Proceedings of SALT 32: 891–914, 2022

Neg-raising with belief predicates as a scaleless implicature*

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Abstract I propose a novel analysis for neg-raising (NR) with belief predicates, where the NR reading 'think not' is achieved as a scaleless implicature derived from applying an exhaustivity operator (from Bar-Lev & Fox 2020) to 'not think' and the subdomain alternatives projected by *think*. I show evidence that NR behaves like other types of implicatures derivable by the same operation (scalar implicatures, free choice, other scaleless implicatures), in particular in its sensitivity to the question under discussion and polarity of the environment. An implicature-based approach approximates NR's behavior better than the prominent syntactic and presupposition-based accounts. This analysis revives Romoli's (2013) proposal to treat the NR inference as an implicature while avoiding its undesirable theoretical assumptions.

Keywords: neg-raising, scaleless implicatures, belief predicates, exhaustification

1 Introduction

Neg-raising (NR) is when a matrix verb is negated, but negation appears to be interpreted below the verb. NR is licensed by certain predicates, e.g. English *think*.

(1) 'Iris does**n't** think it's snowing.' $\rightsquigarrow$ *Iris thinks it's **not** snowing.*

There have been a variety of accounts of NR, from those explaining it as a result of syntactic movement (Fillmore 1963; Collins & Postal 2014) to semantic/pragmatic accounts (Bartsch 1973; Horn 1989; Gajewski 2005, 2007), which take NR to stem from an excluded middle requirement. In this paper, I propose a novel account of this inference as a *scaleless implicature*.[1] This accounts bears resemblance to the one proposed by Romoli (2013), in which NR is a scalar implicature. The success of Romoli's account lies in its ability to capture the implicature-like behavior of the inference, contrasting with Gajewski's (2005; 2007) influential presuppositional account, which, as Romoli convincingly argues, struggles with the fact that the

* I thank Sam Alxatib, Itai Bassi, Chris Collins, Deniz Özyıldız and the audience at SALT 32 for helpful discussion. This work is supported by the ERC Synergy Grant No. 856421 (LeibnizDream).

1 See Mirrazi & Zeijlstra 2021 for a similar account of NR that has been put forward concurrently. I do not discuss differences in implementation and argumentation for reasons of space.

excluded middle presupposition does not behave like other presuppositions. But Romoli's analysis comes with an undesirable theoretical feature. It stipulates that NR predicates have an 'excluded middle' scalar alternative, which is absent from the lexicon, going against the consensus of what a scalar alternative should be.

The present proposal maintains the status of the NR inference as an implicature, thus inheriting the advantages of the scalar implicature approach in explaining the distribution of NR while circumventing its main theoretical issue. In this account, the implicature arises not from the presence of a scalar excluded middle alternative, but from the absence of any scalar alternative and the presence of subdomain alternatives—whose existence has independent motivation. With these assumptions, NR can be derived from applying an EXHaustivity operator to a negated belief report, such as the one proposed by Bar-Lev & Fox (2020) that computes implicatures in the grammar. Analyzed in this way, NR falls into a category of inferences that Jeretič 2021a calls 'scaleless implicatures', which underlie wide scope readings of certain necessity modals when negated (e.g. French *falloir*, English *must*), and a variety of other phenomena previously analyzed as such (Bowler 2014; Bar-Lev & Margulis 2014; Bassi & Bar-Lev 2016; Staniszewski 2019, 2020; Bar-Lev 2020, a.o.).

Besides scaleless implicatures, the same EXH operator derives classic scalar implicatures and free choice. We thus expect all these inferences to be subject to the same licensing conditions imposed on EXH. A large part of this paper is dedicated to highlighting empirical parallels between these different types of inferences, building on Romoli's observations that NR has the distribution of an implicature. I compare the behavior of each inference in contexts that expose common characteristics, namely their sensitivity to the Question Under Discussion and the polarity of their linguistic environment. I also show that NR behaves specifically as a scaleless implicature as it conforms to a generalization in which scaleless implicatures are blocked when the predicate triggering them is forced to be eventive (also observed with neg-raising modals). Finally, I argue that a scaleless implicature account is preferable to Romoli's scalar one in that it is theoretically more plausible, and also makes a more accurate prediction of the behavior of *think* in the restrictor of *every*.

This paper is about NR with belief predicates, and provides data for English *think*. The empirical claims appear to extend to *believe* and corresponding French belief verbs, but not to NR desire predicates like *want*, calling for a separate analysis.

2 The scaleless implicature analysis

2.1 In a nutshell

I propose that the NR inference is derived as a *scaleless implicature*, which, generally speaking, is a strengthening from an existential (or negated universal) quantificational claim to a universal one (Jeretič 2021a and references therein), and in this case, from the reading given by the LF where *think* scopes below negation to the stronger reading where *think* scopes above. Scaleless implicatures are derived in frameworks of scalar implicatures computed in the grammar (Fox 2007; Bar-Lev & Fox 2020), as a result of the application of an exhaustivity operator EXH, as illustrated below.

