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Where the air is thin, but the view so much clearer*

Matthijs Westera

Institute for Logic, Language and Computation, University of Amsterdam

Abstract

Thirty years after Groenendijk and Stokhof's (1984) dissertation, the exhaustive interpretation of answers is still one of the central topics in semantics and pragmatics. Groenendijk and Stokhof identified three main problems for a pragmatic account of exhaustivity, which to this date remain largely open. In the present paper I show how these can be resolved by adopting a richer notion of meaning, and taking into account its pragmatic thrust. The resulting theory may be the only one to this date that explains exhaustivity, from start to end, as a genuine case of Gricean conversational implicature.

1 Introduction

The response in (1), when pronounced with a neutral (falling) intonation, is typically interpreted as an *exhaustive answer* to the question:

(1) Who (among John, Bill and Mary) were at the party?
- John was there. $\rightsquigarrow$ *not Bill, not Mary* ('exhaustivity')

This exhaustive interpretation arises despite the response not being (overtly at least) *semantically* exhaustive: that John was at the party is compatible with Bill or Mary also being there. For this reason, many researchers have tried to explain the exhaustive interpretation as a case of *conversational implicature*, in the sense of Grice (1975): an assumption that is necessary for maintaining the assumption that the responder made a *cooperative* contribution to the conversation. To this date, however, no one has managed to explain exhaustivity as such. In fact, not much progress has been made since Groenendijk and Stokhof (1984), henceforth G&S, who already lamented their dissertation's lack of a pragmatic explanation for exhaustivity (p.369):

> Why then didn't we take this grand route over the summits of Gricean reasoning, where the air is thin, but the view so much clearer? The reason is that we do not see a pass that leads into this promised land.

Instead of a mountain pass, G&S identified three main problems for a pragmatic account, which to this date remain largely open. These are, in a nutshell:

- Problem *I*: Partitions are too demanding for a pragmatic account of exhaustivity.
- Problem *II*: Quantity implicatures are too weak for a pragmatic account of exhaustivity.
- Problem *III*: Classical semantics doesn't draw all the distinctions relevant for exhaustivity.

*This paper is dedicated to Jeroen Groenendijk, Martin Stokhof, and Frank Veltman, in appreciation of their inspiring contributions to the field. I am furthermore grateful to Jeroen, as well as Floris Roelofsen and Ivano Ciardelli, for insightful discussions and helpful comments on all previous versions of the theory outlined here. Financial support from the Netherlands Organisation for Scientific Research (NWO) is gratefully acknowledged.

In the present paper I show how these problems are resolved, three birds with one stone, by adopting a richer notion of meaning, namely Roelofsen's *attentive semantics* (2013, present volume), and formulating a set of maxims that govern it.

This Festschrift contribution originates in an attempt to reformulate my recent work on exhaustivity (2012, 2013b) in G&S's terms. Inevitably, this has forced me to reconsider some of my basic assumptions, which, in light of the conceptual clarity achieved by G&S, felt like bungle. The resulting theory inherits and hopefully expands some of G&S's insights. I am quite confident that it is the only theory to this date that explains exhaustivity, from start to end, as a genuine case of Gricean conversational implicature. At the same time, being confronted once again with the rigour of G&S has made me aware of the many open questions that my approach still faces.

2 Three Main Problems Identified by G&S

2.1 Problem *I*: Partitions are Too Demanding

G&S write (p.371):

> If we consider two answers a and a', where a' is the exhaustive variant of a, it will be clear that, if both meet the requirements of Relation and Quality, the exhaustive a' will be preferred by Quantity over the non-exhaustive a. So, we see that instead of providing non-exhaustive answers with an exhaustivity implicature, Quantity rather does the opposite. It prefers exhaustive answers over non-exhaustive ones, and consequently a non-exhaustive answer will pragmatically imply the negation of exhaustivity.

In other words, if a context asks for an exhaustive answer, like 'only John was there', then saying merely 'John was there' will implicate an inability to have said the former, which is the opposite of the exhaustive interpretation that we wish to explain. Now, this prediction as such is not the problem, because it may well be correct (see section 6). Rather, the problem is that G&S predict that *all* contexts in which exhaustivity occurs are as demanding as this, and this renders a pragmatic account of exhaustivity impossible. Now, as G&S remark, the Maxim of Quantity cannot really be blamed for this prediction:

> And it is difficult to see how the Maxim of Quantity, whatever precise formulation one might want to give of it, could not have this effect. For Quantity asks to give as much information as possible, within the bounds set by Relation and Quality. And given the semantic fact that questions ask for an exhaustive specification, exhaustive answers clearly comply better than non-exhaustive ones.

Hence, the culprit must be the assumption that questions ask for an exhaustive specification. At least for a pragmatic account of exhaustivity, we therefore need a replacement for partition semantics, according to which the meaning of a question is not the set of its exhaustive answers, but, rather, the set of its *positive* answers, what G&S call its 'mention-some answers' (cf. section 6). The two sets are given in (2), where I assume that the domain of relevant individuals consists of John, Mary and Bill.

(2) Who came to the party?

a. **Exhaustive answers**: {only John came, only Mary came, only Bill came, only John and Mary came, only John and Bill came, only Mary and Bill came, everyone came, no one came}

b. **Positive answers**: {John came, Mary came, Bill came, John and Mary came, John and Bill came, Mary and Bill came, everyone came}

Of course, merely changing the semantic objects that interrogatives denote, i.e., replacing (2a) by (2b), is not enough. For even if a question is not a partition, the Maxim of Quantity can still be reasonably defined in such a way that it does ask for an exhaustive answer. For instance, although a sufficiently weak Maxim of Quantity was defined by Schulz and Van Rooij (2006), they did not really motivate it, nor argue why a stronger Maxim of Quantity wouldn't hold.

2.2 Problem *II*: Quantity Implicatures are Too Weak

All existing Gricean accounts try to conceive of exhaustivity implicatures as an answer to the question: 'why did the speaker not say something more informative?', as posed by the Maxim of Quantity. However, mere *not-knowing* suffices as an answer to this, which means that the stronger *knowing-that-not*, required for exhaustivity, can never by reached by asking this question alone. G&S also see this, continuing the passage cited above:

> Quantity as such then merely allows one to infer that the answerer who gives a certain specification, does not positively believe of other individuals that they have the property in question too. But this is not the same as inferring that the specification given is meant to be exhaustive, i.e. as inferring that the answerer believes of all other individuals that they do not have the property.

