Only: Meaning and implicatures

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1 Introduction

The issue of how to account for the interpretation of 'only' has always been exciting and challenging. Over the years many sophisticated proposals have been brought forward, but 'only' always managed to strike back by exposing another new and strange property. In this paper we will argue that there is a way to approach the meaning of 'only' that can deal with some of its well-known challenges but still is faithful to classical ideas.

In section 2 we will start our discussion by introducing the traditional and predominant view on the meaning of 'only' – we will call it the *focus alternative approach*. The main aim of the section will be to argue that this is not the right way to account for the meaning of 'only'. In section 3 we will then introduce a different approach, proposed by von Stechow (1991) – the *background alternatives approach*. We will develop a formalization of the latter analysis making use of minimal models and show that there is a close relation between the two contrasting approaches. But even though both approaches share the same driving idea, the background alternatives approach is better capable to deal with the challenges of the meaning of 'only'. The rest of the paper will support this claim by showing that the approach can account for well-known problems of focus alternative proposals.

Of course, we cannot discuss all the puzzles of the meaning of 'only' in one paper. We have, therefore, decided to concentrate on two well-known problems that concern pragmatic properties of 'only'. A closer discussion of the many semantic issues 'only' raises has to wait for another occasion. In section 4 we will deal with the question what part of the meaning of 'only' belongs to its semantics and what part has to be attributed to pragmatic considerations. The next section deals with the relevance dependence of 'only'. Finally, in section 6 we will argue that we should account for the inference from 'Only ϕ' to ϕ as a conversational implicature. This part strongly builds on a proposal made in Schulz (to appear) and van Rooij & Schulz (2004). We will see that this Gricean

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explanation allows us to solve a well-known problem posed by Atlas (1991, 1993) for any pragmatic account of the inference ϕ from 'only ϕ'.[1] Section 7 ends with the conclusions.

2 The focus alternative approach

Intuitively, it seems to be quite clear what 'only' contributes to the meaning[2] of a sentence like, for instance, (1).[3]

(1) John only introduced $[\text{Mary}]_{\mathcal{F}}$ to Sue.

With this sentence we often communicate that, except for Mary, John introduced nobody to Sue. Thus, (1) tells us something, first, about who John has not introduced to Sue – namely everybody besides Mary, and second, about whom John *did* introduce to Sue – namely Mary. Let us introduce some terminology and call the first part of the meaning of (1) we have just distinguished the negative contribution and the second part the positive contribution of 'only'-modified sentences.

Countless proposals how to capture this intuition have been brought forward since the nineteen-sixties.[4] One of the most influential is what we will call the *focus alternative approach*. It has been defended, for instance, in the influential work of Horn (1969) and Rooth (1985, 1992, 1996). According to proposals along the lines of this approach the positive contribution of 'only' can be captured simply by claiming that the proposition in the scope of 'only' is true. The negative contribution is described as the statement that the elements of a set of alternative proposition that differ from the proposition in the scope of 'only' only with respect to the focus value are false.

We want to describe this approach somewhat more formally. To simplify things a bit, throughout this paper we will always take 'only' to denote an operator working on structured propositions $\langle F, B\rangle$ (and possibly other arguments), where F is the semantic meaning of the focus marked constituent and B the semantic meaning of the rest of the sentence (without 'only').[5] Let $Alt(\langle F, B\rangle)$ be the set $\{|\langle F', B\rangle| \ : \ F'$ is type-identical to $F\}$, where the function $|\cdot|$ maps structured propositions on the proposition one obtains by combining its parts. Then according to the focus alternative approach the meaning of 'only' can be described as the following function.

$$only_R(\langle F, B\rangle, A) \quad = \quad \{w \in |\langle F, B\rangle| \ : \ \forall p \in A(p \neq |\langle F, B\rangle| \rightarrow w \notin p)\}.$$

[1] He observes that this inference can only be weakened but not truly cancelled.

[2] If we speak of the 'meaning' of a sentence we refer to the information conveyed by the utterance of this sentence in a particular context. If only the *semantic* meaning is meant this will be made clear explicitly.

[3] We assume that a focus feature can be attached to constituents of a sentence. How this feature is expressed in English will be not discussed in this work.

[4] But see Horn (1996) for discussion of some proposals made already by medieval monks.

[5] Not all of the approaches we will discuss in this paper do assume that 'only' operates on structured propositions. However, this has no influence on the claims we will make.

To give an example for the working of this approach, let us assume, following Rooth (1985), that proper names are of type e and allow as meaning of expressions of this type only rigid individual concepts. Then the alternatives Alt_R of sentence (1) will look as follows ($D_{\langle s,e\rangle,M}$ is the set of rigid individual concepts in model M and $[\alpha]$ denotes the semantic meaning of α).

$$Alt_R(1) = \{\lambda w.[\text{John introduced to Sue}](w)(d(w)) \ : \ d \in D_{\langle s,e\rangle,M}\}.$$

If one applies $only_R$ to (1) taking A to be $Alt_R(1)$ then, indeed, this approach does account for the intuitive interpretation (1) described above.

It is not difficult to see that one of the major challenges of this approach is to define proper restrictions on the set A. Not any member of $Alt(\langle F, B\rangle)$ that differs from $\langle F, B\rangle$ should be claimed to be false by a sentence 'Only F B'. Look, for instance, at (2).

(2) John only introduced [Bill and Mary]$_{\mathcal{F}}$ to Sue.

To account for plurals it has been argued that there is a reading of 'Bill and Mary' taking it to denote a group object consisting of the individuals Bill and Mary. In this case the NP would be type identical to a proper name. $Alt_R(2)$ would be defined as $Alt_R(1)$, with the difference that the individual concepts in $D_{\langle s,e\rangle,M}$ can select plural objects as well. If A is now taken to contain the propositions that John introduced Bill to Sue and that John introduced Mary to Sue – that are both elements of $Alt_R(2)$ – we obtain the wrong prediction that (2) denotes the absurd proposition. More generally, $only_R$ fails as soon as there are propositions among the alternatives in A that are properly entailed by $|\langle F, B\rangle|$.

The aim of this section is to show that the proposals made to provide the necessary restrictions on possible choices for A all suffer serious shortcomings. As we see it, the reason for these problems is that there is something substantial wrong with the idea underlying the focus alternative approach. 'Only' is not about excluding focus alternatives. In the next section we will then introduce a different approach that works over background alternatives instead.

But let us start with a discussion of the proposals made in the literature for how to restrict the focus alternatives. Already Rooth was aware of the necessity to provide such restrictions. He (1985, 1992) proposed that A is a contextually given variable that is normally not resolved to the entire set $Alt_R(\langle F, B\rangle)$. But this is not a convincing way to solve the problem outlined above. How can the way we resolve a contextual given variable systematically exclude interpretations with certain logical properties? Even though it may be that A is a contextually determined subset of $Alt_R(\langle F, B\rangle)$ there have to be additional restrictions on proper antecedents for this variable.

In his paper from 1993, Krifka imposes the following additional requirement on the set A[6]: A has to be a subset of $Alt_K(\langle F, B\rangle) = \{|\langle F', B\rangle| \ : \ F'$ is of the same type as F and $F \not\subseteq F'\}$. If we build this requirement directly into the definition of the meaning of

[6]Actually, Krifka formulates more requirements A has to fulfill. We will come back to them in a minute.

'only' we obtain the following description of this operation.

$$only_K(\langle F, B\rangle, A) = \{w \in |\langle F, B\rangle| \ : \ \forall|\langle F', B\rangle| \in A \ (F \not\subseteq F' \to w \notin |\langle F', B\rangle|)\},$$
$$\text{where } A \subseteq Alt_R(\langle F, B\rangle).$$

Unfortunately, it turns out that this restriction is not sufficient to deal with examples like (2). If $b \oplus m$ is the group object consisting of Bill, b, and Mary, m, then 'Bill and Mary' denotes the generalized quantifier $\lambda w\lambda X.X(b \oplus m)(w)$ in its intended reading. Of course, for the generalized quantifier [Bill] $= \lambda w\lambda X.X(b)(w)$ we have [Bill and Mary] $\not\subseteq$ [Bill]. Thus, by applying Krifka's approach to example (2) we still predict that [(2)] implies that John did not introduce Bill to Sue, and, in general, that the sentence is interpreted as the absurd proposition.

Closely related to this account for the meaning of 'only' is a proposal brought forward by Schwarzschild (1994). He imposes the same restriction Krifka uses, but now not on the focus value and its alternatives, but on the propositions they give raise to when combined with the background. In consequence, his interpretation rule for 'only' claims that the alternative statements for which 'only' concludes that they are false are restricted to propositions that are not entailed by the proposition in the scope of 'only'.[7]

$$only_S(\langle F, B\rangle, A) \ = \ \{w \in |\langle F, B\rangle| \ : \ \forall|\langle F', B\rangle| \in A \ (|\langle F, B\rangle| \not\subseteq |\langle F', B\rangle| \to w \notin |\langle F', B\rangle|)\},$$
$$\text{where } A \subseteq Alt_R(\langle F, B\rangle).$$

It is obvious, that $only_S$ will not be subject to the problem we have discussed for the focus alternative approach. The proposition that John introduced Bill and Mary to Sue implies that John introduced Bill to Sue, simply in virtue of the distributivity of a predicate like 'introduce', which is standardly guaranteed in terms of meaning postulates. Therefore, $only_S$ applied to (2) does not conclude that John did not introduce Bill to Sue.