(2) $[\![$ EXH [NEG [x think p]] $]\!] \equiv [\![$ x think NEG p $]\!]$

Thus, the NR inference is analyzed on a par with other implicatures derived from the application of EXH. These include scalar implicatures, free choice (following Fox 2007), and other scaleless implicatures. Different implicatures obtain from different properties of the prejacent's alternative set; for scaleless implicatures, they arise in case an expression has subdomain alternatives but no scalar alternative.

In this work, I take *think* to be a universal quantifier (as is standard) which has subdomain alternatives and no scalar alternative. A scaleless implicature is computed when *think* is negated, which, as a weak quantificational claim, qualifies for strengthening (while non-negated *think* is already strong). This computation is analogous to cases discussed in Jeretič 2021a,b of negated root necessity modals (English *must*, French *falloir*) giving rise to apparent wide scope readings via scaleless implicature.

In 2.2 I present Bar-Lev & Fox's (2020) grammatical theory of scalar implicatures and show how it accounts for scalar implicatures and free choice. I then show in 2.3 how with minimal assumptions about *think* it derives NR as a scaleless implicature.

2.2 Scalar implicatures and the grammatical theory

Let's begin with the well-known phenomenon of scalar implicature. An example is given in (3), where an existential expression, here a modal, is strengthened to its conjunction with a corresponding negated universal expression.

(3) She's allowed to leave. $\rightsquigarrow$ *'She's not required to leave.'*

It is debated whether implicatures are computed pragmatically (Grice 1975, et seq.), or in the grammar, from an exhaustivity operator (Chierchia, Fox & Spector 2012). Here, I assume the grammatical framework from Bar-Lev & Fox 2020.

2.2.1 The framework

Exhaustification In Bar-Lev & Fox 2020, implicatures are derived as an effect of an exhaustivity operator EXH, defined in (4), which applies to a proposition *p* and a set of alternative propositions *C*. It asserts *p*, negates all Innocently Excludable (IE) alternatives (5a)—those that can be negated non-arbitrarily and consistently with *p*, and asserts all Innocently Includable (II) alternatives (5b)—those which can be conjoined non-arbitrarily and consistently to the IE-strengthened reading of *p*.

(4) $[\![\text{EXH}]\!](C)(p)(w) \equiv p(w) \wedge \forall q \in IE(p,C)[\neg[\![q]\!](w)] \wedge \forall r \in II(p,C)[[\![r]\!](w)]$

(5) a. $IE(p,C) = \bigcap\{C' \subseteq C : C' \text{ is maximal \& } \{\neg[\![q]\!] : q \in C'\} \cup \{p\} \text{ is consistent}\}$

b. $II(p,C) = \bigcap\{C'' \subseteq C : C'' \text{ is maximal \& } \{[\![r]\!] : r \in C''\} \cup \{p\} \cup \{\neg[\![q]\!] : q \in IE(p,C)\} \text{ is consistent}\}$

I assume, standardly, that when EXH applies to a syntactic phrase P, it applies to $[\![\text{P}]\!]$ and P's set of alternatives $Alt(\text{P})$. Conditions on where and when EXH can apply will be introduced in section 3.1, to account for the distribution of implicatures.

Alternatives The main assumption I make here is that a quantifier Q may project two types of alternatives: *scalar* and *subdomain* alternatives. A **scalar alternative** of Q is a lexical item whose semantics is related to Q by asymmetric containment (Horn 1972, 1989). For instance, duals, like *some* and *all*, are scalar alternatives of each other. (I also take that an expression is a scalar alternative to itself, following standard convention; this has non-trivial consequences when multiple quantifiers project their alternatives.) In (6), I give examples of scalar alternatives of English quantifiers, where connectives are also quantifiers, whose domain is the set of coordinands.

(6) a. $ScalarAlt$(or) = {or, and}
$ScalarAlt$(and) = {or, and}

b. $ScalarAlt$(some) = {some, most, all}
$ScalarAlt$(all) = {some, most, all}

I assume that a quantifier's scalar alternative must correspond to a lexical item (in line with Horn 1972; Katzir 2007; Fox & Katzir 2011, a.o.). Work on scaleless implicatures (Jeretič 2021a: Ch3) provides support for this claim, where an investigation of several cases of scaleless implicature triggers reveals that their 'obligatoriness' exactly correlates with the absence of a lexical scalar alternative.

The other type of alternatives I consider are **subdomain alternatives**. In addition to being crucial in deriving scaleless implicatures, these have been proposed to account for several other phenomena (often under different names/definitions, but with equivalent results): implicatures embedded under disjunction (Sauerland 2004), free choice with disjunction and indefinites (Kratzer & Shimoyama 2002; Alonso-Ovalle 2005; Fox 2007), and polarity items (Krifka 1995; Chierchia 2013). For a quantifier Q over a domain D, Q's subdomain alternatives are obtained by replacing D with a non-empty subdomain $D' \subseteq D$.[2] I give examples below.