This problem holds independently of Problem *I*, i.e., partitions are too demanding independently of the Maxim of Quantity, and the Maxim of Quantity is too weak independently of partition semantics. A possible solution was already proposed by Mill (1867), who writes (p.501; citation from Horn (2001), my emphasis):

> If I say to any one, 'I saw some of your children to-day', he might be justified in inferring that I did not see them all, not because the words mean it, but because, if I had seem them all, it is most likely that I should have said so: even though this cannot be presumed *unless it is presupposed that I must have known whether the children I saw were all or not.*

That is, an additional *competence assumption* is invoked to strengthen the Quantity implicature. This solution has remained basically unchanged for almost one and a half centuries, and it demotes exhaustive interpretation to a case of *default inference*, rather than conversational implicature. And although it strikes me as ad-hoc and unsatisfactory, some of the fiercest defenders of a pragmatic account of exhaustivity have presented the required competence assumption as a good thing, e.g., Geurts (2011) (p.30):

> One of the main virtues of [this approach] is that it distinguishes between weak [i.e., not-knowing-that] and strong [i.e., knowing-that-not] implicatures, and connects them via the Competence Assumption.

To my awareness, this positive attitude to what G&S considered a shortcoming is shared by all (or at least all *recent*) pragmatic accounts of exhaustivity, except my own (2013b).

One reason why this contextual competence assumption is embraced in the literature, is that cancelling the responder's competence automatically cancels the exhaustivity implicature:

(3) Who were at the party?
- I'm not sure about the others, but John and Bob. $\not\rightsquigarrow$ *no one else.*

But this is hardly surprising, because to be competent *is* to be able to give an exhaustive answer. Instead, a proper test case would be to cancel not the speaker's *competence*, but, rather, only the *competence assumption*, and see if exhaustivity likewise disappears. Interestingly, it doesn't:

(4) I'm probably asking the wrong person, but who were at the party?
- John, Bob, Mary, and Sue. $\rightsquigarrow$ *no one else.*

This suggests that the responder's competence is not assumed in the context, but, instead, it is somehow conveyed by the responder herself. G&S were right, therefore, in considering this to be a serious puzzle for a Gricean account of exhaustivity. The challenge is to explain how a speaker can implicate her own competence, *without* putting a competence requirement directly into the maxims – after all, there is nothing uncooperative about being incompetent.

Put differently, the age-old idea that exhaustivity is an answer to the question 'why did the speaker not say something more informative?' is clearly wrong. But then, to what question is exhaustivity the answer? And by which maxims is such a question posed?

2.3 Problem *III*: Classical Semantics is Too Coarse

As G&S observe (p. 301 onwards), their account of exhaustivity derives the wrong predictions (as any account would) if it is based on a semantics that assigns the same denotation to the terms 'John' (5a) and 'John, or John and Mary' (5b):

(5) Who were at the party?
  a. John. $\rightsquigarrow$ *not Mary.*
  b. John, or John and Mary. $\not\rightsquigarrow$ *not Mary.*

After all, if these two responses are semantically equivalent, then no account, whether semantic or pragmatic, could capture the fact that only (5a) has an exhaustive interpretation. G&S's (provisional) solution is to take *plurals* seriously, and assign to 'John and Mary' not the set of properties had both by John and by Mary, but, rather, the set of properties had by the *group* consisting of John and Mary. However, while this may work for the term answers in (5), it will not generalize to the analogous case with sentential answers, i.e.:

(6) Who were at the party?
  a. John was at the party. $\rightsquigarrow$ *not Mary.*
  b. John was there, or John was there and Mary was there. $\not\rightsquigarrow$ *not Mary.*

The reason is that, although the suggested treatment of plurality would forge a distinction at the level of *terms*, it would not make a difference at the level of *propositions*. To tell (6a) and (6b) apart, the meanings of the constituents of (6b) should somehow be recognisable from the semantics of the sentence as a whole. We thus need a semantics that is richer than a classical semantics. An attempt by Schulz and Van Rooij (2006) comes closest to solving this problem, but not in a very principled way: they store each of the propositions expressed by a disjunct in a discourse referent.

2.4 Outline

In the present paper, I show that these three major problems can be solved by adopting *a richer notion of meaning*, namely Roelofsen's *attentive semantics* (2013). In addition to the *information* provided by an utterance, this semantics models the possibilities that a sentence *draws attention to*. Intuitively, a question draws attention only to its positive answers, and the

difference between (6a) and (6b) is precisely that the latter, but not the former, draws attention to the possibility that both John and Mary were at the party. This richer notion of meaning gives rise to a new set of maxims that govern attentive content, and helps to (re-)motivate the old maxims that govern informative content.

In section 3 I present a quite different (though formally equivalent) definition of Roelofsen's attentive semantics. In section 4 I motivate a small number of maxims, that follow a traditional recipe but operate on this richer semantics. In section 5 I show that it solves the three problems. In section 6 I discuss 'mention-some' and 'mention-all' contexts. In section 7 I conclude.

3 Attentive Semantics

I adopt Roelofsen's *attentive semantics* (2013), which builds on *inquisitive semantics* and in particular Ciardelli's *possibility semantics* (2009). In attentive semantics, sentences embody both *informative content* and *attentive content*. Roelofsen defines this semantics by modelling both informative and attentive content in a *single semantic object*, which is a set of classical propositions. This setup, while formally concise, is not ideal for the present purposes, because by looking at this single semantic object we cannot see directly what a sentence's pure attentive content is – it is masked by a veil of informative content. Let me illustrate this with an example. Let $\|\varphi\|$ denote the classical proposition expressed by φ, and let $[\![\varphi]\!]^R$ denote the semantic object that Roelofsen's attentive semantics assigns to it. In Roelofsen's semantics, we get:

(7) a. $[\![p \wedge q]\!]^R = \{\|p \wedge q\|\}$
b. $[\![p \vee q]\!]^R = \{\|p\|, \|q\|\}$

However, according to Roelofsen's *attentiveness* order, omitted here, $p \wedge q$ is *more attentive* than $p \vee q$. Thus, with regard to the order $p \wedge q$ *behaves as if* it draws attention to more possibilities than $p \vee q$. That is, $p \wedge q$ behaves as if its actual attentive content, when separated from its informative content, is the set $\{\|p\|, \|q\|, \|p \wedge q\|\}$.