But also this proposal has been criticized (see, for instance, Kadmon, 2001). In particular, it has been argued that $only_S$ is still too strong. The argument runs as follows. Consider (3), adapted from Kratzer (1989).

(3) Paula only painted [a still-life]$_{\mathcal{F}}$.

Among the alternatives to 'Paula painted [a still-life]$_{\mathcal{F}}$' there is also the proposition expressed by the sentence 'Paula painted apples'. This sentence is not entailed by 'Paula painted a still-life', and, therefore, when $only_S$ is applied, (3) implies that Paula did not paint apples. This is obviously a wrong prediction. The still-life may very well have contained apples.[8]

There are also other problems the approach of Schwarzschild (1994) has to face. Consider, for instance, cases where the NP in focus denotes an upward monotone generalized

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[7] In Krifka (1995) you find a closely related but slightly weaker proposal (although it is not really used for the analysis of 'only' there): $only^*_K(\langle F, B\rangle, A) = \{w \in |\langle F, B\rangle| \ : \ \forall|\langle F', B\rangle| \in A \ ([\langle F', B\rangle] \not\subset |\langle F, B\rangle| \to w \notin |\langle F', B\rangle|\}$. $only^*_K$ is equivalent to $only_S$ iff A is closed under conjunction.

[8] Kratzer's (1989) solution to this problem involves her notion of *lumping*, a world-dependent entailment relation.

quantifier without a unique minimal element – lets call such generalized quantifiers *indefinite*.

(4) a. John only introduced [Bill or Mary]$_{\mathcal{F}}$ to Sue.

b. John only ate [an apple]$_{\mathcal{F}}$.

With focus constituents of the type of generalized quantifiers (from now on GQs) it is even more obvious that one needs restrictions on the set of alternatives than it was for the examples we have discussed so far. Consider, for instance, the consequences it would have if [no student] was an admissible alternative to [Bill or Mary] in example (4a). It would mean that from (4a) it followed that John introduced a student to Sue. At first one may think that a restriction of the alternative focus values to upward monotone GQs solves the problem in this case, but one still has to deal with 'bad' alternatives. For instance, for (4a) we would predict that the propositions stating that John introduced Bill to Sue and that John introduced Mary to Sue can be elements of A (the GQs [Bill] and [Mary] are upward monotone). They are not entailed by this sentence and thus, by $only_S$ concluded to be false. But that means that (4a) is predicted to denote the absurd proposition.

Let us try to get some grip on what is the point here. Assume that we have a sentence of the form 'only $[Q]_{\mathcal{F}}$ B' where Q is an indefinite GQ. The problem is that for every world w where $Q(w)(B(w))$ is true we can find an upward monotone GQ Q' such that $Q'(w)(B(w))$ holds but $\lambda v.Q(v)(B(v)) \not\subseteq \lambda v.Q'(v)(B(v))$. We simply construct Q' as denoting in every world the set of sets containing $B(w)$. Then the claim $\lambda v.Q(v)(B(v)) \not\subseteq \lambda v.Q'(v)(B(v))$ follows as soon as we assume that there are some worlds v such that $Q(v)(B(v))$ is true and $B(w) \not\subseteq B(v)$. In consequence, the rule $only_S$ predicts that 'only $[Q]_{\mathcal{F}}$ B' denotes the absurd proposition.[9]

It seems that Krifka (1993) was aware of this problem and that this has driven him to impose an additional restrictions on the alternatives that are excluded by 'only'. He demands that the alternatives of indefinite generalized quantifiers are indefinite themselves. But while this seems to provide a way out for (4a), the problem is immediately back if we extend the disjunct a bit, as in (5). Now the alternative propositions 'John introduced Bill or Mary to Sue' and 'John introduced Mary or Peter to Sue' will be responsible for the prediction that (5) denotes the absurd proposition.

(5) John introduced [Bill, Mary, or Peter]$_{\mathcal{F}}$ to Sue.

There is another move in the paper of Krifka that seems to provide an escape route. Krifka (1993) distinguishes two readings for (4b). According to the first reading John ate only an apple and nothing more substantial. The second reading states that there is an

[9] So far we have implicitly considered only rigid GQs. Actually, the problem we just discussed can be observed also for upward monotone GQs with unique minimal element if you assume that they (or their alternatives) are not rigid. For instance, if 'Mary' denotes in one world the set of sets containing individual a and in some other word the set of sets contain the individual b, then $only_S$ predicts (1) to denote the absurd proposition. See also the related discussion at the end of this section.

apple x which John ate, and John did not eat anything else besides x. For the second reading Krifka proposes a different underlying structure: the indefinite NP has wide scope over 'only' and the focus marking is attached to the variable left behind: $\exists x : apple(x) \wedge only(ate(John, x_{\mathcal{F}}))$. Let us assume that the alternative set for variables is the same as Rooth (1992) proposes for proper names, namely the set of rigid individual concepts.[10] The application of $only_S$ yields in this case $\exists x : apple(x) \wedge \forall i \in D_{\langle s,e\rangle,M}[ate(John, x) \not\subseteq ate(John, i) \rightarrow \neg ate(John, i)]$. This interpretation does not give rise to the problem observed above. Other problems remain, however. For instance, one had to explain why indefinite quantifiers always take wide scope with respect to 'only'.[11] Furthermore, to be able to treat an example like (4a), we have to assume that also the disjunction can scope over 'only', i.e. the structure of this sentence can look as follows: $\exists x : (x = b \vee x = m) \wedge only(introduce(j, x_{\mathcal{F}}, s))$. Another problem of this solution is that it does not extend to focus constituents of other types than NPs, while the problem discussed above does seem to generalize. For instance, if we adopt the material implication interpretation of conditionals, then the interpretation rule $only_S$ wrongly predicts that sentences of the kind 'Only if $[\mathrm{A}]_{\mathcal{F}}$, then C' denote the absurd proposition, because for every world w where 'If A then C' is true we can find a proposition A' such that $(A \rightarrow C) \not\subseteq (A' \rightarrow C)$ and $w \in (A' \rightarrow C)$.[12] The solution Krifka (1993) proposed for (4a)-(4b), however, is not available here.

Furthermore, even if we ignore these complications, there is a certain problem the approach inherits from Rooth's proposal. Although this problem is independent of the type of the constituent in focus, let us discuss the example (4b) at hand. The analysis proposed by Krifka works only if one assumes the alternatives of the focussed variable to be *rigid* individual concepts. Rooth (1985) explicitly makes this assumption for the focus value of expressions of type e. Krifka has to follow Rooth here. For suppose that we would allow for arbitrary individual concepts c that propositions of the form $\lambda w.ate(John, c)(w)$ are among Alt('John ate an apple'). Let us take a world w where John ate nothing besides a certain object α which is an apple in w. In such a world (4b) should come out as true. Furthermore, we assume, that the individual concept c – let us think of c as the apple you plucked yesterday – denotes α in w. There are other worlds were this does not hold, because you ate the apple yourself. Then, the proposition $ate(John, c)$ will be true in w but not identical to the proposition that John ate object α. But then (4b) would come out as false in w, because there is a alternative that is true in w but not entailed by the proposition that John ate object α. More generally, all approaches to the meaning of 'only' we have discussed so far have to make the assumption that all alternatives to the focus denotation F have the same extension as F in all worlds or in no world. The question is how we can motivate this necessary restriction on alternatives.[13]

[10] Krifka (1993) is not particularly clear on this point. He says that we should treat variables as names. However, he treats names as generalized quantifiers.

[11] A possible explanation could be that otherwise the sentence would denote the absurd proposition and pragmatic considerations exclude such an interpretation.

[12] See von Fintel (1997) for more discussion.

[13] Krifka's proposal, however, to take the element in focus to be a variable left when moving the NP above 'only', is not necessary subject to this criticism. We said in footnote 8 that Krifka is not explicit

So far we have seen that none of the proposed restrictions on the focus alternatives that are excluded by 'only' lead to convincing results. As we see it, this is due to a general misunderstanding of the working of 'only' by the focus alternative approach. Proper restrictions on focus alternatives cannot be given because 'only' simply does not operate on focus alternatives.

Let us take a step backward and ask ourselves what makes the focus alternative approach intuitively so attractive. It is its closeness to the intuitive meaning of a sentence like (1): it implies that for all other individuals besides Mary John did not introduce them to Sue. The problem is that 'other individuals besides Mary' cannot in general be translated into focus alternatives. But how can we then capture this intuitive meaning? We can reformulate the claim that John introduced nobody besides Mary to Sue also as the statement that the set of people that John introduced to Sue is the smallest set containing Mary. But 'the set of people that John introduced to Sue' is nothing else than what is denoted by the background of (1). So, why not try this: while we may no be able to systematically translate 'other individuals besides Mary' into focus alternatives, we can systematically translate 'the set of people John introduced to Sue' into background alternatives. The function of 'only' could then be described as selecting minimal elements among these background alternatives such that still the proposition in the scope of 'only' is true. This is the fundamental idea behind the approach introduced in the next section.

