Neg-raising *believe* and *Maximize Presupposition*[*]

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Abstract

We point out a puzzle that comes from the interaction of *Maximize Presupposition* (MP) with the Neg-raising verb *believe*. In response, we offer a reformulation of MP that we call *Maximize Update* (MU). MU compares not only the presuppositions of the relevant competing forms, but the conjunctions of the forms' presuppositions with their assertions. The principle favors the stronger of these. We compare MU with the possibility of combining MP with other accounts of neg-raising.

1 Introduction

In contexts where it is common ground that Tesla designed the Tesla coil, it is odd to say (B):

(B) Kim believes that Tesla designed the Tesla coil.

(B) is odd because it seems to suggest that Tesla did not in fact design the Tesla coil. This inference, on current thinking, results from competition between (B) and an alternative of it, (K), where the factive verb *know* replaces *believe*:

(K) Kim knows that Tesla designed the Tesla coil.

The context we have in mind here supports the factive presupposition of (K), and because (B) and (K) otherwise assert the same thing, (K) blocks (B). The principle that makes this blocking happen, which finds its roots in Hawkins 1978, Hawkins 1991, and Heim 1991, states that a form ϕ is to be favored over another ψ iff ϕ's presupposition asymmetrically entails ψ's, and ϕ and ψ are otherwise contextually equivalent. In current literature the principle is called *Maximize Presupposition* (MP). We borrow the formulation in (1) from Spector and Sudo 2017:

(1) **Maximize Presupposition (MP)**:
If S' is an alternative to S, and $\mathrm{Dom}([\![S']\!]^{c}) \subset \mathrm{Dom}([\![S]\!]^{c})$, then favor S' to S in any context c where $c \cap [\![S]\!]^{c} = c \cap [\![S']\!]^{c}$.[1]

From (1), and assuming the lexical entries in (2) and (3) for *believe* and *know*,

(2) $[\![believe]\!]^{w} = [\lambda p_{\langle s,t\rangle} \,.\, \lambda x_{e} \,.\, \mathrm{BEL}_{x,w} \subseteq p]$ (to be revisited)

(3) $[\![know]\!]^{w} = [\lambda p_{\langle s,t\rangle} : p(w) = 1 \,.\, \lambda x_{e} \,.\, \mathrm{BEL}_{x,w} \subseteq p]$

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[1]We assume that a context c is a set of possible worlds (the context set), and we write $[\![\,]\!]^{c}$ to mean $[\lambda w \,.\, [\![\,]\!]^{w}]$.

it follows that (K) is to be preferred to (B) by speakers who share the opinion that Tesla designed the Tesla coil. Conversely, (1-3) lead to the result that (B) is felicitous only in contexts where Tesla is *not* presumed to have invented the Tesla coil.[2]

With this in mind, consider (nB), the negation of (B):

(nB) Kim does not believe that Tesla designed the Tesla coil.

Unlike (B), (nB) is natural in our context. Yet by the same assumptions reviewed above, (nB) should be odd given the availability of the alternative (nK):

(nK) Kim does not know that Tesla designed the Tesla coil.

The only difference between (nB,nK) and (B,K) is the presence of negation. But at first glance it isn't obvious why negation should stop MP from favoring (nK) to (nB) in the same way that it favors (K) to (B). The presuppositions of (nB,nK), and the logical relation between them, are the same as those of (B,K), and it is reasonable to think that the negations of two assertorically equivalent sentences like (B,K) are also assertorically equivalent. What, then, changes with (nB,nK)?

The answer is that *believe*, unlike *know*, is a "neg-raising" verb: while (nK) says — setting aside its factive presupposition — that it is not the case that Kim believes Tesla to have designed the Tesla coil, (nB) says that Kim believes that he did not. Let us use the term NR to refer to this property of the verb *believe*; that when it is negated, it is understood to say that the (relevant) attitude holder *believes* that the (relevant) attitude is *false*. We summarize this, informally and theory-neutrally, in (4):

(4) **NR**: [*not believe S*] implies [*believe not S*]