To distill from a sentence's Roelofsonian meaning its pure attentive content, a separate set of rules would have to be defined that removes the informative layer. I think it is both easier and cleaner to define the attentive component separately from scratch. I will do this for a fragment of *first-order* logic, but aside from the richer language, the resulting system will be formally equivalent with Roelofsen's semantics.

Definition 1 (Informative and attentive content)**.** *For all formulae φ:*

1. *Let $\|\varphi\|$ denote the* informative content *expressed by φ, i.e., it's classical proposition, a set of first-order models.*

2. *Let $[\![\varphi]\!]$ denote the* attentive content *expressed by φ, i.e., the set of classical propositions, now called* possibilities*, that it draws attention to.*

I will omit a definition for informative content, because it is just classical first-order semantics. For clarity, I will use Roelofsen's notion of *restriction* of attentive content A to a piece of information b: $A_b = \{a \cap b \mid a \in A\}$. Attentive content is defined as follows, for the relevant fragment of first-order logic, given a suitable class of models $\mathfrak{M}$ on a domain D, and relative to an assignment function g:

Definition 2 (Attentive content)**.**
For P an n-ary predicate, $t_1 \ldots t_n$ terms, φ, ψ formulae, x a variable:

1. $[\![Pt_1 \dots t_n]\!]_g = \{\|Pt_1 \dots t_n\|_g\}$
2. $[\![\neg\varphi]\!]_g = \{\|\neg\varphi\|_g\}$
3. $[\![\varphi \vee \psi]\!]_g = [\![\varphi]\!]_g \cup [\![\psi]\!]_g$
4. $[\![\varphi \wedge \psi]\!]_g = [\![\varphi]\!]_g \cup [\![\psi]\!]_g \cup [\![\varphi]\!]_{g\|\psi\|_g} \cup [\![\psi]\!]_{g\|\varphi\|_g}$
5. $[\![\exists x\varphi]\!]_g = \bigcup_{d\in D}[\![\varphi]\!]_{g[x\mapsto d]}$

Throughout this paper I assume that the domain consists of the individuals John, Mary and Bob, denoted by j, m, and b, and *groups* composed of these individuals. Having groups in the domain is not strictly necessary for the three puzzles, but it will turn out to provide an interesting insight into the pragmatics, and it adds a touch of G&S. Without risk of confusion (for we will only see unary predicates), let us conventionally use jm to denote the group composed of John and Mary, and likewise for the other combinations. Let the unary predicate letter P denote the set of (groups of) individuals who were at the party. The example sentences relevant for the three main problems are translated as follows:

(8) Who were at the party? $[\![\exists xPx]\!] = \{\|Pj\|, \|Pm\|, \|Pb\|, \|Pjm\|, \|Pjb\|, \|Pmb\|, \|Pjmb\|\}$

a. John was there. $[\![Pj]\!] = \{\|Pj\|\}$

b. Only John was there. $[\![Pj \wedge \neg\exists x(x \neq j \wedge Px)]\!] = \{\|Pj\|, \|\neg\exists x(x \neq j \wedge Px)\|\}$

c. John was there, or John and Mary were there. $[\![Pj \vee Pjm]\!] = \{\|Pj\|, \|Pjm\|\}$

d. John was there, or John was there and Mary was there. $[\![Pj \vee (Pj \wedge Pm)]\!] = \{\|Pj\|, \|Pm\|, \|Pj \wedge Pm\|\}$

An alternative translation for the question in (8), which would also work for our purposes, is $\exists xPx \vee \neg\exists xPx$, which draws attention also to $\|\neg\exists xPx\|$. This may seem like a natural choice, because the who-question allows for a 'no one' answer. However, 'no one' is not a positive answer (as G&S likewise said about 'nowhere', p.532), and therefore I do not think the question draws attention to it. See section 6.4 for a possible explanation of why 'no one' is a good response.

To avoid confusion with Roelofsen's semantics, I should emphasize that the informative content of a sentence cannot be distilled from its attentive content. For instance, $Pj \wedge Pm$ is attentionally equivalent to $Pj \vee Pm \vee (Pj \wedge Pm)$, but informationally stronger. However, there is a way to glue informative content and attentive content together and obtain the Roelofsonian meaning of a sentence. Given a suitable generalization of Roelofsen's semantics to first-order logic, let $[\![\varphi]\!]^R$ denote again the Roelofsonian meaning, and as before let $A_b = \{a \cap b \mid a \in A\}$.

Fact 1 (Conservativeness w.r.t. Roelofsen)**.** *For all formulae φ:* $[\![\varphi]\!]^R = [\![\varphi]\!]_{\|\varphi\|}$.

Proof. By induction: Atomic formulae and negation are left to the reader.

Conjunction:
$$\begin{aligned}[\![\varphi \wedge \psi]\!]_{\|\varphi\wedge\psi\|} &= ([\![\varphi]\!] \cup [\![\psi]\!] \cup [\![\varphi]\!]_{\|\psi\|} \cup [\![\psi]\!]_{\|\varphi\|})_{\|\varphi\wedge\psi\|} \\ &= [\![\varphi]\!]_{\|\varphi\|\|\psi\|} \cup [\![\psi]\!]_{\|\psi\|\|\varphi\|} = [\![\varphi]\!]^R_{\|\psi\|} \cup [\![\psi]\!]^R_{\|\varphi\|} = [\![\varphi \wedge \psi]\!]^R\end{aligned}$$

Disjunction:
$$\begin{aligned}[\![\varphi \vee \psi]\!]_{\|\varphi\vee\psi\|} &= ([\![\varphi]\!] \cup [\![\psi]\!])_{\|\varphi\vee\psi\|} \\ &= [\![\varphi]\!]_{\|\varphi\|} \cup [\![\psi]\!]_{\|\psi\|} = [\![\varphi]\!]^R \cup [\![\psi]\!]^R = [\![\varphi \vee \psi]\!]^R\end{aligned}$$