3 A background alternative approach

Assume that the extension of the background is of type $\langle f, t\rangle$ (thus, the background denotes a property of objects of type f). In consequence, the focus extension is either of type f or of type $\langle\langle f, t\rangle, t\rangle$ – let us assume, without loss of generality, that the second is the case. A quite direct formalization of the informal description of the meaning of 'only' we ended up with in the last section is this:

$$only_{vSt}(\langle F, B\rangle) = \{w \in W \ : \ F(w)(B(w)) \ \& \ \neg\exists B' \subseteq D_{f,M}(F(w)(B') \ \& \ B' \subset B(w))\}.$$

$only_{vSt}$ claims that for each world w the extension of the background property, $B(w)$, is a minimal element of the extension of the focus, $[F](w)$. For example (1), for instance, F = [Mary] denotes in w a generalized quantifier of type $\langle\langle e, t\rangle, t\rangle$ and B = [John introduced to Sue] a predicate of type $\langle e, t\rangle$. According to this approach to 'only' (1) is predicted to be true in w if $B(w)$ is a smallest element of $[Mary](w) = \{B' \subseteq$

about what the alternatives are for variables. We assumed what appeared to us most straightforward and treated them as Rooth treats proper names. But according to most theories of formal semantics variables are of type e, i.e. denote individuals and not individual concepts. We might propose that therefore also their alternatives have to be of this type. Under this assumption the problem discussed above disappears. But notice, that this change would not solve the other problems of Krifka's (1993) proposal discussed above.

$D_{e,W}$: $\{mary\} \subseteq B'\}$, i.e., if $B(w) = \{mary\}$. Thus, it is predicted for (1) that John introduced Mary to Sue and nobody besides Mary.[14]

In contrast to focus alternative approaches $only_{vSt}$ does not make use of focus alternatives but quantifies over alternative background extensions. We will call such accounts for the meaning of 'only' *background alternative approaches*. If you take F to be a term answer to a question with question predicate B, then this rule for the interpretation of 'only' is what Groenendijk & Stokhof (1984) have proposed to describe the exhaustive interpretation of this answer. Von Stechow (1991) was the first to adapt their approach in this way to a semantic rule for 'only'.

In an earlier paper (van Rooij & Schulz, to appear) we have proposed a slightly altered description of exhaustive interpretation than what has been proposed by Groenendijk & Stokhof. This was motivated by certain false predictions of their approach. For instance, by quantifying over all possible extensions for the background (or question-predicate) meaning postulates for these properties cannot be respected.[15] Because these problems arise with $only_{vSt}$ as well – consider for instance example (3) – , we propose as a starting point a parallel altered version for the interpretation of 'only'. This interpretation makes essential use of the model with respect to which we interpret expressions. Therefore, we have to be a little bit more precise on our notion of model. We take a model M to fix a set of objects W_M, which we call worlds, a set D_M of individuals, and an interpretation function $[\cdot]^M$ for the non-logical vocabulary. The formal definition of $\text{ONLY}(\langle F, B\rangle)$ will make use of the ordering relation '$<_B$' between the worlds W_M of a model M. We say that $v <_B w$ iff v is exactly like w except that the extension of B in v is smaller than in w: $B(v) \subset B(w)$.

Definition 1 *(The meaning of 'only' - the basic case)*
Let ψ be a sentence of the form 'only ϕ' where F is the semantic meaning of the focus in ϕ and B the semantic meaning of its background. We define the meaning $\text{ONLY}(\langle F, B\rangle)$ *of ψ as the following proposition:*

$$\text{ONLY}^M(\langle F, B\rangle) = \{w \in W_M \ : \ F(w)(B(w)) \ \& \ \neg\exists v \in W_M(F(v)(B(v)) \ \& \ v <_B w)\}.$$

In contrast with $only_{vSt}$, the function ONLY does not select minimal extensions for B among all possible semantic objects having the same type as B, but only among those objects that are adopted by B as extension in some world of model M. Still, both approaches to the meaning of 'only' are closely related. As explained in van Rooij & Schulz (to appear), if the background predicate does not occur in the focus and we assume that W_M is the set of all possible worlds/models, then $only_{vSt}$ gives rise to the same predictions as ONLY^M.[16]

[14] For expository reasons we treat here proper names as denoting rigid GQs. In contrast to the proposals discussed in the last section this assumption can be dropped for the background alternative approach.

[15] For more details see van Rooij & Schulz (to appear).

[16] Nevertheless, as we will see later on, the new version has a lot of conceptual advantages over $only_{vSt}$.

In this and the previous section we have contrasted two conceptually different semantic analyses of 'only': one where we quantify over *focus*-alternatives, and one where the quantifier ranges over *background*-alternatives. In the end, in definition 1, we implemented the latter approach by quantifying over alternative worlds. It is interesting to note that the minimal model analysis can also be reformulated as involving a set of alternative propositions. In this reformulation it looks more like the versions we discussed in section 2, like $only_S$. Let us define a function *Alt* mapping sentences ϕ with background predicate B on the set of propositions that claim certain objects to have the background property. Thus if the extension of the background of ϕ is of type $\langle f, t\rangle$, then $Alt^M(\phi) = \{B(j) \, : \, j \in D_{f,M}\}$. For example (1) this comes down to the same set of alternatives Rooth proposed, namely the set of propositions claiming that John introduced j to Sue for all j in the domain of individuals. However, if the element in focus is an NP the approaches differ. Now we can define an ordering between worlds based on $Alt(\phi)$. We say that $v <_{Alt(\phi)} w$ iff v is just like w except that $\{p \in Alt(\phi) | v \in p\} \subset \{p \in Alt(\phi) | w \in p\}$. Then, if F and B are the interpretations of focus and background of ϕ (with respect to M) the following holds.

$$\text{ONLY}^M(\langle F, B\rangle) = \{w \in W_M : \ F(w)(B(w)) \ \& \neg\exists v \in W_M(F(v)(B(v)) \ \& \ v <_{Alt(\phi)} w)\}.$$

Thus, we might as well say that w verifies (1) iff w verifies the sentence 'John introduced Mary to Sue' and there is no other world v which verifies this sentence that makes less elements of $Alt(1)$ true than w does. The reason for this equivalence, of course, is that if we define $Alt(F(B))$ in terms of B as suggested above, it follows that $<_B$ and $<_{Alt(\phi)}$ gives rise to the same ordering relation between worlds.

It is standard to assume that the alternatives to a certain semantic object should be type-identical to this object. The alternatives used in the formula above do not (necessarily) have this property. For instance, this is not the case if the expression in focus denotes a generalized quantifier. Notice, however, that ONLY^M does not have to face any of the problems of focus alternative approaches we discussed in the last section and, for instance, makes correct predictions for the examples (2), (4a), and (5).

4 The excluded versus the non-excluded

When ONLY is applied to examples as (1), here repeated as (6), the sentence is interpreted as stating both, that except for Mary, John introduced nobody to Sue – this is what we called the negative contribution of this sentence – and that, in fact, he did introduce Mary to Sue – this was the positive contribution. Both, the positive and the negative contribution together constitute what we have described as the information conveyed by such a sentence. Thus, the approach seems to do a good job in describing our intuitions about the meaning of 'only'.

For instance, the reformulation of the condition $B' \subset B(w)$ as an order over possible (admissible) worlds, $v <_B w$, allows for high flexibility and generality in the proposed meaning of 'only'. As we have mentioned earlier, Krifka (1993) claimed that there is a second reading for sentences like (4b) that we have not discussed so far. It is the nowadays well-known *scalar reading* of 'only'. The definition given above may provide a description that is able to account for both readings.

(6) John only introduced [Mary]$_\mathcal{F}$ to Sue.

But 'meaning' is still a very general term. The next question we can ask is whether ONLY is also a correct description of the *semantic* meaning of this word, or, to put it otherwise, whether we should put [*only*] in place of ONLY, the former representing in our notation the semantic meaning of 'only'. Horn (1969, 1996) and others have given convincing evidence that this is not the case. More in particular, certain observations strongly suggest that what we have called the positive contribution of a sentence containing 'only' – the claim that John introduced Mary to Sue for example (6) – should *not* be part of the semantic meaning of this sentence. Let us review the critical observations.

The first argument involves negative polarity items (NPIs). NPIs like 'any' are appropriate when they occur in the background of a sentence with 'only', as in (7a), but not when they are part of the focus, as in (7b).[17]

(7) a. Only [John]$_\mathcal{F}$ has *any money* left.

b. *John only has [*any money*]$_\mathcal{F}$ left.

It is well established that NPIs are licensed in assertions only in case they occur in downward entailing contexts. A context $X - Y$ is downward entailing (DE) iff from the truth of $X\alpha Y$ and the fact that β entails[18] α it follows that $X\beta Y$ is true as well. Thus, a context is DE iff an expression occurring in it can be replaced by a semantically stronger expression *salva veritate*. If the semantic meaning of 'only' combines both the positive and the negative contribution discussed above, one cannot account for (7a), because the background is then not predicted to be downward entailing. If the semantic meaning of 'only' is exhausted by the negative contribution, however, we can. Moreover, in this way we predict correctly that the focus part of a sentence is not a licenser of NPIs.

