be ranked in any way, the violation of the lower constraint *ACC becomes fatal in this case.

Interpretation *spy* is however the optimal candidate for sentence (25).

(25)	**INF, CONS**	***ACC**
ort	!(*)	
spy		(*)

Interpretation *spy* does not violate any conversational maxims in this case – it is informative indeed, and, therefore, it is preferred over the alternative *ort* which is instead inconsistent with the background information. Our principles wrongly predict that the unnatural concept *the shortest spy* is part of our domain of quantification in this case.

In order to better understand the nature of this problem, I will compare this case with the example of Odette's lover discussed in the first part of this article. The two cases will involve the violation of exactly the same interpretation constraints. But while in the case of the shortest spy (sentence (25)), as we have seen, our ranking made the wrong predictions, in the case of Odette's lover our predictions will be correct. I will argue that the crucial difference between these two cases can be captured only by taking the speaker's perspective into consideration.

Odette's lover. The context is as it was described above. Leo is talking to Theo, and both know that Theo is Odette's lover. Furthermore they know that Swann would not assent to 'Theo is Odette's lover' or 'Theo is going to the Opera tomorrow'. I restate the relevant sentences:

(28) Swann knows that you are Odette's lover.

(29) Swann knows that you are going to the Opera tomorrow.

As in the previous example these sentences can receive two interpretations:

(30) $\exists x_n(x_n = addressee \wedge \Box\phi\ (x_n))$ and $\lambda w[theo]_w \in \wp(n) \mapsto theo$

(You are Theo and) Swann would assent to 'Theo ... '

(31) $\exists x_n(x_n = addressee \wedge \Box\phi\ (x_n))$ and $\lambda w[lover]_w \in \wp(n) \mapsto lover$

(You are Odette's lover and) Swann would assent to 'Odette's lover ... '

Only the contents in (31) are consistent with the background information.

Our OT analyses of the sentences (28) and (29) are summarized in the following diagrams:

(28)	**INF, CONS**	***ACC**
theo	(*)	
lover	(*)	!(*)

(29)	**INF, CONS**	***ACC**
theo	!(*)	
lover		(*)

Interpretation *theo* is optimal for sentence (28), and indeed the sentence is intuitively false in this situation. Interpretation *lover* is optimal for sentence (29), and indeed the sentence is acceptable in the described situation.

The OT tableau for example (29) and that for example (25) of the shortest spy, are identical. In both cases the only interpretation which does not contradict the common ground is one that involves a violation of *ACC. However, in the case of Odette's lover the

predictions of our constraints are correct, and in the case of the shortest spy they weren't. How is the former case different from the latter? Why do we in the case of Odette's lover accommodate a new domain of quantification in order to save consistency while in the case of the shortest spy we don't?

We can interpret sentence (29) as saying 'Swann would assent to *Odette's lover is fat*' (content *lover*), while we are not ready to interpret sentence (25) as 'Ralph would assent to *the shortest spy is fat*' (content *spy*). The explanation I would like to propose for why this last interpretation is not assigned to sentence (25) in the described situation, is that a speaker who would have used such a sentence to express such a content would not have been cooperative. Indeed, content *spy* could have been conveyed in a much more efficient way, by means of an alternative form, namely (32).

(32) Ralph believes that *the shortest spy* is fat.

(25) Ralph believes that *Ortcutt* is fat.

In the described context, sentence (32), on its *de dicto* reading, can express the content under discussion without any constraint violation. Therefore, it is better than (25), which, to convey the same content, requires accommodation.

The existence of an alternative more efficient expression for content *spy* seems to prevent its selection as the preferred interpretation for (25) in the described situation.[9]

The case of Odette's lover is crucially different. Although also here the chosen formulation violates *ACC, it is hard to find a more efficient form for the content under consideration. In that situation Leo could have used sentence (33) instead of (29) to say what he wanted to say and he would not have violated *ACC. But a use of the former sentence instead of the latter would not have been more efficient given the circumstances of the utterance.

(33) Swann knows that *Odette's lover* is going to the Opera tomorrow.

(29) Swann knows that *you* are going to the Opera tomorrow.