Existential quantification analogously to disjunction. □

4 Attentive Pragmatics

4.1 The Maxims

Since we have two meaning components (informative and attentive content), there will be two sets of conversational maxims that govern it. The maxims that govern *informative* content are

very traditional:

Definition 3 (Informative maxims)**.**

1. ***I-Quality:*** *Say only that which you take to be true.*
2. ***I-Quantity 1:*** *Confirm all (sets of) relevant possibilities you can, respecting I-Quality.*
3. ***I-Quantity 2:*** *Confirm only (sets of) relevant possibilities.*

The maxim of I-Quality is taken straight from Grice (1975), as is the spirit of I-Quantity 1 and 2. In this attentive setting, the maxim of I-Quantity 1 derives from the fact that we are interested in what the world is like, and that we prefer certainty over mere possibility. If some possibility a is already relevant *as a possibility*, then pointing out that a is *actual* would be even more relevant. The same holds more generally for *sets* of possibilities. Finally, the maxim of I-Quantity 2 prohibits overinformativity, i.e., in G&S's terms it prefers *being an answer* over *giving an answer*.

One might wonder whether the rule in (9), the negative twin of I-Quantity 1, is not a maxim:

(9) *Reject* every relevant possibility you can, respecting I-Quality.

Indeed, this is assumed by Roelofsen (2013), who calls it the 'Maxim of Transparency'. However, I don't think this rule generally holds (and it shouldn't, for otherwise we would, like G&S, run into Problem I). A possibility can be relevant *as a possibility*, and thereby even more so *as an actuality*, without thereby automatically being relevant as an *impossibility*. For instance, if I want to know as many people as possible who went to the party, then telling me that Mary *didn't* go does not contribute to that goal, unless if it helps me confirm of others that they *did* go – but the latter is already sufficiently covered by I-Quantity 1 (especially by *pragmatic* compliance with this maxim, cf. section 4.3). One could object: 'But wouldn't it be good to point out that Mary didn't go? Otherwise we might be wasting time thinking about it!' Certainly, but it is even better in that case to just *not draw attention to Mary at all*, i.e., neither to the possibility that she went, nor to the possibility that she didn't go.

Of course, the fact that the rule in (9) does not *generally* hold, does not prove that it does not *typically* hold, as maxims should. I might as well have given what G&S call a *mention-some* context as an example to show that not even I-Quantity 1 holds! In section 6 I will therefore return to this issue. I will make more precise what kind of context I take to be the most typical, and how general I take the assumes maxims to be (*quite* general!). In addition, I will review Roelofsen's motivation for assuming (9) as a maxim.

As for attentive content, I assume the following maxims:

Definition 4 (Attentive maxims)**.**

1. ***A-Quality:*** *Draw attention only to possibilities compatible with your information state.*
2. ***A-Quantity 1:*** *Draw attention to every relevant possibility, respecting A-Quality.*
3. ***A-Quantity 2:*** *Draw attention only to relevant possibilities.*

Note that they follow the same recipe as the I-maxims. I think these maxims are all straightforwardly understood as aspects of rational, cooperative interaction. The maxim of A-Quality is assumed also by Roelofsen (2013), who calls it 'Attentive Sincerity'. The maxims of A-Quantity 1 and 2 together basically equate 'relevant' with 'worth drawing attention to'. In comparison, G&S's theory would equate 'relevant' with 'worth asserting or rejecting'. In what follows, I will occasionally say of a speaker, in uttering φ, leaving a possibility a *unattended*, by which I mean that a is a relevant possibility that is not contained in the attentive content expressed by φ. The 'unattended' possibilities are crucial for exhaustivity, as we shall see.

4.2 The Maxims (Formal)

The maxims do not tell us directly which possibilities, in a given context, are the relevant ones. However, we can assume that all dialogue takes place against the background of a *question under discussion* (QUD). If we assume that the maxims were observed in setting the QUD, then the maxims of A-Quantity 1 and 2 tell us that the relevant possibilities are exactly those possibilities that the QUD draws attention to. This is also how G&S circumvent (or solve) the problem of characterising relevance. Using the notion of a QUD, we can formulate the maxims more concisely:

Definition 5 (The maxims)**.** *For a cooperative speaker with information state s (set of worlds), uttering φ in response to a QUD ψ:*

1. ***I-Quality:*** $s \subseteq \|\varphi\|$
2. ***I-Quantity 1:*** *For all* $Q' \subseteq [\![\psi]\!]$*, if* $s \subseteq \bigcup Q'$*, then* $\|\varphi\| \subseteq \bigcup Q'$
3. ***I-Quantity 2:*** *For some* $Q' \subseteq [\![\psi]\!]$*,* $\|\varphi\| = \bigcup Q'$
4. ***A-Quality:*** *For all* $a \in [\![\varphi]\!]$*,* $s \cap a \neq \varnothing$
5. ***A-Quantity 1:*** *For all* $q \in [\![\psi]\!]$*, if* $s \cap q \neq \varnothing$*, then* $q \in [\![\varphi]\!]$
6. ***A-Quantity 2:*** $[\![\varphi]\!] \subseteq [\![\psi]\!]$

Note that, as far as the QUD is concerned, the maxims care only about its *attentive* content. Based on this, the I-maxims constrain the response's informative content, and the A-maxims constrain its attentive content.

4.3 Semantic and Pragmatic Compliance

An important component of G&S's theory is their distinction between *semantic* and *pragmatic* answerhood. Translating this roughly to the attentive setting: a response is a semantic answer if it complies with I-Quantity 1 and 2, and it is a pragmatic answer if this is the case relative to the hearer's information state. Consider the following example (where the question could also be translated as $Pj \vee \neg Pj$, but I don't, for the same reason as omitting 'no one' from 'who?' in (8)):

(10) Was John at the party? (Pj)

a. He was. (Pj)

b. It was raining. (R)

Response (10a) is a semantic answer, while response (10b) can only be a pragmatic answer, and only if the hearer takes herself to know that if it was raining, John was (or wasn't) at the party. To adapt G&S's distinction to the attentive setting, it must be made more general. For note that (10b), in providing a pragmatic answer, not only violates I-Quantity 1, but also A-Quantity 1: both possibilities of the question are left unattended by the response. Hence, we need to be able to speak of the response as pragmatically compliant also with A-Quantity 1.