(7) a. $SubdomainAlt$(A, B or C) = {A, B or C; A or B; A or C; B or C; A; B; C}

b. $SubdomainAlt$(everyone <*in {A,B,C}*>) = {everyone <*in {A,B,C}*>, everyone <*in {A,B}*>, everyone <*in {A,C}*>, everyone <*in {B,C}*>, everyone <*in {A}*>, everyone <*in {B}*>, everyone <*in {C}*>}

2 Note that the structural alternative account by Katzir (2007); Fox & Katzir (2011) only predicts subdomain alternatives for connectives, and therefore calls for some kind of amendment to allow for subdomain alternatives for quantifiers, if one is to use that theory.

I assume, following Jeretič 2021a, that a quantifier is lexically specified to have subdomain alternatives or not (in contrast with scalar alternatives, whose presence depends on available expressions in the lexicon).

Finally, the alternatives of Q 'project' up to any expression containing it: the alternatives of a linguistic expression E containing a quantifier Q are obtained by replacing Q in E with each of Q's alternatives.

(8) $Alt([_E...Q...]) = \{[_E...Q_i...] | Q_i \in Alt(Q)\}$

2.2.2 Deriving scalar implicatures and free choice

Scalar implicatures We begin in (9) with Boolean disjunction, taken to be the meaning of English *or*, which triggers a 'not both' scalar implicature.

(9) $S =$ Zoe talked to Yann or Wynn.' $= y \vee w$
⇝ *She didn't talk to both.* $\wedge \neg(y \wedge w)$

The set of alternatives of the disjunction crucially contains *and*, assumed to be Boolean conjunction. It also contains subdomain alternatives, i.e. the disjuncts.

(10) $Alt(S) = \{y \vee w,\ y,\ w,\ y \wedge w\}$

The set of IE alternatives, in (11a), is the intersection of the maximal sets of alternatives whose negation is consistent with the prejacent; here we end up with the conjunctive alternative alone. For the II alternatives, we find the maximal sets of alternatives consistent with the utterance and the negation of the IE alternative. Their intersection, in (11b), is simply $\{y \vee w\}$, which is S itself.

(11) a. $IE(S, Alt(S)) = \bigcap\{\{y,\ y \wedge w\},\ \{w,\ y \wedge w\}\} = \{y \wedge w\}$
b. $II(S, Alt(S)) = \bigcap\{\{y,\ y \vee w\},\ \{w,\ y \vee w\}\} = \{y \vee w\}$

The exhaustifier excludes the scalar alternative (i.e. the IE alternative), which derives the scalar implicature. Including the II alternative is trivial.

(12) $\text{EXH}[Alt(S)][S] \equiv (y \vee w) \wedge \neg(y \wedge w)$

Free Choice Typical examples of free choice involve a disjunction under an existential operator. Two inferences are generally identified in such configurations:

(13) $S =$ Zoe can talk to Yann or Xorr. $= \Diamond(y \vee x)$
⇝ *Zoe can't to talk to both.* [exclusivity] $\wedge \neg\Diamond(y \wedge x)$
⇝ *Zoe can talk to Yann and can talk to Xorr.* [free choice] $\wedge \Diamond y \wedge \Diamond x$

S has the following set of alternatives projected by the disjunction (those projected by the existential modal $\Diamond$ can be ignored for our present purposes).

(14) $Alt(S) = \{\Diamond(y \vee x),\ \Diamond y,\ \Diamond x,\ \Diamond(y \wedge x)\}$

The IE set in (15a) contains the conjunctive alternative only, similarly to the simple disjunction case. The II alternatives, in (15b), on the other hand, are a larger set than for the simple disjunction in that they contain the subdomain alternatives (including them is now consistent with the negated conjunctive alternative).

(15) a. $IE(S,Alt(S)) = \bigcap\{\{\Diamond y,\ \Diamond(y \wedge x)\},\ \{\Diamond x,\ \Diamond(y \wedge x)\}\} = \{\Diamond(y \wedge x)\}$
b. $II(S,Alt(S)) = \bigcap\{\{\Diamond y,\ \Diamond w,\ \Diamond(y \vee x)\}\} = \{\Diamond y,\ \Diamond x,\ \Diamond(y \vee x)\}$

The exclusivity inference arises due to exclusion of the conjunctive alternative, parallel to the scalar implicature from the previous section. The free choice inference arises from including the II subdomain alternatives $\Diamond y$ and $\Diamond w$. Final result is below.

(16) $\textsc{exh}\ [Alt(S)][S] \equiv \Diamond(y \vee x) \wedge \neg\Diamond(y \wedge x) \wedge \Diamond y \wedge \Diamond x$

2.3 Scaleless implicature derivation for neg-raising

I now show how scaleless implicatures are derived in the case at hand, namely NR with *think*. I adopt a standard semantics for a belief predicate like *think* as a universal quantifier over DOX(x), the set of worlds compatible with x's beliefs (Hintikka 1969).