It might seem that (4) by itself explains why (nB) and (nK) are acceptable: the two sentences are not equivalent in the given context, hence not subject to MP, because (nB) asserts something stronger than (nK). But this explanation is incomplete, because it is not accompanied by a theory of where NR inference comes from. If it comes from an opinionatedness presupposition, as Bartsch (1973) and Gajewski (2005, 2007) have proposed, then indeed (nB) and (nK) would no longer be in the domain of MP, because neither would have presuppositions that entail the other's. But then, for the same reason, (B) and (K) should also no longer be in the domain of MP, leaving the oddness of (B) unexplained. If NR comes from a scalar implicature, as proposed by Romoli (2012, 2013), then (nB) and (nK) could be explained if we show independent evidence that MP can operate on exhaustified sentences, not just on their implicature-less literal meanings. This too is not trivial, and we will explain why it is difficult to find independent support for it. Finally, if NR came from the assertoric meaning of (nB), then we would have to assume either a theory where *believe* is ambiguous, or a theory that derives NR from a syntactic mechanism (Fillmore 1963; Collins and Postal 2014, 2018). The first of these options is stipulative; the second, we will argue, makes incorrect predictions elsewhere. Our own proposal is a replacement of MP with another principle, which we call *Maximize Update* (MU), that compares not only the presuppositions of the given alternatives but the conjunctions of their presuppositions together with their assertions.

[2] Careful readers may have noticed a slight change in our narrative: We opened with the claim that (B) *presumes* that Tesla did *not* design the Tesla coil, but from MP we derived the weaker result that the context of (B) does *not presume* that Tesla designed the Tesla coil. The stronger of these two results – the first – is an example of an *antipresupposition*. Readers are referred to Percus 2006 and Chemla 2008 for discussion of the connection between MP and antipresuppositions.

Before we proceed, we want to note that we are not the first to observe this interaction between MP and the NR property of *believe*. Percus (2006), in fn. 14. credits Gillian Ramchand with an observation like ours, and speculates on a connection to NR but does not develop a detailed account. To our knowledge, the interaction has not been discussed elsewhere.

We will begin our presentation in Section 2 with the "semantic" view of NR, i.e. the view that derives inference from a presupposition of opinionatedness, and after some discussion we propose our own solution. We then discuss the implicature-based view (Section 3), and the syntactic view (Section 4).

2 The semantic view of NR and *Maximize Update*

Proponents of the semantic account of NR write an "opinionatedness" presupposition into the semantics of *believe*, as in (5):

(5) $[\![\textit{believe}]\!]^w = [\lambda p_{\langle s,t\rangle} . \lambda x_e : \textsc{opn}_{x,w}(p) . \textsc{bel}_{x,w} \subseteq p]$ (revised from (2))

(6) $\textsc{opn}_{x,w}(p)$ iff $\textsc{bel}_{x,w} \subseteq p \vee \textsc{bel}_{x,w} \subseteq \overline{p}$

As the reader can see, the opinionatedness presupposition in (5) does not strengthen the truth conditions in positive belief ascriptions, like (B), because opinionatedness follows logically from the assertion itself. However, in cases like (nB) where the verb *believe* appears under negation, the opinionatedness presupposition leads to NR, as desired:

(nB) Kim does not believe that Tesla designed the Tesla coil

a. $[\![(\text{nB})]\!]^w$ is defined only if $\textsc{opn}_{k,w}([\![\textit{Tesla designed the Tesla coil}]\!]^{\cent})$ ($\textsc{opn}_{k,w}(t)$)

b. If defined, $[\![(\text{nB})]\!]^w = 1$ iff $\textsc{bel}_{k,w} \subseteq \overline{[\![\textit{Tesla designed the Tesla coil}]\!]^{\cent}}$ ($\textsc{bel}_{k,w} \subseteq \overline{t}$)

In words, (nB) is only interpretable if Kim has an opinion about whether Tesla designed the Tesla coil, and if it is interpretable, (nB) is true iff it is not the case that Kim believes that Tesla designed the Tesla coil. Since (by the presupposition) Kim has an opinion on the matter, it follows that Kim believes that Tesla did not design the Tesla coil. This is the NR inference.