There are a number of reasons for why (33) would not have been more efficient than (29) in this context. In particular, (33) seems to

[9] Similar blocking effects have been used to explain phenomena of disparate nature by many authors in particular Horn and more recently Blutner.

crucially violate a principle which requires using the pronoun ''you'' to refer to the addressee in a conversation. We can derive this principle from a more general generation constraint, which I will call the *Referential Device Principle* (RDP). This assumes the hierarchy of referential devices in (34) from Zeevat (2002) (with the addition of the clause for proper names, which is mine).

RDP. A referential device can be selected only if the application criteria of the classes above in the following hierarchy do not apply.

(34)

NP type	**selection condition**
reflexive	c-command
1st and 2nd pers. pron	conversation participant
demonstratives anaphoric short definites proper names ...	presence in attention space high salience through mention old, dependence on high salient familiarity ...
long definites	new and unique
indefinites	new

RDP is typically a generation constraint, but it can also influence interpretation, as is shown by the following example from Grice (also discussed in Zeevat 2002).

(35) X is meeting a woman this evening.

According to Grice, sentence (35) has the implicature that the woman under discussion cannot be known to be X's mother, or sister, and, if we follow the hierarchy in (34), we can further infer that she is not the speaker, the addressee, and so on.

As *ACC is an economy principle for the interpreter, RDP can be viewed as an economy principle for the speaker. The noun phrases that are lower in the hierarchy involve more structure than the higher ones and, therefore, are more expensive to use. In what follows I will assume the following tentative ranking:

CONVERSATIONAL MAXIMS > *ACC ≡ RDV

The economy principles for speaker and addressee are not ranked in any way – speaker's and addressee's efforts are equally important. Both can be overruled in order to satisfy the conversational maxims.

The following example illustrates how Zeevat's hierarchy seems to influence our ways of reporting propositional attitudes.

Lorenzo's mother. Consider the following situation. Miss Jones, the new director of Lorenzo's school, would assent to 'Lorenzo's mother is Spanish'. However, she has no idea who Lorenzo's mother is. Lorenzo's mother's name is Maria. Consider now the following sentences used to report the described situation in the following contexts.

C1 Maria to her husband:

(36) The new director of Lorenzo's school believes that *I* am Spanish.

C2 Maria's husband to Maria:

(37) The new director of Lorenzo's school believes that *you* are Spanish.

C3 Maria's husband to her mother:

(38) The new director of Lorenzo's school believes that *Maria* is Spanish.

C4 Lorenzo's teacher to a colleague:

(39) a. Miss Jones believes that *she* [pointing at Maria] is Spanish.
b. Lorenzo's mother is Italian, but Miss Jones believes that *she* is Spanish.
c. (?) Miss Jones believes that *Maria* is Spanish.

All these examples, with the only exception of (39c), seem to be adequate ways for describing the situation in the given circumstances. It seems to me that (40) could also be used in all previous contexts. In fact, its selection might be preferred in the case where Miss Jones and her (*de dicto*) beliefs are under discussion, say as an answer to the question 'what does Miss Jones believe?'.[10]

[10] This would suggest that relevance could help in selecting between (40) and its *de re* alternatives. However in a context in which the conversational goals are not specified both formulations seem to be acceptable.

(40) Miss Jones/The new director believes that *Lorenzo's mother* is Spanish.

How can we account for these data? All the examples (36)–(39) under the intended interpretation violate *ACC – a domain containing the non-rigid concept *Lorenzo's mother* must be accommodated. On the other hand, the alternative form (40) would violate RDP in all contexts, except C4(c), where the familiarity condition for the use of proper names is not satisfied. If we assume that these two principles are equally ranked,[11] we predict that all forms can be used in the described circumstances, with the exception of (39c), which is ruled out by the alternative candidate (40), which, as we have said, in C4(c) does not involve any constraint violation.

Example (37) has exactly the same structure as example (29) of Odette's lover, while example (39c), I would like to suggest, is parallel to example (25) of the shortest spy.

(29) Swann knows that you are going to the Opera tomorrow.
(25) Ralph believes that Ortcutt is fat.