To that end I assume that *any* of the maxims can be complied with either semantically or pragmatically, where semantic compliance is as defined above (Definition 5). To make sense of pragmatic compliance in the attentive case, I assume that the hearer's state consists of both *information* and *attentive associations*, the latter modelled as a reflexive relation on possibilities:

Definition 6 (Hearer state)**.** *The hearer's state* $\boldsymbol{h}$ *is a pair* $\langle h, \alpha \rangle$*, where* $h \subseteq \mathfrak{M}$ *a set of first-order models, and* $\alpha \subseteq \wp\mathfrak{M} \times \wp\mathfrak{M}$ *a reflexive relation.*

The attentive associations work as follows: if a hearer's attention is drawn to the possibilities in $[\![\varphi]\!]$, it is automatically drawn to the possibilities in $\alpha([\![\varphi]\!])$. Because the relation is reflexive, it can only draw attention *to*, not *away from*, possibilities (though this natural assumption is inessential for our present purposes). For now, I will not assume any other restrictions on α, the investigation of which is a work in progress (as is the investigation of whether the attentive associations can be derived, somehow, from the information state alone). For (10b) to *pragmatically comply* with the maxim of A-Quantity 1, the hearer's attentive associations α should lead her attention from the possibility that it was raining, to the possibility that John was at the party, i.e., $\|Pj\| \in \alpha([\![R]\!])$.

Using this setup, pragmatic compliance with the maxims is defined as follows:

Definition 7 (Pragmatic compliance with the maxims)**.** *A cooperative speaker with information state s (set of worlds), uttering* φ *in response to a QUD* ψ*, addressed to a hearer with state* $\mathbf{h} = \langle h, \alpha \rangle$*,* pragmatically complies *with a maxim iff, respectively:*

2. ***I-Quantity 1:*** *For all* $Q' \subseteq [\![\psi]\!]$*, if* $s \subseteq \bigcup Q'$*, then* $\|\varphi\| \cap h \subseteq \bigcup Q'$

5. ***A-Quantity 1:*** *For all* $q \in [\![\psi]\!]$*, if* $s \cap q \neq \varnothing$*, then* $q \in \alpha([\![\varphi]\!])$

With the other maxims exactly as in Definition 5.

For the other maxims pragmatic and semantic compliance amount to the same, because their violations – uttering a falsehood, giving too much information, drawing attention to an impossibility, drawing attention to an irrelevant possibility – cannot be fixed be adding information or adding attended possibilities. Note furthermore that semantic compliance with a maxim entails pragmatic compliance with a maxim, but (of course) not vice versa - pragmatic compliance is the weaker notion. Like G&S, I assume a general preference for semantic over pragmatic compliance, but I will leave this implicit.

5 How the Three Problems are Solved

So how are the three main problems solved? The crucial examples were given in (8) above, repeated here:

(8) Who were at the party? $[\![\exists x Px]\!] = \{\|Pj\|, \|Pm\|, \|Pb\|, \|Pjm\|, \|Pjb\|, \|Pmb\|, \|Pjmb\|\}$

a. John was there. $[\![Pj]\!] = \{\|Pj\|\}$

b. Only John was there. $[\![Pj \wedge \neg\exists x(x \neq j \wedge Px)]\!] = \{\|Pj\|, \|\neg\exists x(x \neq j \wedge Px)\|\}$

c. John was there, or John and Mary were there. $[\![Pj \vee Pjm]\!] = \{\|Pj\|, \|Pjm\|\}$

d. John was there, or John was there and Mary was there. $[\![Pj \vee (Pj \wedge Pm)]\!] = \{\|Pj\|, \|Pm\|, \|Pj \wedge Pm\|\}$

Problem *I*: Partitions are Too Demanding

With attentive content we can think of a question as drawing attention to its positive answers, and I used this to motivate a Maxim of Quantity that likewise asks only for positive answers. Compare (8a) and (8b), which instantiate a and a' from the first G&S quote in section 2. Although (8b) is more informative, both responses support the same subsets of the question's

possibilities (namely those containing $\|Pj\|$). Hence I-Quantity 1 doesn't have a preference, and uttering (8a) will not implicate an inability to utter (8b), so we do not run into G&S's problem. Furthermore, I-Quantity 2 now *disprefers* (8b) for being overinformative (and A-Quantity 2 for it being over*attentive*). If you were nevertheless to utter (8b), you would thereby implicate that you find the extra information, that John was alone, especially relevant.

Notice that a *pragmatic* way of complying with A/I-Quantity 1 is available for (8a), although it is dispreferred compared to the semantically compliant, exhaustive reading. Suppose there is very salient common knowledge that if John is at a party, then someone with a difficult name, say, Quasimodo, is also there, and likewise an attentive association from John being at the party to Quasimodo being there. In this case uttering (8a) may be used to convey that *both* John and Quasimodo were there, pragmatically complying with A/I-Quantity 1. In this case the preference for semantic compliance is outweighed by the risk of mispronouncing his name.

Finally, I should highlight that Problem I is solved also (or mainly) because a negative counterpart of I-Quantity 1, that asks for the *rejection* of relevant possibilities, does not hold. As announced, I will say more about this in section 6.

Problem *II*: Quantity Implicatures are Too Weak

Of course the I-Quantity 1 implicature is still too weak for exhaustivity, but with attentive content A-Quantity 1 comes into play. Response (8a) leaves many possibilities unattended, of which A-Quantity 1 requires that the speaker believes these to be false, and this yields the exhaustivity implicature. That is, exhaustivity results from a clash between A-Quantity 1 and A-Quality. In comparison, existing theories tried to explain it as a clash between I-Quantity 1 and I-Quality. Put differently, in my approach, exhaustivity is an answer to the question 'why did the speaker not say something more *attentive*?', rather than '[...] *informative*?'. The theory derives exhaustivity implicatures without requiring a contextual competence assumption, and without putting a competence requirement into the maxims: a speaker implicates exhaustivity (and thereby her own competence) because her competence dictates that she leaves certain possibilities unattended. If the speaker hadn't been competent, she should have uttered a more attentive alternative, like (8c,d), to which I turn next.