But adding a presupposition of opinionatedness into the meaning of *believe* presents us with a problem. Being opinionated about p does not entail p, and p does not entail being opinionated about p. This means that neither of (B,nB) should compete with (K,nK) by MP, because the presuppositions of (K,nK) no longer entail those of (B,nB). In the case of (nB) and (nK) this is a good result, because both examples are acceptable, but in the case of (B) and (K) the result is not welcome.

Note that as long as asymmetric entailment is required to hold between the presuppositions of the two competing forms, any alternative to MP will fail to distinguish between the negated pair of alternatives (nB,nK), which are both acceptable, and the unnegated pair (B,K), which are not both acceptable. For example, Spector and Sudo's (2017) Presupposed Ignorance Principle (7) favors the (presuppositionally-stronger) alternative that current context supports. But because neither *know* nor the presuppositional *believe* is presuppositionally-stronger than the other, there is no way to predict the oddness of (B).

(7) **Presupposed Ignorance Principle**:

If S' is an alternative to S, and $\text{Dom}([\![S']\!]^{\cent}) \subset \text{Dom}([\![S]\!]^{\cent})$, then S is infelicitous in any context c where $c \subseteq \text{Dom}([\![S']\!]^{\cent})$.

A more radical revision of MP, one that does not make direct reference to presuppositions, is proposed by Anvari (2018). The principle requires that context preserve entailment between alternatives: a form S is infelicitous iff it entails an alternative S' in context, but does not entail it logically:

(8) **Logical Integrity (LI)**:

If S' is an alternative to S, and $[\![S]\!]^{\text{¢}} \not\subseteq [\![S']\!]^{\text{¢}}$, then S is infelicitous in any context c where $c \cap [\![S]\!]^{\text{¢}} \subseteq c \cap [\![S']\!]^{\text{¢}}$

But LI also fails to distinguish the unnegated (B,K) from the negated (nB,nK). The principle correctly blocks "*believe p*" (e.g. (B)) in p-contexts, because in p-contexts "*believe p*" entails "*know p*", but it does not entail it logically. However, the same holds of "*not believe p*" (e.g. (nB)) in p contexts: "*not believe p*" entails "*not know p*" in a p-context, but it does not entail it logically.

We propose to replace *Maximize Presupposition* with *Maximize Update*:

(9) **Maximize Update (MU)**:

If S' is an alternative to S, and $[\![S']\!]^{\text{¢}} \subset [\![S]\!]^{\text{¢}}$, then favor S' to S in any context c where $c \cap [\![S]\!]^{\text{¢}} = c \cap [\![S']\!]^{\text{¢}}$.

MU, like LI, does not make any direct reference to the presuppositions of the forms under comparison. Instead it compares their update potential, as it were, by comparing the sets of worlds in which they are true: if S' is defined and true in a strictly narrower set of worlds than S, and if the two forms are otherwise contextually equivalent, then S' is to be favored.

The effect of MU on (B,K) is as we want it to be: the worlds where (B) is true are worlds where Kim's belief state supports the proposition that Tesla designed the Tesla coil (10a); the worlds where (K) is true make up a proper subset of these — they are worlds where Tesla designed the Tesla coil *and* where Kim has that belief (10b). Crucially, proper subsethood holds between these two sets of worlds despite the lack of entailment between the presuppositions of *believe* and *know*. When their presuppositions and assertions are considered together, *know* comes out stronger, and is therefore preferred when supported.

(10) a. $[\![(\text{B})]\!]^{\text{¢}} = \{w : \text{BEL}_{k,w} \subseteq t\}$

b. $[\![(\text{K})]\!]^{\text{¢}} = \{w : t(w){=}1 \ \& \ \text{BEL}_{k,w} \subseteq t\}$

In the case of (nB,nK), however, things are different. Worlds where (nB) is true (and defined) are worlds where Kim is opinionated about whether Tesla designed the coil, and does not have the opinion that he did. These are therefore worlds where Kim believes that Tesla did not design the Tesla coil (11a). On the other hand, worlds where (nK) is true (and defined) are worlds where Tesla designed the Tesla coil, but where it is not the case that Kim has that belief (11b):

(11) a. $[\![(\text{nB})]\!]^{\text{¢}} = \{w : \text{BEL}_{k,w} \subseteq \overline{t}\}$

b. $[\![(\text{nK})]\!]^{\text{¢}} = \{w : t(w){=}1 \ \& \ \text{BEL}_{k,w} \not\subseteq t\}$

Clearly, neither of (11a,11b) is a subset of the other, so (nB,nK) are correctly predicted not to compete under MU.