The former is acceptable in the described context because the alternative form containing the long description ''Odette's lover'', although more economical for the addressee, since it does not involve accommodation, requires more effort for the speaker, and, therefore, is not strictly better.[12] Example (25) is not accepted in the described context, because there is an alternative form which is strictly better, namely the form containing the description ''the shortest spy'', which

[11] Helen de Hoop has suggested that eventually RDP should possibly be divided into a series of constraints which might be differently ranked with respect to the other constraints. In particular, she suggested that the principle which requires the speaker to use I to refer to herself should be stronger than *ACC, predicting that sentence (40) is never felicitous in context C1. This issue certainly requires further investigation.

[12] Our analysis predicts that the speaker can freely choose between using the personal pronoun or the long description in this situation. Our intuitions about this case, however, are not so sharp. Possibly the use of the personal pronoun is preferred here. We could account for this fact either by introducing a ranking between *ACC and RDP (see footnote 11) or, as suggested to me by Paul Dekker, by assuming that the use of the long description violates RELEVANCE here. It's Theo's life which is in danger here and the use of ''you'' rather than the more neutral ''Odette's lover'' is a better way to express the speaker's personal commitment and feelings about the situation. Note, however, that a formalization of a notion of relevance which would capture this intuition is not at all trivial.

does not involve any constraint violation. It does not require any accommodation, but also it does not violate RDP. The long description "the shortest spy" can be used in this case because none of the selection conditions for any of the alternative shorter referential devices apply. In particular, "Ortcutt" is not a good referential device in this case, because no familiarity can be assumed between us (readers of a philosophical article) and Ortcutt himself.

It should be clear that on our account, the difference between these two examples does not rely on the nature of the cognitive relation between the subject and the object of belief or on the appropriateness of the concept *Odette's lover* versus *the shortest spy*, but crucially on the circumstances of the utterance. If we slightly change these circumstances, for example by assuming in the case of the shortest spy that the participants to the conversation are familiar with Ortcutt or that Ortcutt himself is speaking, we predict, I believe correctly, that the concept *the shortest spy*, could be part of our domain of quantification. The former case would be similar to example (38) and the latter to example (36) above. In the following section, this analysis is made formally precise.

3.5. *Bi-directional Optimality Theory*

Our intuitive explanation of the cases of the shortest spy and Odette's lover involved interactions of the principles *ACC and RDP. *ACC is an interpretation constraint, but, as we have seen, it influences speakers as well, who if cooperative, should choose forms which can be interpreted without shifts of domains of quantification. On the other hand, RDP is typically a generation constraint, but, as we have seen, it can influence interpretation. These interactions between interpretation and generation constraints cannot be formulated in the uni-directional analysis we have used in the previous section, in which inputs are given by single sentences and no reference is made to alternative forms that the speaker might have used. In order to formalize these cases we need a bi-directional analysis.

In bi-directional optimality (Blutner 2000; Blutner and Jäger 2000), optimal solutions are searched along two dimensions: (i) the dimension of the interpreter, who compares different meanings for a given syntactic form; and (ii) the dimension of the speaker, who compares different forms for one and the same meaning to be communicated. Different form-meaning pairs are ordered with respect to ranked interpretation and generation constraints. A candidate

(form, meaning) is *optimal* iff there are no other better optimal pairs (form1, meaning) or (form, meaning1) (see the notion of *weak optimality* (or super-optimality) in Blutner and Jäger 2000).

As an illustration of the notion of weak optimality consider the following example. Suppose we have four form-meaning candidates ordered as follows by our ranked constraints:

(41) $(F1, M1) > (F1, M2) > (F2, M1) > (F2, M2)$

Weak optimality selects here two optimal candidates: (Fl, M1) and, somehow surprisingly, (F2, M2). The former pair is optimal because it is the best candidate. The latter is optimal, although it is the worse candidate, because there are no other optimal alternative pairs containing F2 or M2. Both (F1, M2) and (F2, M1) are indeed blocked by the optimal and better (F1, M1). Weak optimality has been used by Blutner to formalize what Horn has called the *division* of *pragmatic labour*, that is, the tendency to use unmarked forms for unmarked situations and marked forms for marked situations (see Horn 1984). If we take F1 and F2 above to stand for unmarked and marked forms respectively, and M1 and M2, for unmarked and marked situations, the predictions of weak optimality indeed capture Horn's observation.