Problem *III*: Classical Semantics is Too Coarse

Attentive semantics can of course draw the relevant distinction between (8a) and (8c,d), but something peculiar is going on. The response in (8c) leaves the possibility $\|Pm\|$ unattended, just like (8a), so semantic compliance with A-Quantity 1 would dictate, for both responses alike, that the speaker believes the possibility to be false, i.e., that Mary wasn't at the party. The response in (8d) does draw attention to $\|Pm\|$, but it leaves $\|Pjm\|$ unattended, hence semantic compliance with A-Quantity 1 requires that the speaker believes that John and Mary weren't at the party. That is, the theory does not seem to predict the absense of exhaustivity witnessed in (8c,d).

Fortunately the notion of *pragmatic* compliance saves the day – plus the fact that being at a party is typically a *distributive* property. If the hearer knows that Pjm, she typically knows that Pj and Pm, and vice versa; and the attentive associations of the hearer should reflect this. The responses in (8c,d) can therefore *pragmatically* comply with the relevant maxims: through the hearer's attentive association from $\|Pjm\|$ to $\|Pm\|$, response (8c) draws attention to $\|Pm\|$, and through the association from $\|Pj \wedge Pm\|$ to $\|Pjm\|$, (8d) draws attention to $\|Pjm\|$. Hence, through pragmatic compliance and the distributivity of party attendance, it is predicted that neither (8c) nor (8d) has the exhaustivity implicature that (8a) has.

But if we cut these attentive associations, that is, if we consider a non-distributive property, the two examples behave quite differently. I assume analogous translations as for (8c,d):

(11) Who drank a whole bottle of wine yesterday? $\exists x Bx$

a. John did, or John and Mary (as a group) did. $Bj \vee Bjm$

b. John did, or John did and Mary did. $Bj \vee (Bj \wedge Bm)$

Now, because the ties between $\|Bm\|$ and $\|Bjm\|$ are cut, response (11a) even *pragmatically* does not draw attention to $\|Bm\|$, yielding the implicature that the speaker believes Mary didn't drink a whole bottle of wine. Response (11b) does not have this implicature; instead, it leaves $\|Bjm\|$ unattended, hence it implicates that John and Mary didn't, as a group, drink a whole bottle of wine, even though both of them individually did.

In sum, the distinctions that are relevant for exhaustivity can be drawn by attentive semantics. Indeed, by having *groups* of individuals in the domain (which was not strictly necessary for Problems *I* and *II*), it may seem that *too many* distinctions are drawn. However, the notion of pragmatic compliance cuts the speaker some slack in this respect, and taking distributivity into account yields the correct predictions. I am only marginally aware of the literature on distributivity, but it seems to me that the combination with exhaustivity may provide some valuable insights into both fields, and I hope to look into this further.

6 Mention-Some, Mention-All

6.1 *The* Maxims? For Which Kind of Context?

An important feature of attentive semantics, that was crucial for solving Problem *I*, is that the meaning of a question determines the set of its *positive answers*, rather than its *exhaustive answers*, as given in (2) above, repeated here.

(2) Who came to the party?

a. **Exhaustive answers**: {only John came, only Mary came, only Bill came, only John and Mary came, only John and Bill came, only Mary and Bill came, everyone came, no one came}

b. **Positive answers**: {John came, Mary came, Bill came, John and Mary came, John and Bill came, Mary and Bill came, everyone came}

Closely related to the distinction between exhaustive and positive answers is the distinction G&S draw (p.457 and beyond) between *mention-some contexts*, in which it suffices to give *some* entities with the relevant property, i.e., a positive answer, and *mention-all contexts*, which are more demanding. Mention-all contexts are thought to be the ones where exhaustivity occurs, and the most basic, while mention-some contexts are thought to witness an absense of exhaustivity. The examples of interest thus far have all been (though implicitly) mention-all cases. The following is a typical example of a mention-some context:

(12) Where can I buy an Italian newspaper?
– In the little kiosk around the corner. $\not\rightsquigarrow$ *nowhere else.*

As Groenendijk and Stokhof note (p.532), a pragmatic explanation for the absense of exhaustivity in mention-some contexts is attractive, but based on partition semantics it is hopeless: there is no way to asymmetrically obtain from a partition (2a) the set of only the positive answers (2b), and yet this would be needed for a proper notion of mention-some answerhood. Indeed,

I could have presented this as a 'Problem *IV*' from the start, but this would have too greatly increased the intended scope of this paper, and would have promised too much of a solution. Nevertheless, the present shift to attentive semantics invites a brief look at this puzzle.

The problem is particularly interesting because it raises the issue of *how general* the maxims are that I have assumed, and for which kind of context they are defined. For if exhaustivity is truly absent in (12), this must mean that the maxims of A/I-Quantity 1 are inactive, or at least significantly weakened, in that context. And if maxims can be switched off so easily, then my argument in section 4 against assuming the rule in (9) as a maxim (to reject as many possibilities as possible) is rather weak: all I have shown is that there exists a context in which the rule doesn't hold. Addressing this concern is the main aim of the next subsections. In section 6.2 I explore two accounts of mention-some contexts, one of which does *not* compromise the generality of the maxims of A/I-Quantity 1. In section 6.3 I look more closely at mention-all contexts, and distinguish two kinds. In section 6.4 I revisit Roelofsen's (2013) motivation for adopting rule (9) as a maxim.

6.2 A Pragmatic and a Semantic Account of Mention-Some

Following G&S, I will discuss a *pragmatic* approach, that explains mention-some contexts in terms of the pragmatic question-answer relation, and a *semantic* approach, that reduces mention-some contexts to the semantics of the question. The latter may seem impossible, for questions already draw attention only to their positive answers, so how could they be made even weaker? The future looks much brighter for a pragmatic account, that could run as follows:

(13) **A pragmatic account:** In a mention-some context, the maxims of A-Quantity 1 and I-Quantity 1 are deactivated, or at least significantly weakened.