(17) a. $[\![$ think $]\!] = \lambda p \lambda x. \forall w \in \textsc{dox}(x).p(w)$
b. $[\![$ Jo doesn't think it's snowing $]\!] = \neg\forall w \in \textsc{dox}(\text{jo}).\mathsf{snow}(w)$

I assume that a *think* utterance's alternatives include subdomain alternatives, and no scalar alternative. There is no lexical item in English that corresponds to the dual of *think* (i.e. an existential epistemic attitude with meaning 'admit the possibility'), nor any other predicate that has a strictly weaker meaning than *think*. This supports the claim that *think* has no scalar alternative.[3] Furthermore, I assume that *think* projects subdomain alternatives, which are formed by replacing the quantifier's domain (the belief set) with each of its non-empty subdomains. So for a negated *think* utterance like (17b), we have the set of alternative propositions shown in (18).

(18) $Alt((17b)) = \{\neg\forall w \in D.\mathsf{snow}(w) | \varnothing \subset D \subseteq \textsc{dox}(\text{jo})\}$

I give an example derivation of NR using EXH from Bar-Lev & Fox. (19) is a negated thought report before exhaustification with a simplified belief set $\{w_1, w_2\}$ (the result is generalizable to an infinite domain, as shown in Jeretič 2021a: Ch2); its corresponding alternative set is in (20).

3 I ignore potential scalar alternatives stronger than *think*, e.g. *know* or *be certain*. Their presence does not interfere with the results of this paper.

(19) $S = \neg B_{\{w_1,w_2\}}p$ (notation for $\neg\forall w \in \{w_1,w_2\}.p(w)$)

(20) $Alt(S) = \{\neg B_{\{w_1,w_2\}}p,\ \neg B_{\{w_1\}}p,\ \neg B_{\{w_2\}}p\}$

Among these alternatives, none of them are IE. First, there is no scalar alternative to exclude, and furthermore, the subdomain alternatives $\neg B_{\{w_1\}}p$ and $\neg B_{\{w_2\}}p$ cannot be excluded non-arbitrarily without contradicting the prejacent. Next, we compute the II set. All alternatives are includable without contradiction.

(21) a. $IE(S,Alt(S)) = \varnothing$
b. $II(S,Alt(S)) = \{\neg B_{\{w_1,w_2\}}p,\ \neg B_{\{w_1\}}p,\ \neg B_{\{w_2\}}p\}$

When EXH is applied, the subdomain alternatives are all included. The result is equivalent to a wide scope reading of *think* above negation, i.e. the NR inference.

(22) $\textsc{exh}\ [Alt(S)][S] \equiv \neg B_{\{w_1,w_2\}}p \wedge \neg B_{\{w_1\}}p \wedge \neg B_{\{w_2\}}p \equiv B_{\{w_1,w_2\}}\neg p$

Subdomains alternatives of quantifiers over variable domains There is a complication that I have ignored so far. The domain of *think* is anchored to an individual introduced in the syntax, and that individual can be variable (for example, with a quantifier subject, e.g. 'everyone thinks'). There is to my knowledge no definition of subdomain alternatives of a quantifier whose domain is assignment-dependent; I give one here, using choice functions that pick out for each x a member of the power set of $\textsc{dox}(x)$ minus the empty set, i.e. the set of all non-empty subsets of $\textsc{dox}(x)$.

(23) $Alt(think) = \{\lambda p \lambda x.\forall w \in f(\mathscr{P}(\textsc{dox}(x))/\varnothing).p(w) \mid f$ is a choice function defined on $\mathscr{P}(\textsc{dox}(x))/\varnothing$ for all $x\}$

This definition is used in sections 2.4.1 and 3.2.2 for derivations where *think* has a quantifier subject.

2.4 Key predictions

2.4.1 Negative quantifier subjects

NR is observed with negative quantifier subjects, where the reading corresponds to a narrow scope negation under a universal quantifier, as shown in (24).

(24) No-one thinks it's raining. $\rightsquigarrow$ *Everyone thinks it's not raining.*

(25) $S = \neg\exists x.\forall w \in \textsc{dox}(x).\mathsf{rain}(x)$

This sentence involves a quantified subject, so we use the generalized definition of a subdomain alternative of a quantifier over a variable domain, as follows.

(26) $Alt(S) = \{\neg\exists x \in D.\forall w \in f(\mathscr{P}(\textsc{dox}(x))/\varnothing).\mathsf{rain}(w) \mid f$ is a choice function defined on $\mathscr{P}(\textsc{dox}(x))/\varnothing$ for all $x \in D\}$

Take a simple model with two individuals $D_e = \{x_1, x_2\}$, each having a belief set containing two worlds: $\textsc{dox}(x_1) = \{w_1, w_2\}$, $\textsc{dox}(x_2) = \{w_3, w_4\}$. Examples of choice functions satisfying the conditions in (26) are in (27); corresponding alternatives built from them are in (28).