In what follows, I will follow Blutner and adopt a dynamic perspective on meanings. Meanings are identified with subsets of the relevant alternatives given by the context which represents the common-ground of the participants to the conversation (Stalnaker 1978). For assertions, these alternatives are possible worlds. For questions, since partitions can be represented as equivalence relations over the set of words, the relevant alternatives are pairs of possible worlds.[13] Let us see now how our examples of the shortest spy and of Odette's lover can be analyzed in this framework.

The shortest spy. The interpretation problem posed by this example is characterized as a competition between a number of alternative form-meaning pairs. We have two relevant alternative forms:

(42) Ralph believes that *Ortcutt* is fat.
(43) Ralph believes that the *shortest spy* is fat.

As for the alternative meanings, let A be a conceptual cover expressing identification by name and B be a cover containing the

[13] See Groenendijk (1999) for a dynamic treatment of interrogative sentences along these lines.

concept the *shortest spy*. For simplicity, assume A and B are the only two covers available. Each of the two sentences above has then three possible interpretations. Let $\wp$ be a conceptual perspective such that $\wp(n) = \text{A}$ and $\wp(m) = B$.

(42) Ralph believes that Ortcutt is fat.
a. *de dicto*: $\Box Fo$
b. *de re* under A: $\exists x_n(x_n = o \wedge \Box Fx_n)$
c. *de re* under B: $\exists x_m(x_m = o \wedge \Box Fx_m)$

(43) Ralph believes that the shortest spy is fat.
d. *de dicto*: $\Box Fs$
e. *de re* under A: $\exists x_n(x_n = s \wedge \Box Fx_n)$
f. *de re* under B: $\exists x_m(x_m = s \wedge \Box Fx_m)$

Since we have assumed that it is known that Ortcutt is the shortest spy, only worlds satisfying this identity will be part of the common-ground. Therefore, the six possible interpretations above collapse into only two different possible dynamic meanings, namely:

ort The subset of the common ground in which it is true that Ralph would assent to 'Ortcutt is fat'.
spy The subset of the common ground in which it is true that Ralph would assent to 'the shortest spy is fat'.

Meaning *ort* corresponds to interpretations (a), (b) and (e) above. Meaning *spy* corresponds to interpretations (c), (d) and (f).

We have then four form-meaning candidates which are evaluated with respect to the five constraints introduced in the previous sections. This gives rise to the following tableau (⇒ indicates an optimal solution).

		CON	**RDP, *ACC**
⇒	('Ortcutt'-*ort*)	(*)	
	('Ortcutt'-*spy*)		(*)
	('shortest spy'-*ort*)	(*)	(*)
⇒	('shortest spy'-*spy*)		

The candidate (''shortest spy'', *spy*) is optimal because it does not violate any constraint – the use of the long description here does not violate RDP because the selection conditions for the alternative referential devices do not apply. Therefore, candidates (''shortest spy'', *ort*) and (''Ortcutt'', *spy*) are blocked. The remaining other optimal pair is then (''Ortcutt'', *ort*). Sentence (42) is interpreted as 'Ralph

would assent to *Ortcutt is fat*' and not as 'Ralph would assent to *the shortest spy is fat*'. Our ranked constraints correctly predict that the unnatural concept *the shortest spy* is not taken to be part of our domain of quantification in Kaplan's situation.

Let us now turn to the case of Odette's lover.

Odette's lover. As in the previous example, we have here a competition between four candidates. The speaker can choose between the following two forms:

(44) Swann knows that *you* are going to the Opera tomorrow.
(45) Swann knows that *Odette's lover* is going to the Opera tomorrow.

The interpreter can choose between the following two dynamic meanings, derived as above from the possible interpretations for (44) and (45).[14]

theo The subset of the common-ground in which it is true that Swann would assent to 'Theo is going to the Opera tomorrow'.

lover The subset of the common-ground in which it is true that Swann would assent to 'Odette's lover is going to the Opera tomorrow'.

The four resulting candidates are evaluated in the following tableau.

		CON	RDP, *ACC
	'you'-*theo*	(*)	
⇒	'you'-*lover*		(*)
	'lover'-*theo*	(*)	(*)
⇒	'lover'-*lover*		(*)

Contrary to the previous case, the use of the long definite "Odette's lover" here does violate RDP, since the conditions for the selection of the shorter device "you" are satisfied in the present context. We have then two optimal solutions, namely the pairs ("you", *lover*), and ("lover", *lover*). We correctly predict that Leo's intended meaning can be conveyed by sentence (44) in the described situation.[15]

[14] Here again it is essential that it is common knowledge that the addressee, Theo, and Odette's lover are one and the same man.