A second observation provided by Horn (1996) in favor of an approach that takes only the negative contribution to constitute the semantic meaning of 'only' is the fact that the appropriateness of the following sentences clearly indicates that in contrast to the negative contribution (i.e., nobody but John smokes in (8a)-(8b)), the positive contribution (John smokes) is *cancelable*. Parts of the semantic meaning of a sentence, however, should not be cancellable.

(8) a. Only [John]$_\mathcal{F}$ smokes, {if even he does/and maybe even he does not.}

b. *Only [John]$_\mathcal{F}$ smokes, {if nobody else does/and maybe somebody else does.}

Finally, if both, the positive and the negative contribution together would constitute the semantic meaning of sentences containing 'only', we would predict that the negation

[17] Notice that under certain circumstances NPIs can occur in the focus. Consider, for instance, the following example from Horn (1996).

(i) Only the students who had *ever* read *anything* about polarity passed.

According to Beaver (2004), the NPIs in (i) are not licensed by 'only' but by 'the students who'.

[18] The notion of entailment we employ here is polymorph, applied to multiple types.

of such a sentence conveys that either the positive or the negative contribution is false. Thus, an example like (9) should have the semantic meaning that either there are other people besides John that smoke, or John does not smoke. Intuitively, however, only the first part of the disjunction is conveyed by (9). Thus, the negation behaves as if only the negative contribution but not the positive one is part of the semantic meaning of 'only'.

(9) Not only $[\text{John}]_{\mathcal{F}}$ smokes.

The same arguments holds for denials of assertions with 'only', as demonstrated with the following example (due to Horn (1969)):

(10) a. Only $[\text{John}]_{\mathcal{F}}$ smokes.

b. No, that's not true. {Mary does as well/ *He does not.}

All three problems suggest that the positive contribution is not part of the semantic meaning of 'only'. Therefore, we propose as description of the semantic content the following adapted version of ONLY.

Definition 2 *(The semantic meaning of 'only')*
Let ψ be a sentence of the form 'only ϕ' where F is the semantic meaning of the focus in ϕ and B the semantic meaning of its background. We define the semantic meaning $[only](\langle F, B\rangle)$ of ψ as the following proposition:

$$\begin{aligned}[only](\langle F,B\rangle) &= \{w \in W :\ \exists v \in W[F(v)(B(v))\ \& \\ &\qquad\qquad [\neg\exists u \in W(F(u)(B(u))\ \&\ u <_B v)]\ \&\ w \leq_B v]\} \\ &= \{w \in W | \exists v \in \text{ONLY}(\langle F,B\rangle)(w \leq_B v)\}.\end{aligned}$$

If ϕ has background predicate B, according to this rule 'Only ϕ' is true in worlds where B has a smallest extension such that ϕ is true or an extension that is a subset of such a minimal element. Applied to an example, 'Only $[\text{John}]_{\mathcal{F}}$ smokes' is predicted to be true in all worlds where the extension of 'smoke' is either $\{john\}$ or $\emptyset$. Similarly, the sentence 'Only $[\text{men}]_{\mathcal{F}}$ smoke' is true only in case all smokers are men or there are no smokers. This analysis of 'only' excludes that, in the first example, somebody else besides John smokes, and, in the second, that someone smokes who is not a man. Thus, this rule takes exclusively the negative contribution to be the semantic meaning of 'only'. In this way all observations made above are accounted for.

Now that the positive contribution is no longer taken to be part of the semantic meaning of 'only', we are left with the question what then is the status of this information. The obvious way to solve this problem is to propose that the inference from 'Only ϕ' to ϕ is one of a pragmatic nature. We will discuss in section 6 what kind of analysis is most appropriate. But before we come to the pragmatics of 'only' let us first discuss a problem that arises for our context independent analysis of 'only'.

5 Context dependence

5.1 The problem of context dependence

Problematic for the semantic analysis of 'only' proposed in the previous section is that it does not mirror the context dependence of its truth conditions. Not from every use of 'only' one concludes that everything not described by the focus does not have the background property – as claimed by [*only*]. For instance, if Johnny comes back from the swimming pool and his mother asks him who else was there, his answer 'Only Billy' is by [*only*] predicted to mean that except for Billy and little John, nobody was there at all. In certain contexts, however, the answer only rules out that other *friends* of Johnny were there. Thus, it seems that in this case 'only' does not restrict the extension of the predicate $\lambda x.x\ was\ at\ the\ swimming\ pool\ with\ John$ but rather the contextually relevant subset $\lambda x.x\ is\ a\ friend\ of\ John\ and\ was\ with\ him\ at\ the\ swimming\ pool$. We observe similar effects of context dependence in many other cases as well. For instance, suppose that Ann and Bob are playing poker, Ann called, and Bob gives up putting his cards on the deck. Now the following dialogue takes place:

(11) a. Ann: What cards did you have?

b. Bob: Only two kings.

Our interpretation rule [*only*] takes Bob's answer to convey the same information as if he had said 'I had two kings'. Thus, no information is added by 'only' to the sentence in its scope. The reason is that because of the poker-game rules, in every world Bob had exactly five cards. Therefore selecting worlds where Bob had a minimum of cards such that two of them are kings or less than this will give you all the worlds where Bob had 5 cards and two of them where kings – certainly the wrong result. Intuitively, however, Bob's answer *does* exclude certain hands of cards that Bob could have had– for instance, that he had additional kings. In general, it is excluded that he had a *better* hand in terms of the rules of the game. Thus again, 'only' seems to restrict the extension of a contextually relevant subset of the background predicate, namely the set of cards that contribute to the value of Bob's hand. This reading of 'only' is also known as the *scalar reading*.[19] So far, [*only*] cannot account for this interpretation.

5.2 Solving the problem by Relevance

To model the context dependence of 'only' we have to provide a formal description of this relevance dependent subset of the background predicate 'only' operates on. In order to

[19] In fact, we think that the reading of 'only' in this example is the same as the reading Krifka (1993) claimed as one of the readings of example (4b), repeated below.

(4b) John only ate [an apple]$_{\mathcal{F}}$.

What our function [*only*] cannot account for yet is the reading according to which John ate only an apple and nothing more substantial.

do so what we need first is some formal way to access contextual relevance. Fortunately, a lot of work has been done on this subject and a whole family of orders comparing the relevance of propositions in a particular context have been proposed.[20] As in van Rooij & Schulz (to appear) we will use the ordering of propositions defined in terms of their utility values here and call it $\geq^r$. The utility value of a proposition is defined in terms of the extent to which learning that proposition helps the addressee to solve a decision problem he has to face. How can we use this order to find the relevant subset of the extension of some predicate B? We use it to define a second ordering between possible extensions of B. We will say that X is at least as relevant a set with respect to background B as Y is, $X \geq^r_B Y$, if the information that all elements of X have property B, $\lambda v(X \subseteq B(v))$, is at least as relevant as the corresponding information for Y.

$$X \geq^r_B Y \quad \text{iff} \quad \lambda v(X \subseteq B(v)) \geq^r \lambda v(Y \subseteq B(v)).$$

We will propose that 'only' is defined relative to the set of all minimally large but maximal relevant subsets of the background predicate – such that it only contains those individuals really cared for in the context. These minimal elements are not necessarily uniquely determined. Therefore we define $Opt(B, w)$ as the set of all subsets of B that fulfill these two requirements. ('$>^r_B$' and '$\cong^r_B$' are defined in the usual way.)

$$Opt(B, w) = \{X \subseteq B(w) | \neg\exists Y \subseteq B(w)(Y >^r_B X) \;\&\; \neg\exists Z \subset X(Z \cong^r_B X)\}.$$

Obviously, it depends on what is (known to be) relevant to the addressee what kind of set $Opt(B, w)$ denotes. Suppose that the addressee is known to be interested in learning the full extension of predicate B. Then $\leq^r$ predicts that in w, $\lambda v[B(w) \subseteq B(v)] \geq^r \lambda v[X \subseteq B(v)]$ iff $B(w) \supseteq X$ (and thus that $\geq^r$ comes down to entailment). Then it will be the case for each world w that $Opt(B, w)$ denotes the singleton set $\{B(w)\}$. Assume now that the addressee is only interested in who of John, Mary, and Sue have the property denoted by B, i.e., in w, $\lambda v[(B(w) \cap \{j, m, s\}) \subseteq B(v)] \geq^r \lambda v[X \subseteq B(v)]$ iff $B(w) \cap \{j, m, s\} \supseteq X$. In that case $Opt(B, w)$ will denote the singleton set $\{B(w) \cap \{j, m, s\}\}$. In our card-game example, $Opt(B, w)$ will consist of the singleton set consisting of exactly those cards that Bob has in w that determine the value of his hand according to the rules of poker. Finally, if the addressee is only interested in learning of one place where she can buy an Italian newspaper *that* she can buy one there, $Opt(B, w)$ will consist of the set of all singleton sets of places where she can buy an Italian newspaper in w.