(27) $f_1 : \mathscr{P}(\textsc{dox}(x_1)) \to \{w_1\},\ \mathscr{P}(\textsc{dox}(x_2)) \to \{w_3, w_4\}$
$f_2 : \mathscr{P}(\textsc{dox}(x_1)) \to \{w_1\},\ \mathscr{P}(\textsc{dox}(x_2)) \to \{w_3\}$

(28) a. $\neg(\forall w \in \{w_1\}.\mathsf{rain}(w) \vee \forall w \in \{w_3, w_4\}.\mathsf{rain}(w))$
b. $\neg(\forall w \in \{w_1\}.\mathsf{rain}(w) \vee \forall w \in \{w_3\}.\mathsf{rain}(w))$

There are no IE alternatives. We can see this by attempting to exclude the alternatives least likely to affect the result, i.e. the strongest ones (excluding them would yield the weakest result), which are those built from singletons, e.g. (28b) (since universal quantification under a negated existential, a DE context, gets stronger as the domain shrinks). Excluding those goes as follows.

(29) Conjunction of the negation of each singleton-based alternative:
$(\mathsf{r}(w_1) \vee \mathsf{r}(w_3)) \wedge (\mathsf{r}(w_1) \vee \mathsf{r}(w_4)) \wedge (\mathsf{r}(w_2) \vee \mathsf{r}(w_3)) \wedge (\mathsf{r}(w_2) \vee \mathsf{r}(w_4))$
$\equiv \forall w \in \textsc{dox}(x_1).\mathsf{rain}(w) \vee \forall w \in \textsc{dox}(x_2).\mathsf{rain}(w)$

The result is in contradiction with S. Excluding any subset of these alternatives would be arbitrary, and therefore disallowed. Any other alternative is weaker than one of these alternatives, therefore is non-IE by virtue of a stronger alternative being non-IE. Therefore, there are no IE alternatives.

We now show that including S's strongest alternatives, i.e. the singleton-based alternatives, is consistent with the utterance (including any weaker alternative will be trivial); all alternatives are thus II. Doing so yields the observed inference.

(30) $\textsc{exh}[Alt(S)][S] \equiv \neg(\mathsf{r}(w_1) \vee \mathsf{r}(w_3)) \wedge \neg(\mathsf{r}(w_1) \vee \mathsf{r}(w_4)) \wedge \neg(\mathsf{r}(w_2) \vee \mathsf{r}(w_3)) \wedge \neg(\mathsf{r}(w_2) \vee \mathsf{r}(w_4)) \equiv \forall x.\forall w \in \textsc{dox}(x).\neg\mathsf{rain}(w)$

2.4.2 Cyclic neg-raising

NR with belief predicates is known to be cyclic (Fillmore 1963), meaning that a negation scoping above more than one belief predicate can be interpreted in the scope of the most embedded proposition,[4] as shown in (31).

4 Horn (1971) observes that cyclic NR is partial: in particular, NR is not cyclic when a desire predicate embeds a belief predicate. Partial cyclicity is an instance of a distributional difference in the NR of belief vs desire predicates, supporting the scope of this paper being limited to belief predicates.

(31) I don't think Zoe thinks it's raining. $\rightsquigarrow$ *I think Zoe thinks it's not raining.*

Cyclic NR is accounted for within the scaleless implicature analysis if we assume that both belief predicates project their own alternatives, as shown in (33). The IE and II sets are a simple extension of the basic case (where no alternative is IE, and all are II). In (35) we see how including singleton-based alternatives derives cyclic NR (including the others will be redundant as the NR reading is maximally strong).

(32) $S = \neg B_{\{w_1,w_2\}} B_{\{w_3,w_4\}} p$

(33) $Alt(S) = \{\neg B_D B_{D'} p \,|\, D \subseteq \{w_1, w_2\}, D' \subseteq \{w_3, w_4\}\}$

(34) $IE(S, Alt(S)) = \varnothing;\ II(S, Alt(S)) = Alt(S)$

(35) $\textsc{exh}_{Alt(S)} S \equiv \neg B_{\{w_1\}} B_{\{w_3\}} p \wedge \neg B_{\{w_1\}} B_{\{w_4\}} p \wedge \neg B_{\{w_2\}} B_{\{w_3\}} p \wedge \neg B_{\{w_2\}} B_{\{w_4\}} p$
$\equiv B_{\{w_1\}} B_{\{w_3\}} \neg p \wedge B_{\{w_1\}} B_{\{w_4\}} \neg p \wedge B_{\{w_2\}} B_{\{w_3\}} \neg p \wedge B_{\{w_2\}} B_{\{w_4\}} \neg p$
$\equiv B_{\{w_1,w_2\}} B_{\{w_3,w_4\}} \neg p$

3 Arguments in favor of neg-raising as a scaleless implicature

The scaleless implicature analysis of NR adds to a long literature on the subject, to which I will not be able to make full justice here. Instead, I will provide additional support for the treatment of NR as an implicature, by showing that its distribution is similar to that of other implicature types in its sensitivity to the QUD (Question Under Discussion, Roberts 2012) and the polarity of the environment, and to other scaleless implicatures in its interaction with aspect. Having defended a treatment of NR as an implicature, I argue why the scaleless implicature analysis is superior to the scalar implicature one from Romoli 2013, primarily from a theoretical standpoint.