For instance, in a mention-some context, the maxims could be replaced by the following:

(14) a. **Weak I-Quantity 1**: Confirm *some* relevant possibilities, respecting I-Quality.
b. **Weak A-Quantity 1**: Draw attention to *some* relevant possibilities, respecting A-Quality.

It is easy to see that an account along these lines would predict that exhaustivity can be absent in cases like (12). Of course, an additional pragmatic story is required to explain how dialogue participants know which maxims, weak or strong, are being observed; but, as G&S note, a story to disambiguate the context or the question will be required by *any* account of the phenomenon.

Although simple and intuitive, I feel some resistance toward this pragmatic approach. The original Gricean Maxim of Quantity asks of a speaker that she is just as informative as required for the current purposes of the exchange. One of the merits of G&S's account is that this informal description is replaced by a formal account of what it means to resolve a question under discussion. They reduce the context-dependence of the Maxim of Quantity to a single, well-understood parameter, the question under discussion. Yet the above pragmatic account compromises this clear picture, by effectively building an informal escape hatch into an otherwise perfectly formal maxim. Of course, it would be naive to think that all pragmatic reasoning can be captured in unnegotiable rules, but surely having *some* unnegotiable rules would facilitate conversation?

There are other reasons not to be too welcoming to the pragmatic account sketched above, pertaining to our intuitive understanding of the phenomenon. First of all, our intuitions may unknowingly be based at least in part on intonational differences: the response in (12) is particularly natural with an intonation contour with a rising pitch towards the end. This contour,

indicated below by '↗', cancels exhaustivity in *any* context, regardless of how demanding the questioner is:

(15) Give me all the places in a 10 mile radius where I can buy an Italian newspaper.
  a. The kiosk around the corner.↗ $\not\rightsquigarrow$ *nowhere else.*
  b. The kiosk↗, the gas station↗, the mall↗, ... $\not\rightsquigarrow$ *nowhere else.*

Elsewhere I have argued that the rising pitch marks the violation of a maxim (Westera, 2013a); perhaps A-Quantity 1 in (15a) ('I have not attended to all possibilities I consider possible'), and I-Quantity 1 in (15a) ('I have not confirmed all possibilities I know to be true'). Of course, for a maxim to be violated, it must be active, which means that the pragmatic account sketched above is, at least for the case of *rising* mention-some answers, both unnecessary and wrong.

Secondly, it is not at all clear to me that exhaustivity is indeed absent when the response is pronounced with a final *fall*. If the response in (12) is pronounced thusly, it seems to me that, had there been a place where they sold Italian newspapers that was closer by, the responder should have said so. In other words, it seems to me that the response in fact implicates exhaustivity as usual, but only *relative to an implicitly restricted domain*:

(16) Where can I buy an Italian newspaper?
  - In the little kiosk. $\rightsquigarrow$ *nowhere else that is nearby, is easier to direct you to, etc.*

If this observation is correct, it suggests a *semantic* account of mention-some contexts, based on implicit domain restriction, along the following lines:

(17) **A semantic account:** In a mention-some context, the domain over which the wh-phrase in the question ranges is restricted to the set of *nearby places easiest to direct someone to*, or something in this vein.

Given that implicit domain restrictions are independently necessary, this makes for quite a minimal explanation of the mention-some phenomenon. Note that this account is 'semantic' only to the extent that implicit domain restrictions enter into the meaning of the question (and not everyone believes they do, for an overview see Stanley & Szabó, 2000). But in any case, implicit domain restrictions are, indeed, *implicit*, and must be figured out through pragmatic reasoning.

An immediate prediction of the semantic approach outlined here is that when the places in the domain are made *explicit*, exhaustivity with respect to those places obtains as usual (provided the response is pronounced with a final falling pitch), i.e., there are no mention-some questions with a fully explicit domain:

(18) Among the kiosk, the gas station and the mall, where can I buy an Italian newspaper?
  - In the kiosk. $\rightsquigarrow$ *Not the gas station; not the mall.*

Even if this observation is correct, there are probably ways to account for it within the pragmatic account sketched in (13) – though I cannot think of a way that is not *ad hoc*. A more detailed survey of examples like these goes beyond the scope of this paper. In addition, G&S identify many arguments in favour and against both their semantic and their pragmatic approach, that should be re-evaluated in the new, attentive setting. I think what I called the 'semantic' approach, which really belongs to semantics only marginally, may be a promising middle way. For now, let the take-home message be that the future looks bright for an account of mention-some contexts based on attentive semantics, with the important note that mention-some contexts need not compromise the generality of the maxims of A/I-Quantity 1, however appealing the pragmatic account that *does*.

6.3 Two Kinds of Mention-All Contexts

G&S take mention-all contexts to ask for an exhaustive answer, i.e., an answer that mentions for all relevant entities whether they have the relevant property or not (e.g., p.530). However, I think we should distinguish between *two kinds* of mention-all contexts: contexts that (as G&S would have it) ask for an exhaustive answer, and contexts that merely ask one to give as many entities with the relevant property as possible. I will call the former mention-all$_X$ (for *eXhaustive* answers), and the latter mention-all$_P$ (for *Positive* answers). In a nutshell:

- **Mention-some**: I want to know some x that are P. (though see above)
- **Mention-all$_P$**: I want to know all x that are P.
- **Mention-all$_X$**: I want to know for all x whether they are P or not.

The difference between mention-all$_P$ and mention-all$_X$ may seem subtle; even G&S themselves remark, in a more informal passage on mention-all$_X$ contexts, that 'the informant is invited to mention all places in Amsterdam where Italian newspapers are sold' (p.458), which actually describes a mention-all$_P$ context. The difference is in fact quite striking. Suppose the domain is known to me. Then, in a mention-all$_X$ context, when my request is fully resolved, I *know* that it is fully resolved; for it is fully resolved only if I know of every x whether it is P or not, and when I do I will *know* I do, because I know the domain. In a mention-all$_P$ context, however, even if my request is fully resolved, I may not be aware of it; i.e., even if I know all x that are P, I may not know that these are indeed *all* the x that are P. This reflects that fact that, in a mention-all$_P$ context, unlike a mention-all$_X$ context, I am simply *not interested* in knowing what the maximal set is of x that are P; I am merely interested in knowing as many x that are P as possible - indeed, *all* x, if possible.