If there were always only one such optimal subset $X \in Opt(B, w)$ for each w we were done by now: we could simply define a predicate $B^* := \lambda w.X \; for \; X \in Opt(B, w)$ and say that the meaning of 'only' has to be described as $[only](F, B^*)$. Thus, to describe 'only' correctly we could have kept our old formalization, but apply it to the relevant subset B^* of B. However, we saw above that $Opt(B, w)$ may contain more than one element. That makes our definition a bit more complicated. We have to introduce a new order comparing worlds.

[20] See van Rooij (2004) for a number of candidates and relations between them.

Definition 3 *(Relevance 'only')*
Let ψ be a sentence of the form 'only ϕ' where F is the semantic meaning of the focus in ϕ and B the semantic meaning of its background. We define the relevance-dependent semantic meaning $[only](\langle F, B\rangle)$ of ψ as the following proposition:

$$[only]_{rel}(\langle F, B\rangle) \;=\; \{w \in W : \exists v \in W\ [F(v)(B(v))\ \&\ [\neg\exists u \in W(F(u)(B(u))\ \&\ u <^r_B v)]\ \&\ w \leq^r_B v]\}$$

$$\text{where } v \leq^r_B w \text{ iff}_{cet\ par}\ Opt(B,v) \cap Opt(B,w) \neq \emptyset \text{ or } \forall X \in Opt(B,v) \exists Y \in Opt(B,w) : X \subseteq Y.$$

Making use of $[only]_{rel}$ instead of $[only]$ immediately improves our predictions. In a context where it is only relevant who of Johnny's friends were at the swimming pool, Johnny's answer 'Only [Billy]$_{\mathcal{F}}$ was at the swimming pool', for instance, we now predict that it only excludes that other *friends* of Johnny were at the swimming pool. The reason is that at each world w, the only element of $Opt(B, w)$ is the set of friends of Johnny in w that were at the pool. For the poker-game dialogue (11a)-(11b) something similar is obtained: By applying $[only]_{rel}$ we predict that Bob's answer 'Only two kings' only rules out that Bob has additional cards that would have increased the value of his cards. Thus, by means of relevance, we have explained the *scalar* reading of 'only' and shown that it can be thought of as a natural special case.[21]

In the above examples $Opt(B, w)$ denoted a singleton set for each w. It is easy to see that in this case $[only]_{rel}(\langle F, B\rangle)$ comes down to $[only](\langle F, B^*\rangle)$.[22] This is typically not the case if the questioner is interested just in some object fulfilling the question predicate. For instance, Ann in the example below wants to buy an Italian newspaper. She does not have to know every place in town to get one. One place is sufficient.

(12) a. Ann: Where can I buy an Italian newspaper?

b. Bob: At the central station.

c. Bob: Only [at the central station]$_{\mathcal{F}}$.

It is a well-known observation that in such a context answer (12b) is not understood as implying that the central station is the only place to buy an Italian newspaper. In fact, Bob's answer conveys nothing more than its semantics meaning: the central station is one place to buy an Italian newspaper. Thus, in such contexts answers are not interpreted exhaustively, or, as is proposed in van Rooij & Schulz (to appear), exhaustive interpretation has no effect because the semantic meaning of the answer conveys already all the information Ann wants.

[21] It should be clear that in terms of it we can also account for the reading of (4b), according to which John ate only an apple and nothing more substantial.

[22] $[only]$ is a special case of $[only]_{rel}$: the case where for each w, $Opt(B, w) = \{B(w)\}$. As suggested in the main text, this results in case $\geq^r_B$ reduces to the superset relation (and $\geq^r$ to standard entailment).

As observed by Alistair Butler (p.c.), Bob's answer (12c) means something different from (12b). From (12c) we *do* infer that Ann cannot buy an Italian newspaper at any other place than at the central station. Apparently, the well-known similarity between the exhaustive interpretation of answers and the meaning of 'only' breaks down in this case. Let us see how our approach to the meaning of 'only' can deal with this observation. Suppose, that we have a model M with $W_M = \{u, v, w, x\}$ and where the background B = 'Can buy an Italian newspaper' has the following extensions: $B^M(u) = \{c(entral)s(tation)\}, B^M(v) = \{p(alace)\}$, $B^M(w) = \{cs, p\}$, and $B^M(x) = \emptyset$. In a context where Ann is known to be only interested in some place to buy an Italian newspaper, we obtain that $Opt(B, x) = \{\emptyset\}$, $Opt(B, u) = \{\{cs\}\}, Opt(B, v) = \{\{p\}\}$, and $Opt(B, w) = \{\{cs\}, \{p\}\}$. From this it follows that the four worlds are related by $\leq^r_B$ in the order: $x <^r_B u =^r_B v =^r_B w$. When we now select the worlds where it is true that at the central station one can buy Italian newspapers and for which there exists no other world making this true and that is strictly $\leq^r_B$-smaller, we end up with the set $\{u, w\}$. $[only]^M_{rel}$ is true in those worlds of W_M that are smaller or equal to the elements of this set, thus, in the worlds $\{u, v, w, x\} = W_M$. That means that according to our approach Bob's answer is trivial. We propose that therefore the context is reinterpreted. Ann concludes that Bob got the contextual relevance wrong and switches to the default notion of relevance in the context of questions, namely that the whole extension of the predicate in question is relevant, i.e. Ann wants to know all places where she can buy an Italian newspaper. In this case $[only]_{rel}$ comes down to $[only]$ and we predict the observed interpretation for (12c) that Ann cannot buy an Italian newspaper at the palace.

6 The pragmatics of 'only'

6.1 The pragmatic contribution as a conversational implicature

Finally, we want to explain how the positive contribution of an 'only' modified sentence comes about, i.e. why we normally infer from 'Only ϕ' that ϕ is the case. It has often been proposed (see, for instance, Horn (1969)) that this information, for example (13) the inference that John smokes, is due to the presuppositions of 'Only ϕ'.

(13) Only [John]$_{\mathcal{F}}$ smokes.

An important argument in favor of a presuppositional analysis is that we not only from (13), but also from its negation, (14), typically infer that John smokes.

(14) Not only [John]$_{\mathcal{F}}$ smokes.

But various authors have argued against this presuppositional analysis. First of all, although it is only seldomly heard, one can bring forward a theoretical argument against this proposal: according to the most popular analysis of presuppositions, viz. the satisfaction theory of Karttunen, Stalnaker, and Heim, presuppositions are not cancelable. But we have seen already in section 4 that the inference that John smokes from (13) can explicitly be cancelled by the speaker.[23] Second, Geurts & van der Sandt (2004) argue that for other sentential operators than negation, the supposed presupposition does not show the standard projection behavior. To them, at least, none of (15a)-(15c) very strongly suggests that John smokes.[24]

(15) a. It is possible that only [John]$_{\mathcal{F}}$ smokes.

b. Did only [John]$_{\mathcal{F}}$ smoke?

c. If only [John]$_{\mathcal{F}}$ smokes, there is no reason to get upset.

Furthermore, the presuppositional analysis would predict that (16) is a pragmatically well-formed sentence, though Geurts & van der Sandt (2004) note that this is not the case.

(16) ?If John smokes, then only [John]$_{\mathcal{F}}$ smokes.

Finally, Horn himself (in (1996), followed by Geurts & van der Sandt (2004)) argues that the following dialogue should be quite peculiar if (13) presupposed that John smokes, because the latter is then already taken to be common knowledge. In fact, however, the dialogue seems to be perfectly ok.

(17) a. Paul: Who smokes?

b. Paula: Only [John]$_{\mathcal{F}}$ smokes.

Abandoning the strong presuppositional view discussed above, Horn (1996) – followed by Geurts & van der Sandt (2004) – proposes, instead, that (13) gives rise to the weaker *existential presupposition* that somebody smokes. He notes that by combining this proposed presupposition of (13) with an analysis that takes the semantic meaning of (13) to be exhausted by what we have called its negative contribution, we still make the desired prediction that John smokes. Adopting an existential presupposition also seems correct to account for sentences like (18).

(18) Only [men]$_{\mathcal{F}}$ smoke.

As observed by McCawley (1981, p. 226) and others, this sentence seems to 'imply' only that some men smoke, not necessarily that all of them do. And this is exactly what we predict on the proposal under consideration.

Whether or not 'only' sentences come with an existential presupposition, it is easy to see that in general it cannot be the correct analysis to account for the positive contribution

[23] One of the authors that has used this argument is Rooth (1992). He takes it to show that a sentence like (13) does not even give rise to an existential presupposition, let alone the one Horn (1969) proposed.

[24] To be honest, for us these examples *do* indicate that John smokes, but, then, Geurts & van der Sandt use some other examples where this suggestion is also for us less strong.

of a sentence 'Only ϕ'. Although the proposed analysis gives rise to pleasing predictions for examples like (13) and (18), for only slightly different examples it fails to give the desired outcome. For instance, for sentences as (19) we would like to predict the inference that John and Peter smoke.

(19) Only [John and Peter]$_{\mathcal{F}}$ smoke.

This will not come out, however, if we assume that (19) only gives rise to the existential presupposition that somebody smokes.