3.1 The neg-raising inference behaves like an implicature

If scalar implicatures, free choice inferences, scaleless implicatures and NR are derived from the application of the same operator EXH, as proposed in the previous section, we should observe similarities in the licensing of all these inferences. In this section I show that they pattern together in their QUD and polarity sensitivity. I also formulate conditions on EXH that account for these properties.

3.1.1 QUD sensitivity

In this section, I argue that all implicature types—scalar implicatures, free choice, scaleless implicatures, NR—pattern together in their QUD sensitivity, focusing on unembedded environments (see the next section for embedded environments). I propose that the QUD sensitivity can be captured by the following condition on EXH.

(36) QUD-based condition on EXH application: EXH need not apply if the unstrengthened reading is a complete answer to the QUD, otherwise it must.

Scalar implicatures The licensing of scalar implicatures in unembedded contexts is known to be sensitive to discourse conditions, and in particular to the QUD. See Hulsey, Hacquard, Fox & Gualmini 2004; Gualmini, Hulsey, Hacquard & Fox 2008; Zondervan, Meroni & Gualmini 2008; Magri 2009; Benz & Salfner 2011; Jeretič 2021a for relevant discussion. A hallmark property of scalar implicatures is that they are 'cancellable', but I suggest that this claim is misleading, as the availability of cancellation appears to strictly depend on the QUD. Indeed, one observation present in all of the above-cited works (though stated in a variety of ways) is that scalar implicatures can be cancelled if doing so provides a complete answer to the QUD.

I illustrate this with the following example. Take the implicature of non-necessity triggered by *allowed*. In (37), the implicit QUD is about general rules related to covid restrictions. The use of *allowed* under this QUD obligatorily triggers a scalar implicature. This is shown by the infelicitous continuation; if it is at all possible, it sounds like a correction, rather than a typical cancellation.

(37) *Context: A teacher announces daily covid-related rules about going to school.*
Today, kids are allowed to go to school. ??...in fact, they are required to.

This example contrasts with one where the QUD licenses suspension of the implicature, i.e. has a cell corresponding to the unstrengthened meaning. In (38), we have such a QUD, stated in an explicit question, and a scalar implicature is not computed, as shown by the available "cancellation" of the implicature.

(38) A: Are the kids allowed to go to school today?
B: Yes they are allowed to, finally. ✓...in fact, they are required to.

Free choice Free choice is known to be robustly derived, with an example in (39). However, with the right QUD, it can be suspended, as shown in (40).

(39) Some students took algebra or logic this year. #...in fact, none took logic.

(40) *Context: A teacher is voicing the responses to a questionnaire to the school's principal. This year, no students took logic. Questionnaire question: Did some students take algebra or logic this year? Teacher:*
✓Yes, some students took algebra or logic this year. (though none took logic)

Scaleless implicatures In Jeretič 2021a, scaleless implicatures are also shown to be sensitive to the QUD. For example, take French necessity modal *falloir*,[5] which,

5 This also works with *must* in some Englishes (in which, perhaps, deontic *must* is frequent enough).

like *think*, triggers a scaleless implicature when negated, from $\neg\Box$ to $\Box\neg$. A QUD of the type $\{\Box, \neg\Box\}$ allows the implicature to be suspended, since doing so provides a complete answer ($\neg\Box$) to it. I first show that the implicature must be computed in the absence of such a QUD: in (41), a question other than $\{\Box, \neg\Box\}$ is asked, and only the strong reading $\Box\neg$ is available, as shown by diagnostic continuations.

(41) *B is an academic who can generally choose to go to their office; they have to go if there is a meeting; they can't go if an officemate tests positive.*

A: Qu'est-ce que tu vas faire aujourd'hui? 'What are you going to do today?'

B: Il **faut pas** que j'aille au bureau...
it must neg that I-go to office
'I {must not, ✗don't have to} go to the office...'

i. ...because an officemate tested positive. (✓$\Box\neg$)

ii. #because I have no meeting planned, so I prefer to stay at home. (✗$\neg\Box$)

In contrast, in a context which makes available the QUD $\{\Box, \neg\Box\}$, the weak meaning $\neg\Box$ is available: its diagnostic continuation is now felicitous.

(42) *Same context.*

A: Tu dois aller au bureau aujourd'hui? 'Do you have to go to the office today?'