Note that, by its definition, MU makes the same prediction as MP in every case where two forms S, S' are equivalent in their assertions but where S' has a stronger presupposition than

S. In these cases, $[\![S']\!]^{\text{¢}}$ is a proper subset of $[\![S]\!]^{\text{¢}}$, because $[\![S']\!]^{\text{¢}}$ is effectively a conjunction of two propositions $\phi \,\&\, \psi'$ — the assertion and presupposition of S' respectively — while $[\![S]\!]^{\text{¢}}$ is by assumption a weaker conjunction $\phi \,\&\, \psi$, ψ being weaker than ψ'. MP favors S' because of the presuppositions alone; MU favors S' because of the "conjunction" of the presuppositions with their assertions.

Note also that MU, like Anvari's LI, correctly blocks uses of weaker scalar items like *some* in contexts where they are equivalent to their stronger alternatives, like *all*. Cases of this kind were discussed in Magri 2009, 2011. (12), from Magri 2011, is an example:

(12) Context: Prof. Smith assigns the same grade (possibly a different one every term) to all of his students.

a. #This year, Prof. Smith assigned an A to some of his students.

b. ✓This year, Prof. Smith assigned an A to all of his students.

Magri took data like these to show that scalar implicature calculation is not based on purely pragmatic grounds; given that the context in (12) does not distinguish between the *some* and the *all* alternatives, there is no reason for the imagined listener in this context to infer, on hearing (12a), that the professor did not assign an A to all of his students. Either of (12a,b) should therefore be acceptable, yet only (12b) is.

Magri's conclusion that extra-literal inferences, like scalar implicatures, are not governed solely by contextual factors does not change under LI, since LI makes reference both to logical entailment and contextual entailment. MU is similar in this respect. (12a) is dispreferred even though it is contextually equivalent to (12b); it is dispreferred because it is *logically* weaker than (12b). We therefore do not see MU as a pragmatic principle.

We now turn our attention to alternative ways of explaining (nB,nK) without altering the basic formulation of MP. These are (a) the possibility of deriving NR as a scalar implicature, and (b) the possibility that NR results from interpreting negation in an embedded position.

3 NR as a scalar implicature

The idea of deriving NR as an implicature comes from Romoli 2012. A central assumption in the proposal is that *believe* has a formal alternative that states opinionatedness. Let us abstract away from the form of this alternative, and call it *opn* for short. *Opn* has the following semantics:

(13) $[\![opn]\!]^w = [\lambda p_{\langle s,t\rangle} \,.\, \lambda x_e \,.\, \textsc{opn}_{x,w}(p)]$,
where as before: $\textsc{opn}_{x,w}$ iff $\textsc{bel}_{x,w} \subseteq p \vee \textsc{bel}_{x,w} \subseteq \overline{p}$

And *believe* itself has no presupposition of opinionatedness. This is the original entry we saw in (2):

(2) $[\![believe]\!]^w = [\lambda p_{\langle s,t\rangle} \,.\, \lambda x_e \,.\, \textsc{bel}_{x,w} \subseteq p]$

In positive contexts, *opn* does not participate in the implicatures of *believe*, because its truth conditions follow from those of *believe*: $\textsc{bel}_{x,w} \subseteq p$ asymmetrically entails $\textsc{opn}_{x,w}(p)$.