McCawley (1981) and Horn (1992) have claimed that the inference from (13) 'Only [John]$_{\mathcal{F}}$ smokes' that John smokes; from (19) that John and Peter smoke; from (18) that some men smoke, and from 'B, only if A' to the truth of 'If A, then B' is a conversational implicature. This is supported by the observation that these kinds of inferences pass standard tests for conversational implicature such as *'but'*-reinforcement ('Only John smokes, but he does.') and (epistemic) cancellation ('Only John smokes and perhaps even he does not'). In the remainder of this paper we want to discuss in how far such a Gricean approach to the inference can be made precise. First, we will show that the positive contribution ϕ of a sentence 'only ϕ' can be described as result of the *exhaustive interpretation* of such a sentence. Here we will make use of a description of exhaustive interpretation proposed in Rooij & Schulz (20004, to appear). In these papers it has also been argued that exhaustive interpretation itself has to be understood as a Gricean interpretation rule, based in particular on the conversational maxim of quality, the first subclause of his maxim of quantity, and an additional principle of competence maximization. We will sketch this approach here and show how in terms of it we can account for the cancellation of the inference to ϕ from 'only ϕ'.

In van Rooij & Schulz (2004, to appear) the following rule of exhaustive interpretation of a sentence with respect to a question predicate B has been proposed.

Definition 4 *(Exhaustive interpretation)*
Let ϕ be an answer to a question with question predicate B. We define the exhaustive interpretation $[exh](\phi, B)$ of ϕ with respect to background B as the following proposition:

$$[exh]^M(\phi, B) = \{w \in [\phi]^M \ : \ \neg\exists v \in [\phi]^M (v <_B w)\}.$$

Under the additional assumption often defended that the background predicate of a sentence is the predicate of an implicit or explicit question the sentence answers, $[exh]$ is identical to ONLY. This should not come as a surprise given the often noticed similarity between exhaustive interpretation and the meaning of 'only'. However, there are important theoretical differences between the operators $[only]$, ONLY, and $[exh]$. Although $[exh]$ and ONLY describe the same interpretation function, they are complementary with respect to which part of their meaning is analyzed as semantic meaning and which part as due to pragmatic considerations. For a sentence 'Only [Peter]$_{\mathcal{F}}$ smokes' we have argued that its semantic meaning is that nobody besides Peter smokes and its pragmatic meaning that Peter smokes. Exhaustive interpretation, however, is in van Rooij & Schulz (2004, to appear) understood as a pragmatic interpretation function based on Gricean maxims of conversation that strengthens the semantic meaning of a sentence ϕ. The answer '[John]$_{\mathcal{F}}$ smokes' to a question 'Who smokes?' semantically conveys that John smokes and exhaustive interpretation then adds the pragmatic information that John is the only one that smokes. This difference between $[exh]$ and ONLY nicely reflects the opposite cancelation behavior in both cases and predicts answers 'John' and 'Only [John]$_{\mathcal{F}}$' to be non-equivalent.

It turns out that in terms of $[exh]$ we can not only account for the fact that the answer '[John]$_{\mathcal{F}}$ smokes' pragmatically implies that John is the only smoker, but also that 'Only [John]$_{\mathcal{F}}$ smokes' pragmatically conveys that John does smoke. To see this, notice that in sentences like (13), (18) and (19) the background-predicate occurs negatively, i.e., in a downward entailing context. As argued by von Stechow and Zimmermann (1984) and van Rooij & Schulz (2004), in these cases we should interpret exhaustively not with respect to background-predicate B, but rather with respect to the complement of B. Thus, we should interpret (13) as $[exh]([only](\langle \lambda P.P(john), S\rangle), \bar{S})$. In this way, we predict that the background-predicate 'Smoke' has *at most* John in its extension due to the truth-conditional meaning of (13), and *at least* John because of exhaustive interpretation.[25] By a similar reasoning we can account for the inference from (19) that John and Peter smoke, something that Geurts & van der Sandt (2004) could not.

6.2 The epistemic force of the implicature

In the previous section we have shown that the inference from 'Only [John and Peter]$_{\mathcal{F}}$ smoke' that John and Peter smoke can be explained as an effect of exhaustive interpretation, and we have claimed that exhaustive interpretation should be thought of as a conversational implicature. However, we have not explained yet why what follows from the exhaustive interpretion of a sentence can be taken to be a conversational implicature, nor how such an implicature can be canceled. With respect to cancelation, the most challenging aspect of our analysis of the inference from 'only ϕ' to ϕ is that we must be able to explain Atlas' (1991, 1993) asymmetry in acceptability between the following sentences:[26]

(20) a. Only [Hillary]$_{\mathcal{F}}$ trusts Bill, if (even) she does/
and perhaps even she does not.

b. *Only [Hillary]$_{\mathcal{F}}$ trusts Bill, and (even) she does not.

[25] This is based on the fact that in general $[exh]([only](\langle F, B\rangle), \bar{B}) = [exh]([F(B)], B)$.

[26] These examples motivated Atlas to adopt for (13) a 'conjunctive' analysis according to which both the negative and the positive contributions discussed at the beginning of section 2 are taken to be semantically entailed by the 'only'-sentence. The examples also convinced Horn (2002) to give up his earlier analyses (Horn, 1969, 1992, 1996) of 'only' where the inference from 'Only Hillary trusts Bill' that Hillary trusts Bill is taken to be due to a presupposition or conversational implicature. One should be aware of the fact that Atlas' observations are also problematic for an approach that takes the positive contribution to be part of the semantic meaning of 'only'. Such an analysis has difficulties to account for (20a).

As the examples show, in case of the sentence 'Only [Hillary]$_{\mathcal{F}}$ trusts Bill' it is possible to cancel the implicature that the speaker *knows* that Hillary trusts Bill – as in (20a) –, but not to cancel the inference that the speaker takes it to be *possible* that Hillary trusts Bill. Thus, the challenge we are faced with is that, although the inference might be cancelable, it is only cancelable to a certain extent.

This difference in behavior of the pragmatic information of a sentence can be taken to suggest that the pragmatic meaning splits in two parts with different cancellation behavior and maybe also different sources. Thus, one could propose that a sentence like 'Only [Hillary]$_{\mathcal{F}}$ trusts Bill' gives rise to two kinds of pragmatic inferences: one with *weak epistemic force* saying that the speaker takes it to be possible that Hillary trusts Bill, and one with *strong epistemic force* saying that the speaker knows that Hillary trusts Bill. The epistemic weak inference is difficult to cancel, while the inference with strong epistemic force can be suspended easily. Only the second one entails (by the veridicality of knowledge) the inference we actually want to explain: that Hillary *in fact* trusts Bill.

This fits nicely with an ongoing discussion in the literature on conversational implicatures. A complaint often heard against interpretation rules like [*exh*] has it that all we can conclude by standard Gricean reasoning from 'Only [John]$_{\mathcal{F}}$ smokes' is that the speaker *only knows* of John that he smokes, leaving it open that he does not know of anyone other than John *that* he or she smokes. The strengthening from *not know p* to *know that not p* and further to *not p* is then mostly contributed to the extra assumption that the speaker knows who smokes. We fully agree with this intuition, and we have shown in van Rooij & Schulz (2004) how to make it precise. In this section we give a quick and somewhat informal review of this work.[27]

Here is the general idea behind the approach presented in van Rooij & Schulz (2004, to appear). Exhaustive interpretation can be shown to be the product of (i) taking the speaker to obey the Gricean maxim of quality and the first subclause of the maxim of quantity plus (ii) an additional assumption that the speaker is as competent on the issue under discussion as is consistent with (i). From (i) alone one obtains weak epistemic inferences of the kind that for certain claims the speaker does not know that they hold. The competence maximization in (ii) strengthens the inferences in (i) from not knowing to knowing not, hence, to inferences with strong epistemic force. The veridicality of knowledge then allows to conclude the truth of the fact. We claim that assumption (ii) on the competence of the speaker is highly context dependent and therefore easy to cancel. The first assumption on the obediance to the Gricean maxims, however, is much more robust and the inferences that follow from this assumption are therefore more difficult to cancel.[28] We will show that in this way we can account for the behavior of 'only' with respect to cancelation.

Before we can come to some technical details of the approach we have to introduce additional logical machinery. In order to take the knowledge state of speakers into account,

[27]The work of Benjamin Spector (2003) is closely related, although not based on the non-monotonic theory of 'only-knowing' due to Halpern & Moses (1985) that we make use of.

[28]Though also these inferences are cancelable, i.e., when the speaker is taken to be uncooperative.

we make use of the tools provided by modal logic. We first extent the language with one modal operator, $\mathbf{K}$, where $\mathbf{K}\phi$ expresses that the speaker knows that ϕ is the case. The formula of the enriched language are interpreted with respect to *pointed models* or *states* of the form $s = \langle M, w \rangle$ that also represent what the speaker knows (assuming a designated speaker). The model M is a quadruple consisting of a set of worlds W_M, a set of individuals D_M, an interpretation function $[\cdot]^M$, and a binary accessibility relation R^M on W_M. R^M is a reflexive, transitive, and symmetric accessibility relation connecting a world w with those worlds in W_M that are consistent with what the speaker knows in w. World w of $\langle M, w \rangle$ is a designated element of W that represents the actual world. Let us call the class of all states that fulfill these conditions $\mathcal{S}$. All sentences are interpreted in the standard way with respect to pointed models, where the accessibility relation is only relevant for the interpretation of sentences of the form $\mathbf{K}\phi$. As usual, such a sentence is counted as true in $\langle M, w \rangle$ if and only if ϕ is true in all worlds in W_M accessible from w according to R_M. The semantic meaning of a sentence consists as always of the set of its verifying states. Thus, we define for each sentence ϕ its semantic meaning $[\phi]^{\mathcal{S}}$ as $\{s \in \mathcal{S} | \phi \textit{ is true in } s\}$. Instead of '$\phi$ is true in s' we will also write $s \models \phi$.