It is a pity that the literature has ignored mostly (or entirely) the mention-all$_P$ context, because I think this is where everyday conversation typically takes place. Looking back on section 4, it is for the mention-all$_P$ context that I have defined the maxims, and for which I have argued that the rule in (9), repeated below, does not hold:

(9) *Reject* every relevant possibility you can, respecting I-Quality.

Repeating the argument from section 4 in the new terminology: the rule in (9) doesn't hold in Mention-all$_P$ contexts, but only in Mention-all$_X$ contexts. To strengthen it, I will add two remarks. First, I *really* think mention-all$_P$ contexts are more natural than mention-all$_X$ contexts, and, at the risk of being circular, I think the occurrence of exhaustivity implicatures is testimony to that. Secondly, the fact that rule (9) holds in mention-all$_X$ contexts doesn't mean that it needs to hold in those contexts *as a maxim*. For it seems to me that a speaker in a mention-all$_X$ context would and should phrase her question differently, not as (19a), but as (19b) or even (19c):

(19) a. Who were at the party?
b. Who were and who weren't at the party?
c. Please tell me for everyone whether they were or weren't at the party.

And since (19b) and (19c) *semantically* ask for an exhaustive answer, i.e., they are partitions, so too will the maxims of A/I-Quantity 1. Hence, even a mention-all$_X$ context does not license the rule in (9) as a separate maxim. Furthermore, note that in response to (19b), a constituent answer will be *semantically* exhaustive. It is less clear to me what happens with a semantically non-exhaustive sentential answer ('John, Mary and Bob were there') in response to (19b) or

(19c). Both G&S's theory and mine predict that no exhaustivity would arise (cf. Problem *I*). However, the relevant examples are all cases of incongruent focus, which may lead to the accommodation of a different question relative to which exhaustivity is computed. And focus is a different topic altogether.

6.4 Roelofsen's Maxim of Transparency

As mentioned in section 4, Roelofsen (2013) does adopt the rule in (9) as a maxim, which he calls the 'Maxim of Transparency'. He invokes this maxim to account for the observation that 'might'-sentences, which he assumes have a purely attentive contribution, seem to demand explicit disagreement (cf. Veltman, 1996):

(20) John might be in London.
– No. [mandatory if responder knows John is *not* in London]

Since I have argued at length against having rule (9) as a maxim, I owe the reader at least a hint at an alternative explanation for this observation. Of course, (20) may be taken to suggest (assuming that the maxim *doesn't* hold) that a purely attentive approach of 'might' is too limited. However, I think that even within Roelofsen's approach there is some room to manoeuvre, and that some manoeuvering of the sort needs to be done anyway: the response in (21) is likewise quite unexpected under the present assumptions.

(21) Who was at the party?
– No one. [mandatory if responder knows no one was there]

The question draws attention only to positive possibilities, hence the negative 'no one' possibility is irrelevant. So why did the responder utter it? Well, what else could the responder have uttered? If none of the relevant possibilities are compatible with the responder's information state, the only things she *could* have uttered would have been (i) a tautology, or (ii) the negative response 'no one', at the cost of violating I/A-Quantity 2. Of these, the second may be the better choice for independent reasons (such as: how does one even express a tautology in natural language, let alone without drawing attention to irrelevant possibilities?). Likewise for the case of 'might': the only alternative response in (20) would have been a tautology.

The foregoing is just a sketch of one of many plausible pragmatic explanations that I can think of, and that do not require the rule in (9) as a maxim. And the same explanation need not hold for (20) and (21); after all, in the latter we have both interrogative syntax and (typically) rising intonation to worry about. Exploring the possible explanations more thoroughly is left to future work.

7 Conclusion

I have shown how three major problems, identified by G&S, can be solved by adopting Roelofsen's (2013) notion of meaning, which embodies both informative and attentive content. The pragmatic thrust of attentive content turns out to be the essential ingredient for exhaustivity. The crucial maxim is A-Quantity 1 ('draw attention to all relevant possibilities') and it's clash with A-Quality ('only draw attention to live possibilities'), replacing the informational Quantity/Quality clash found in all existing pragmatic accounts of exhaustivity, and eliminating the problematic need for a competence assumption. I believe the theory I have advanced, despite its open ends, is the first account of exhaustivity that explains it from start to end as a genuine conversational implicature.

Compared to (Roelofsen, 2013), I have advanced a separate definition of pure attentive content, which enabled a cleaner semantic and pragmatic division of labour, and I have taken first steps toward a first-order attentive semantics. Defining and investigating an attentive semantics for a richer logical language is high on mine and Roelofsen's wish list, and we hope to undertake this in the near future. Compared to my previous work on exhaustivity (Westera, 2012, 2013b), the main innovation is a cleaner division of labour between *informative maxims* and *attentive maxims*, and between *semantic compliance* and *pragmatic compliance*. Roughly, my Maxim of Relation in (2013b) corresponds in the present theory to pragmatic compliance with the attentive maxim of A-Quantity 1. Altogether, the new setup has revealed more clearly, I hope, how my approach overcomes the three problems. Another innovation, taken from G&S, was to explore the pragmatic repercussions of a simple treatment of plurals, which, combined with the notion of pragmatic compliance, turned out to be more interesting than I had expected. Generalizing G&S's notion of pragmatic answerhood to the attentive setting required a new conception of the hearer's state as including a set of *attentive associations*. Although I find this notion intuitive, and it does what it's supposed to do, I have not studied its role in any detail. Finally, I have pointed out some new ways to make sense of the mention-some/mention-all distinction. In particular, I think an account of mention-some in terms of implicit domain restriction is worth pursuing.

It seems to me that G&S's own arguments could have decided the exhaustivity (and perhaps mention-some) debate in favour of a non-partitioned semantics for interrogatives long before I was born – but there was always the doubt whether Grice could do it. Nevertheless, I would be highly surprised if the semantic notion of complete, exhaustive answerhood embodied in partitions turned out not to play a role at all in natural language semantics and pragmatics. Let's not look for that One True Notion of Meaning, for it would lock each natural language expression into its own partition cell.

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