In negative contexts, however, the alternative where *believe* is replaced with *opn* gives rise to an implicature that leads to NR: "*not believe S*" implicates that the alternative "*not opn S*" is false, and "*not opn S*" is false iff "*opn S*" is true. So "*not believe S*" brings with it the implicature that the given attitude holder is opinionated about S. And since the sentence

asserts that the attitude holder does not have the belief that S, it follows that s/he believes that not S. These steps are summarized in (14):

(14) Kim does not believe that S

a. $\text{ALT}(14) = \{\text{Kim does not } opn \text{ that } S, \cdots\}$

b. $\text{EXH}(14a)(14) = 1$ iff $[\![Kim\ not\ believe\ S]\!]^w = 1$ and $[\![Kim\ not\ opn\ S]\!]^w = 0$
$= 1$ iff $[\![believe]\!]^w([\![S]\!]^{\cap})(k) = 0$ and $[\![opn]\!]^w([\![S]\!]^{\cap})(k) = 1$
$= 1$ iff $\text{BEL}_{k,w} \not\subseteq \overline{[\![S]\!]^{\cap}}$ and $\text{OPN}_{k,w}(p)$
$= 1$ iff $\text{BEL}_{k,w} \subseteq \overline{[\![S]\!]^{\cap}}$

Now we can revisit the problem we pointed out in the context of MP. The semantic account of NR assigns independent presuppositions to *believe* and *know*, and by doing so breaks the entailment relation between them that feeds MP. The implicature-based account of NR does not have this problem, however; by its semantics, *believe* has no presupposition of opinionatedness, so its competition with *know* works as initially thought: *know* S is favored over *believe* S in contexts where S is part of the common ground.

What about negated cases? Recall that we want both (nB) and (nK) to be acceptable in our Tesla context. But if we go by literal meaning alone, MP will incorrectly favor (nK) to (nB), because (nK) has a factive presupposition and (nB) presupposes nothing. The question that comes up now is whether MP is indeed sensitive only to literal meanings, or whether it compares the exhaustified meanings of the given forms. If the latter, then neither (nB) nor (nK) would be favored over the other, because the exhaustified meaning of (nB) includes NR (see (14b)), while the exhaustified meaning of (nK) does not.

We do not know how to find independent evidence to support this possibility. The task is difficult because it requires that we compare two forms ϕ and ψ, where ϕ is presuppositionally stronger than ψ, but where ψ with its implicatures assert something beyond what ϕ asserts. Now, suppose that ϕ and ψ are assertorically equivalent. Then the needed implicatures of ψ would have to come from alternatives that ψ has, but that ϕ does not have — indeed, this seems to be the case for *believe* and *know* on Romoli's theory (*opn* is a formal alternative to *believe*, but not to *know*). We cannot at the moment think of other cases that fit this description. Suppose, on the other hand, that ϕ and ψ are not assertorically equivalent. Then they may not be subject to MP in the first place, because MP targets only alternatives that make equivalent assertions in context. We will leave this matter to future work.

4 NR as syntactic neg-raising

For our purposes we will assume a descriptive version of the syntactic account of NR. It is one where (nB) has an LF like (15):

(15) [Kim believes that [NEG [Tesla designed the Tesla coil]]]

Clearly, the interpretation of (15) generates the NR reading of (nB) as part of its *literal* meaning, and because of this, the form's assertion is no longer equivalent to the assertion of (nK). Both sentences are therefore predicted to be acceptable in our context, and the prediction does not change the result we get for the unnegated (B,K).

For the sake of discussion, assume a view that derives all instances of NR from LFs like (15).[3] While (15) is correctly predicted not to compete with (nK), as we just noted, it is predicted to compete with (Kn):

[3] As will point out shortly, not all proponents of the syntactic view believe this.

(Kn) [Kim knows that [NEG [Tesla designed the Tesla coil]]]

Of course, (Kn) is not defined in the context that we are working with, because its presupposition is false. But suppose we change this. Take (Kn′):

(Kn′) Kim knows that Tesla did not found the rock band Tesla.

In our world, (Kn′) has a true factive presupposition.[4] As expected, (Bn′) below is odd, and is predicted to be odd by MP as well as LI and MU:

(Bn′) Kim believes that Tesla did not found the rock band Tesla.