B: Non il **faut pas** que j'y aille...
no it must neg that I-there go
'No I {must not, don't have to} go...'

i. ...because an officemate tested positive. (✓$\Box\neg$)

ii. ...because I have no meeting planned, so I prefer to stay at home. (✓$\neg\Box$)

Neg-raising We now turn to NR's QUD sensitivity. NR can famously be suspended, but as emphasized by Gajewski (2005), and elaborated by Romoli (2013), NR is generally robustly derived, and its suspension is only licensed in particular discourse contexts. Romoli models the suspension conditions in terms of the relevance of the excluded middle; in other words, if the QUD doesn't care about the NR reading, NR can be suspended. I reformulate the condition as follows (in line with the general condition stated in (36)): if the unstrengthened reading (non-NR $\neg$*think p*) is a complete answer to the QUD, then NR is suspendable. So in the presence of a QUD $\{$*think p*, $\neg$*think p*$\}$, NR can be suspended; in the absence of such a QUD, NR is obligatory. In (43), negated thought reports are uttered in discourses free of a QUD of this type, and continuations targetting the non-NR reading are infelicitous.

(43) *Contexts: discourse initial, with no previous mention of the relevant topics.*

a. A: Does Jon have any information about the weather?
B: He doesn't think it's raining, #he's not sure. ✗*non-NR*

b. A: Mel doesn't think God exists. B: #So are they agnostic? ✗*non-NR*

In the presence of a QUD $\{think\ p, \neg think\ p\}$, the non-NR reading is accessible. In (44), the QUD is explicit, and in (45), the prosody indicates an answer to a QUD of this type (as argued in Romoli 2013). Continuations diagnosing non-NR are natural.

(44) a. A: Does Jon think it's raining?
B: No, he doesn't think it's raining, he's not sure. ✓*non-NR*

b. B: Does Mel think God exists?
A: No, Mel doesn't think God exists. B: So are they agnostic? ✓*non-NR*

(45) Jon {DOESN't think, doesn't THINK} it's raining, he isn't sure. ✓*non-NR*

3.1.2 Polarity sensitivity

In this section, I show that NR patterns like other implicatures in that it is sensitive to the polarity of the environment (Fox & Spector 2018: a.o.): it is obligatory in upward-entailing (UE) contexts, and optional in all others (Jeretič 2021a).

Implicatures under negation Implicatures are not available under clausemate negation (not testable for NR), and optionally available under extra-clausal negation.

We first look at the scalar implicature that would be triggered by disjunction under negation $\neg(y \vee w)$. It would have the following meaning: $\neg((y \vee w) \wedge \neg(y \wedge w)) \equiv \neg(y \vee w) \vee (y \wedge w)$, i.e. 'neither or both'. This meaning is not observed:

(46) *I am wondering who Zoe met out of Yann and Wynn. I then realize that Yann and Wynn are inseparable, and Zoe couldn't have met only one.*
Zoe didn't meet Yann or Wynn, # she can only have met neither or both.[6]

Likewise, free choice is unavailable under clausemate negation. The reading would correspond to $\neg(\Diamond y \wedge \Diamond w)$. We diagnose its absence with the infelicitous continuation $\Diamond y \wedge \neg\Diamond w$, compatible with it but not with the lack of inference.

(47) *I think Zoe can talk to either director, Yann or Wynn. You disagree:*
Zoe can't talk to Yann or Wynn, # she can only to talk to Yann.

6 Some authors argue that stressing the scalar item allows for an embedded implicature: 'Zoe didn't meet Yann OR Wynn, she met both.' However, 'both' is only entailed by the negated implicature, its full meaning is 'neither or both', and (46) is odd even with stressed 'or'. Therefore, stressed 'or' could indicate wide scope or contrastive focus under metalinguistic negation (contrasting 'or' and 'and').

Finally, scaleless implicatures are not computed under clausemate negation. I give an example from Walpiri scaleless disjunction *manu*, from Bowler 2014, which cannot have a conjunctive (i.e. strengthened) meaning under negation.

(48) Zoe didn't talk to Yann manu Wynn. $\not\equiv \neg(y \wedge w)$

In contrast, under extra-clausal negation, implicatures are available, albeit dispreferred, showing that the locality with respect to a polarity-flipping operator matters. See below for scalar implicatures and free choice (these examples are minimal pairs with the ones above, thus also validating them as tests).

(49) a. *Same context as (46).* I don't think Zoe met Yann or Wynn,
$^{\checkmark}$she can only have met neither or both.

b. *I think Zoe can talk to either director, Yann or Wynn. You disagree:*
I don't think Zoe can talk to Yann or Wynn, $^{\checkmark}$she can only talk to Yann.

Implicatures optional in other non-UE contexts I now show examples of optional implicatures in a conditional antecedent, illustrative of a general picture in which implicatures are optional in non-UE contexts (for more discussion see Fox 2007; Levinson 2000; Recanati 2003; Horn 1989; Schlenker 2016).

(50) a. If you can go, that means you don't have to. (scalar imp. computed)

b. If you can go, that doesn't mean you don't have to. (no scalar imp.)

We can also diagnose optionality of free choice in a conditional antecedent.

(51) If some students took algebra or logic this year, we'll consider that a success.
Two students took algebra, none logic.

a. $^{\checkmark}$Two students took algebra, it's a success!

b. $^{\checkmark}$No-one took logic, we can't consider it a success.