Now we want to formalize what it means to take the speaker to obey the Gricean maxims of quality and the first subclause of the maxim of quantity. Formalizing that the speaker obeys quality is not that difficult: If our designated speaker utters ϕ, we simply assume that the actual pointed model is one that verifies $\mathbf{K}\phi$. Thus, it is one of the following: $\{s \in \mathcal{S} | s \models \mathbf{K}\phi\}$. To account for the first subclause of the maxim of quantity that demands speakers to convey all (relevant) information they posses, we are going to select among those states where the speaker knows her utterance to be true the states where she has least additional relevant knowledge. This is formalized by defining – as in the case of $[only]$ and $[exh]$ – an order on pointed models and then select minimal elements of this order. But this time the order compares the relevant knowledge of the speaker and we select minimal elements in the set $\{s \in \mathcal{S} | s \models \mathbf{K}\phi\}$.[29] How much relevant knowledge a speaker has is taken to be represented by how many of a class of relevant sentences she knows to hold. To define the set of relevant sentences we make the following simplifying assumption: Let the extension of background predicate B be of type $\langle f, t \rangle$. We assume that $D_{\langle s,f \rangle, \mathcal{S}}$, the set of names of objects of type $\langle s, f \rangle$ in our language, contains one and only one name for every objet of type $\langle s, f \rangle$.[30] Now, we come to the definition of the set of relevant sentences:

Definition 5 *If the extension of the background predicate B is of type $\langle f, t \rangle$ then the following conditions hold for the set $Rel(\phi)$ of sentences relevant to $\phi = \langle F, B \rangle$:*
(i) for every $e \in D_{\langle s,f \rangle, \mathcal{S}}$, $B(e)$ is in $Rel(\phi)$,
(ii) if $a, b \in Rel(\phi)$ then $a \wedge b \in Rel(\phi)$ and $a \vee b \in Rel(\phi)$,
(iii) nothing else is in $Rel(\phi)$.

[29] Remember that the order $\leq_B$ compares the extension of predicate B and ONLY/$[exh]$ select minimal elements out of those worlds where the (embedded) sentence is true.

[30] This restriction is in principle not necessary. In van Rooij & Schulz (to appear) you find a version of the approach that does not make use of it. But we thought that this formalization would be more intuitive to readers used to alternative semantics.

According to this definition what counts as relevant is information that a certain object has the background property. If $\phi =$ '[John]$_{\mathcal{F}}$ smokes', for instance, the set $Rel(\phi)$ contains sentences like 'John smokes', 'Mary smokes' and 'Bill smokes' as well as the conjunctive and disjunctive combinations of them. This is compatible with standard theories about relevance and focus. Therefore, it is not surprising that there is a close connection between $Rel(\phi)$ and the way focus alternatives are defined, remember, for instance, our definition of $Alt(\phi)$. Now we say that the speaker has less relevant knowledge in state s than in s', $s <^{\mathbf{K}}_{Rel(\phi)} s'$, iff the set of alternative sentences known in the former state is a proper subset of the set of alternative sentences known in the latter state:

Definition 6 *(Ordering knowledge states)*

$$s \leq^{\mathbf{K}}_{Rel(\phi)} s' \quad \textit{iff} \quad \{\psi \in Rel(\phi) \ : \ s \models \mathbf{K}\psi\} \subseteq \{\psi \in Rel(\phi) \ : \ s' \models \mathbf{K}\psi\}.$$

We define the Gricean interpretation of ϕ as the set of minimal models where the speaker knows ϕ with respect to the set of alternatives $Rel(\phi)$.

Definition 7 *(A Gricean Interpretation)*

$$[Grice]^{\mathcal{S}}(\phi, Rel(\phi)) = \{s \in [\mathbf{K}\phi]^{\mathcal{S}} \ : \ \forall s' \in [\mathbf{K}\phi]^{\mathcal{S}} : s \leq^{\mathbf{K}}_{Rel(\phi)} s'\}.$$

According to this interpretation function, if the speaker utters '[John]$_{\mathcal{F}}$ smokes' we conclude that the speaker knows that John smokes, but not that Mary smokes, and if she utters '[John or Mary]$_{\mathcal{F}}$ smoke' we conclude that the speaker does not know of anybody that he or she smokes. This is a nice result, but, as suggested in the previous section, in many cases we conclude something stronger: in the first example that Mary, Bill, and all the other relevant individuals *do not* smoke, and the same for the second example, except that now this is not true anymore for Mary. How do we account for this extra inference in terms of our richer modal-logical setting?

In van Rooij & Schulz (2004) we show that this can be accounted for by assuming that speakers, in addition to obeying the Gricean maxims, are *maximally competent* (as far as this is consistent with obeying these maxims). This can be described by selecting among the elements of $[Grice](\phi, Rel(\phi))$, the ones where the competence of the speaker is maximal. To account for this we need a new order that compares the competence of the speaker. This order is described in definition 9 (as usual, we define $\mathbf{P}\phi$ as $\neg\mathbf{K}\neg\phi$).

Definition 8 *(Ordering by possibility statements)*

$$s <^{\mathbf{P}}_{Rel(\phi)} s' \ \textit{iff} \ \{\psi \in Rel(\phi) : s \models \mathbf{P}\psi\} \subset \{\psi \in Rel(\phi) : s' \models \mathbf{P}\psi\}.$$

The minimal models in this ordering are those states where the speaker knows *most* about the alternatives. Now, finally, we define the function $[Grice\ +\ C](\phi, Rel(\phi))$ (C stands for competence) by selecting the minimal elements in $[Grice](\phi, Rel(\phi))$ according to the ordering $<^{\mathbf{P}}_{Rel(\phi)}$:

Definition 9 *(Maximizing competence)*

$[Grice + C]^{\mathcal{S}}(\phi, Rel(\phi)) = \{s \in [Grice]^{\mathcal{S}}(\phi, Rel(\phi)) : \neg\exists s' \in [Grice]^{\mathcal{S}}(\phi, Rel(\phi))(s' <^{\mathbf{P}}_{Rel(\phi)} s)\}$.

There exists a close correspondence between our pragmatic interpretation rule $[Grice + C]$ and a simplified version of our rule of exhaustive interpretation: $[exh^*]^{\mathcal{S}}(\phi, Rel(\phi)) = \{s \in [\phi]^{\mathcal{S}} : \neg\exists s' \in [\phi]^{\mathcal{S}}(s' <^*_{Rel(\phi)} s)\}$, where $s' <^*_{Rel(\phi)} s$ iff $\{\psi \in Rel(\phi) : s' \in [\psi]^{\mathcal{S}}\} \subset \{\psi \in Rel(\phi) : s \in [\psi]^{\mathcal{S}}\}$. Under the assumption that $\forall s \in \mathcal{S}\exists s' \in [exh^*]^{\mathcal{S}}(\phi, Rel(\phi))(s' \leq^*_{Rel(\phi)} s)$ one can show that $[Grice + C]^{\mathcal{S}}(\phi, Rel(\phi)) \models \psi$ if and only if $[exh^*]^{\mathcal{S}}(\phi, Rel(\phi)) \models \psi$.[31]

One respect in which $[exh^*]$ differs from $[exh]$, is that the latter, but not the former takes a ceteris paribus condition into account as well when we compare states: the order '$<^*_{Rel(\phi)}$' used in $[exh^*]^{\mathcal{S}}(\phi)$ only compares the set of sentences in $Rel(\phi)$ that are true in the states, and, thereby, information about the extension of background predicate B. For $[exh]^W(\phi)$ we use the ordering '$<_B$' that not only compares the extension of B (in a way that is very close to what $<^*_{Rel(\phi)}$ does) but also demands that the worlds agree on the interpretation of all other non-logical vocabulary. In van Rooij & Schulz (to appear) we show that a ceteri paribus condition is needed to obtain correct predictions.[32] Fortunately, as discussed in the mentioned paper, the definitions of $[exh]$ and $[Grice + C]$ can be adapted in such a way that again for the non-modal case $[Grice + C]^{\mathcal{S}}$ comes down to $[exh]^{\mathcal{S}}$. This version has the additional advantage that it is not restricted to the propositional case. We stick here to the simplified definitions because they are sufficient to illustrate the working of the general mechanism without getting us involved in too much technical details.

From the above discussion we can conclude that as far as sentences are concerned that do not contain epistemic operators, exhaustive interpretation can be given a natural Gricean justification. For sentences that do contain modal operators the predictions made by $[Grice + C]$ differ from those of $[exh^*]$. However, it turns out that here $[Grice + C]$ improves on $[exh^*]$. We will illustrate this in a moment with some examples. Another advantage of the proposed Gricean derivation of exhaustive interpretation is that it allows us to see the pragmatic information described by exhaustive interpretation as due to two different sources. First due to taking the speaker to obey the maxims of quality and the first subclause of the maxim of quantity, and second due to the assumption that the speaker is as competent as is consistent with the first assumption. This allows us to attribute different cancellation properties to both classes of information. In particular, we will propose that the competence assumption is cancelled as soon as it conflicts with the maxims of Grice - this is already inherent in the way we defined $[Grice + C]$. For $[Grice]$ we propose that it is not that easily given up. As we will see below, this allows us, among other things, to account for Atlas' cancellation data.