[15] We also predict that sentence (45) is an equally good alternative form for the content under consideration. See footnote 12 for a discussion on this possibly dubious result.

Before concluding this section, there is a loose end that I should attend. It concerns the bi-directional analysis of the example of Ann and Bea discussed in Section 3.3.

Ann and Bea. Recall the relevant facts. Ralph believes that the woman on the left, who is smiling, is Bea and that the woman on the right, who is frowning, is Ann. As a matter of fact, exactly the opposite is the case. Bea is frowning on the right and Ann is smiling on the left. Suppose all of a sudden Ralph starts chasing the woman on the left, i.e., Ann. You are asked for an explanation of this surprising fact. Consider now the alternative answers you could give in (46), and their possible meanings in (47).

(46) a. Ralph believes that *Ann* is insane.
b. Ralph believes that *Bea* is insane.
c. Ralph believes that *the woman on the left* is insane.
d. Ralph believes that *the woman on the right* is insane.

(47) a. Ralph would assent to 'Ann is insane'.
b. Ralph would assent to 'Bea is insane'.
c. Ralph would assent to 'the woman on the left is insane'.
d. Ralph would assent to 'the woman on the right is insane'.

If it is common knowledge that Ralph believes that Bea is the woman on the left and Ann the one on the right, meanings (47b) and (47c) are identified in this context, as well as (47a) and (47d).

Consider now candidate (46b)–(47b). Does this pair satisfy relevance? Well, it depends on which notion of relevance one assumes. But, since meaning (47b) is identical with (47c) in this context and (47c) is clearly relevant here, we might want to conclude that (47b) is relevant as well. Furthermore, (46b)–(47b) seems to satisfy *ACC as well, since the meaning under discussion corresponds with the *de dicto* interpretation of the sentence. At first sight, then, our analysis seems to predict that (46b)–(47b) is an optimal candidate. Therefore, meaning (47c)/(47b) for (46a), and meaning (47a)/(47d) for (46b) are blocked and the remaining other optimal pair is (46a)–(47a). This, as an anonymous reviewer observed, is clearly not correct. Intuitively, candidate (46b)–(47b) has two problems in this context. Firstly, the question under discussion, say 'Why is Ralph chasing Ann?', is about Ralph and Ann, so a proper answer should also be about these two individuals. Sentence (46b) does not satisfy this requirement, 'Bea' is not an appropriate referential device for

Ann. Using standard terminology in question–answer analyses (e.g. Roberts 1996), we might say that reply (46b), although might be relevant, fails to be a *congruent* answer here. Compare it with (46a), which ''matches'' the question under discussion, and, therefore, seems to be preferred as a discourse move. Secondly, meaning (47b) can be relevant here only on the assumption that Ralph believes that Bea is the woman of the left (and that Ann is actually the woman on the left). The accommodation of the concept *the woman on the left* seems then to be required for this pairing as well, not to get the intended *de dicto* interpretation, but to see that that interpretation is a relevant one. An adjustment in our theory, in particular a strict formalization of the notion of relevance and its relation with discourse congruence and accommodation, is required to account for these facts, but must be left to another occasion.

4. Conclusion

Objects can be identified from many different perspectives and our evaluation of fragments of discourse may vary relative to these perspectives. In the first part of the article, I have proposed to formalize these different methods of identification by means of sets of individual concepts which uniquely and exhaustively cover the domain of quantification. Our interpretation function was then relativized to a contextual parameter fixing the operative method of identification. This analysis allowed us to shed some new light on a series of traditional puzzles that emerge out of the interaction between intensional operators (attitudes or questions), quantifiers and the notion of identity.

In the second part of the article, the pragmatics of a selection of a method of identification was formalized in the framework of bi-directional optimality theory. Actual interpretation of attitudes and questions were explained as the result of optimization procedures with respect to five generation and interpretation constraints, ranked according to their relative strength.

Dependence on identification methods is just one example of the crucial role of contextual information in natural language use. Hopefully this article has presented a coherent view on how structural and contextual information interact in natural language interpretation.

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