What we would like to point out is that (Bn′) should resemble in all relevant respects the LF of (nB′), assuming that the source of the NR inference in (nB′) is syntactic:

(nB′) Kim does not believe that Tesla founded the rock band Tesla.
(*LF on the syntactic view*: [Kim believes [that NEG Tesla founded the rock band Tesla]])

But (nB′) is not very odd — certainly not as odd as (Bn′). As far as we can see, the syntactic view of NR does not predict this difference. Perhaps one could assume that, despite the similarity of their LFs, (Kn′) is not a formal alternative to (nB′). However, we do not know if this assumption can be defended. Note by comparison that, on the semantic view of NR, (nB′) does not have an LF where negation appears in the scope of *believe*, which means that (nB′) will not have (Kn′) as a formal alternative. The account therefore predicts (nB′) and (Bn′) to behave differently, as desired.

There are more questions to raise. Even if the underlying syntax of (nB) turns out to be the right explanation of its acceptability, and even if something else can be said to distinguish (nB′) from (Bn′), the overall story cannot be extended to other cases of NR that seem to us to have the same profile as *believe*. Let us expand on this.

Collins and Postal (2018) (C&P), citing Horn 1978, have argued that the expressions *is of the opinion* and *it is X's opinion* license an NR inference when they are negated, but that unlike *believe*, they do not license strict NPIs, and do not allow negative auxiliary inversion. From this, C&P conclude that the NR inference in these cases cannot have a syntactic source. The examples below show the relevant data. (16a,b) show that NR follows from the negations of *be of the opinion* and *it is X's opinion*. (17a,b) show that these negation do not allow embedded strict NPIs; (17c) shows they they do not allow auxiliary inversion. (18a,b) show that negated *believe* allows both.

(16) a. Kim is not of the opinion that Mars can be colonized (Based on C&P, ex. 18)
≈ Kim is of the opinion that Mars cannot be colonized

b. It is not Kim's opinion that Mars can be colonized
≈ It is Kim's opinion that Mars cannot be colonized

(17) a. *Kim is not of the opinion that Chris will leave until Friday.

b. *It is not Kim's opinion that Chris will leave until Friday.

c. *It is not my opinion that at any time did he commit perjury.

(18) a. Kim does not believe that Chris will leave until Friday.

b. I do not believe that at any time did he commit perjury.

[4] Tesla is an American rock band that was formed in the early 1980s. Its members have no relation to Nikola Tesla, who died in 1943.

Let us accept the conclusion that the NR inference of *is of the opinion* and *it is X's opinion* does not result from syntactic neg-raising. Now we ask whether the two predicates interact with MP in a similar way to *believe*, specifically, (i) whether they license an "anti-factive" inference when unnegated, and (ii) whether they do not license the inference when negated. We think that the answer is yes to both of these questions: (19a,b) are odd, like (B), and (20a,b) are acceptable, like (nB):

(19) a. ??Kim is of the opinion that Tesla designed the Tesla coil.

b. ??It is Kim's opinion that Tesla designed the Tesla coil.

(20) a. ✓Kim is not of the opinion that Tesla designed the Tesla coil.

b. ✓It is not Kim's opinion that Tesla designed the Tesla coil.

Given this finding, it follows that the syntactic answer to why (nB) is acceptable is not enough, since it cannot apply to cases like (20).

5 Summary

We began with *Maximize Presupposition* (MP) and with the standard account of how it favors (K) over (B) in contexts where (K) is licit. We then showed that both of (nB) and (nK) are licit in these contexts, and speculated on possible reasons behind this. We assumed that the NR property of *believe* plays a key role in the interaction, and with that, we turned the question about (nB,nK) into a question about two things: the different accounts of NR, and the correctness of MP. Our proposal is faithful to the semantic view of NR, but includes a reformulation of MP as *Maximize Update* (MU). MU compares the force of not only the presuppositions of its competitors, but the result of conjoining those presuppositions with the assertions of the given forms. We compared the account to Romoli's (2012) implicature-based theory of NR, and to syntactic views of NR. On the implicature theory, we concluded that MP can explain the acceptability of (nB) *if* the principle is assumed to operate on exhaustified expressions. We were not able to find evidence in favor of or against this possibility, and we explained why finding that evidence is difficult. On the syntactic theory, we argued first that the theory predicts (nB) to behave like (Bn), given that the underlying form in the first case is structurally like the surface form of the second. We claimed, however, that the two forms behave differently. More generally, we pointed out that other NR expressions behave just like *believe* in their interaction with MP, but are not amenable to a syntactic account of the NR inference.

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