What are the consequences of the proposed modal analysis of conversational implica-

[31] The proof of this claim is very similar to the one given in van Rooij & Schulz (2004).

[32] However, this condition should not be as strong as in $\leq_B$. The best predictions are obtained when the ceteris paribus condition is restricted to the non-logical vocabulary besides B that occurs in ϕ.

tures for sentences involving ‘only’? Let us first look at examples (10a) and (15a)-(15c) again, repeated below.

(10a) Only [John]$_{\mathcal{F}}$ smokes.

(15a) It is possible that only [John]$_{\mathcal{F}}$ smokes.

(15b) Did only [John]$_{\mathcal{F}}$ smoke?

(15c) If only [John]$_{\mathcal{F}}$ smokes, there is no reason to get upset.

Remember that these sentences all imply that John smokes, if ‘only’-sentences are taken to presuppose the truth of their embedded clauses. Though we noted in the beginning of this section that not everybody has the intuition that all these sentences strongly suggest that John smokes, we feel that in many circumstances these examples indicate at least something concerning the smoking of John, although, perhaps, not the strong inference the presuppositional analysis would predict. For (10a) used in isolation, however, this inference is uncontroversial. And indeed, we predict that (10a) conversationally implicates that John smokes. In the previous section we have assumed that a sentence of the form ‘Only $(\langle F, B\rangle)$’ should be interpreted pragmatically as $[exh]([only](\langle F, B\rangle), \overline{B})$, i.e. that exhaustive interpretation has to be applied to the complement of B. For the simplified formalization $[exh^*]$ of exhaustive interpretation we have discussed here and its pragmatic derivation via Grice $[Grice\ +\ C]$, this means that we have to apply them to the ‘complement’ of the set of relevant sentences: $\overline{Rel(\phi)} \equiv \{\neg\psi\ :\ \psi \in Rel(\phi)\}$. In other words, instead of comparing how many statements of the form ‘object x has property B’ are true (or does the speaker knows to be true) we now compare how many statements of the form ‘object x does not have property B’ are true (or does the speaker not know to be true). $[Grice]([only](\langle F, B\rangle), \overline{Rel(F(B))})$ entails – in addition to the semantic meaning of the sentence: nobody different from John smokes – that the speaker takes it to be possible that John smokes. If additionally the competence of the speaker is maximized, i.e., (10a) is pragmatically interpreted as $[Grice\ +\ C]([only](\langle F, B\rangle), \overline{Rel(F(B))})$ the interpreter infers secondary that the speaker knows that John smokes.

Also (15a) conversationally implicates that John smokes, if the speaker is taken to be competent. That is, $[Grice\ +\ C](\Diamond([only](\langle \lambda P.P(j), S\rangle)), \overline{Rel(\langle \lambda P.P(j), S\rangle)})$ entails that the speaker knows that John smokes, though now she does not know (but takes it to be possible) of anybody else that he or she smokes. If we do not maximize competence, however, and pragmatically interpret (15a) just with $[Grice]$, the first prediction is lost, and we do not predict anymore that the sentence implicates that John smokes. We are not sure which of these two predictions is empirically more adequate and leave this to future research.

We make exactly the same predictions for example (15b), at least if we replace the maxim of quality for assertions (the speaker has to know that the sentence is true) by a version for questions: the speaker does not know the answer to the question he is asking. That is, the speaker can ask question (15b) appropriately only if she does not know yet whether all people besides John do not smoke, i.e., it has to be the case that the questioner takes it to be possible that (i) each individual different from John does not smoke, and (ii) an individual different from John smokes. When applying the accordingly adapted version of [*Grice*] we predict for John and his alternatives, e.g. Mary and Bill, that the questioner does not know that they do not smoke: she takes it to be possible that John smokes, that Mary smokes, and that Bill smokes. By competence maximization we cannot strengthen the latter two to the inference that the questioner knows that Mary smokes and that Bill smokes, because that would be inconsistent with the quality maxim for questions. We *can* strengthen the inference for John, however, because that the questioner knows that John smokes is compatible with the condition that she does not know yet whether somebody different from John smokes. We take these predictions to be favorable to our analysis. However, in future work more has to be said about the rationale behind taking a questioner to be obeying the first subclause of the maxim of quantity and be maximally competent.

Our treatment of example (15c) is at first sight less encouraging. What we predict in this case depends on what we take to be the background (or the set of alternatives) with respect to which we interpret the sentence. If we assume that [*Grice*] or [$Grice + C$] scopes over the whole conditional sentence – something that seems to be quite natural from a Gricean point of view – we will not predict that (15c) implicates that John smokes. We feel, however, that at least in many cases something special is going on when part of the antecedent of a conditional sentence is focussed. These sentences are used usually as reactions to earlier assertions, particularly to the claim that (it is only) [John]$_{\mathcal{F}}$ (who) smokes. In that case, the inference that John smokes is due to the semantic, or full pragmatic meaning of this earlier assertion.

Finally, and most important for us, consider the examples (20a) and (20b) again:

(20a) Only [Hillary]$_{\mathcal{F}}$ trusts Bill, if (even) she does/
and perhaps even she does not.

(20b) *Only [Hillary]$_{\mathcal{F}}$ trusts Bill, and (even) she does not.

Just as (10a) implicates via [*Grice*] that the speaker takes it to be possible that John smokes, (20a) implicates that it is consistent with what the speaker knows that Hillary trusts Bill. In case of (10a) the extra assumption of competence, formalized in [$Grice + C$], strengthens the latter inference to the fact that the speaker knows that John smokes. The similar inference to the conclusion that Hillary trusts Bill does not go through for (20a). The extra information '... if she does'/'... and perhaps even she does not' is inconsistent with the assumption that the speaker is competent on whether Hilary trusts Bill. Therefore, given how [$Grice + C$] is defined, the competence assumption is not made. Thus, we predict that the second conjunct of (20a) cancels the extra inference due to the assumption of competence.

What the second conjunct of (20b) wants to do, instead, is to cancel the inference based on the Gricean maxim of quality and his first submaxim of quantity. The fact that this gives rise to an inappropriate sentence strongly suggests that one cannot cancel inferences based on these maxims that easily. In any case, once we make this latter assumption, we can explain Atlas' (1991, 1993) asymmetry between (20a) and (20b).

7 Conclusion

In the first part of this paper we contrasted approaches to the meaning of 'only' that quantify over focus-alternatives with ones that quantify over background-alternatives. We argued that analyses of the first type are more problematic than usually recognized, because there is in general a misfit between the alternatives that one intuitively wants to quantify over, and what one gets by varying the focus content in a systematic and compositional way. Therefore, we vote in the end for an approach along the second line and model the meaning of 'only' by quantifying over background-alternatives. Then we argued to make a systematic distinction between the semantic and the pragmatic contribution of an 'only' sentence. More particularly, we claimed that the inference from a sentence 'Only $[\text{John}]_{\mathcal{F}}$ smokes' that nobody else smokes constitutes its semantic meaning, while the information that John smokes is pragmatically implied by the statement. We provided a minimal model analysis of the semantic part, based on Groenendijk & Stokhof's (1984) rule of exhaustive interpretation. It is shown that the resulting analysis makes some appealing predictions, especially if a notion of 'relevance' and is taken into account. In the last substantial section of this paper we argued that the pragmatic inference from 'Only ϕ' to ϕ should be thought of as a conversational implicature, and we have given a precise implementation of the Gricean maxims of quality and quantity$_1$ plus an additional assumption of the competence of the speaker to account for this.

In section 6 we made crucial use of the assumption that what can pragmatically be inferred from Grice's maxims of quantity and quantity$_1$, i.e., those inferences due to [*Grice*], cannot be cancelled easily in a cooperative discourse situation. This assumption, however, might sound counterintuitive. Is it not the case that *all* pragmatic inferences can be cancelled effortlessly? For instance, we, together with many others, propose that the inference from '$[\text{John}]_{\mathcal{F}}$ smokes' to the fact that the speaker does not know that Mary smokes is due to the above mentioned Gricean maxims. It seems obvious, however, that this is an inference that can be cancelled without any trouble.

(21) Paula: $[\text{John}]_{\mathcal{F}}$ smokes. *In fact*, Mary does too.

We believe, however, that such examples do not really constitute counterexamples to our assumption. We think that (21) is appropriate only in case it is used in a context in which Mary's smoking is not at issue, for instance because Paula answered the question who of John and Bill smoke. It seems exactly the function of 'in fact' – and perhaps also of 'too' – to change, or accommodate, the topic of conversation such that Mary's smoking becomes relevant as well. This argument does not prove that our assumption is correct, although it does suggest that it is not as 'wild' as it might seem at first. Whether it makes sense in general, we have to leave to future investigations.

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