Scaleless implicatures are optional too, shown below for negated *falloir* in a conditional antecedent (see Jeretič (2021a) for other triggers and environments).

(52) A: Qu'est-ce que tu vas faire aujourd'hui? 'What are you going to do today?'

B: S'il **faut pas** que j'aille au bureau, ... 'If I must not go to the office, ...'
if.it must neg that 1s.go to office

i. ...I don't have the choice, I must stay working at home.' ($^{\checkmark}\Box\neg$)

ii. ...I prefer to stay at home. ($^{\checkmark}\neg\Box$)

Neg-raising Polarity sensitivity is also observed with NR. To my knowledge the observations in this section are novel. We cannot test clausemate negation, since that slot is already occupied. In other non-UE environments (scope of 'no-one', 'exactly 2', 'unlikely', conditional antecedents), NR is optional, in contrast with UE environments ('someone', 'possible'), where NR is obligatory. I also fix a QUD that does not license implicature suspension to zoom in on the effect of polarity.

In (53), in the UE scope of *someone*, only the NR reading is available. This is shown by an infelicitous continuation compatible with the non-NR reading only.

(53) A: What do people think of Jon? B: Someone doesn't think Jon is smart.
...#But at least, no-one has the opinion that he's stupid. ✗*non-NR*

In (54), in the DE scope of *no-one*, the non-NR reading appears to be most available, as shown by the felicitous continuation targetting it. NR is also possible, but under a particular prosody, i.e. with a break after 'no-one', or stress on 'doesn't'.[7]

(54) A: What do people think of Jon? B: No-one doesn't think Jon is smart.
[*non-NR: everyone thinks J is smart; NR: no-one has the opinion that J is stupid*]
...C: That's not true, I don't have an opinion about Jon. ✓*non-NR*
...because he clearly shows potential. ✓*NR*

In (55), under non-monotonic 'exactly 2', both readings seem equally available.

(55) A: What do people think of Jon? B: Exactly 2 people don't think he is smart.
[*non-NR: all but 2 people think J is smart; NR: 2 people think J is stupid*]
...but that's because those 2 people don't know who Jon is. ✓*non-NR*
...C: I'm surprised anyone believes he's stupid. ✓*NR*

Another contrast between UE environments, where NR is obligatory, and non-UE environments, where NR is optional, is shown with epistemic modals in (56).

(56) What does Zoe think of Jon?
a. It's possible she doesn't think he's smart #and just has no opinion. ✗*non-NR*
b. It's unlikely that she doesn't think he's smart.
...She generally thinks people are smart. ✓*non-NR*
...She generally doesn't have strong negative opinions about people. ✓*NR*

In a conditional antecedent, a DE context, NR is also optional, as shown in (57).

(57) If/As long as Sue doesn't think Jon is cheating on her, she's happy.
...So she prefers to ignore his suspicious behavior. ✓*non-NR*
...She can only relax if she checks his phone for any immoral behavior. ✓*NR*

7 This prosody could indicate a higher position for 'no-one' and therefore less local negation, which would match the general observation that local negation disallows implicature computation. It could also reflect a QUD licensing the reading. I leave this for further research. In any case, what is relevant is that the non-NR is most available, showing clear polarity sensitivity of NR.

Analysis The explanation for sensitivity to polarity and locality of the non-UE operator can be captured with conditions on the EXH operator (from Jeretič 2021a).

(58) Polarity-based conditions on EXH application:

a. EXH must apply when it makes the utterance globally stronger relative to the non-exhaustified version, and is optional elsewhere

b. EXH can adjoin to any TP, and nowhere else

I show how these assumptions are enough to capture the distribution of implicatures, namely, obligatory computation in UE contexts (in the absence of an implicature-suspending QUD), no computation under clausemate negation, and optional computation under any other non-UE operator.

Take a weak expression $\exists$ (can also stand in for $\neg\forall$) that triggers an implicature when EXH is applied to it. EXH $\exists$ is stronger than $\exists$, so EXH is obligatory when $\exists$ is unembedded. A **UE operator** OP is entailment-preserving, so OP(EXH $\exists$) is stronger than OP($\exists$), making EXH obligatory. When $\exists$ is under **clausemate negation**, there is no TP boundary between negation and $\exists$ for EXH to apply, therefore the configuration $\neg$EXH $\exists$ is unavailable.[8] So EXH can only apply globally: EXH $\neg\exists$. In this case, there is no strengthening because the expression $\neg\exists$ is maximally strong. Under any other **non-UE operator** OP, there is generally a TP boundary at which EXH can apply. This is true of extra-clausal negation, or conditional antecedents, which embed clauses. In the case of a quantifier subject like 'no-one', it can QR above the TP boundary, and EXH can apply at the TP level between OP and $\exists$. Since OP is non-UE, EXH will not globally strengthen the utterance, and is thus optional.

If EXH applies above OP, its effect depends on the semantics of OP. When OP is DE, it reverses entailment relations, therefore the alternatives of OP($\exists$) are all weaker than OP($\exists$) (since the alternatives of $\exists$ are all stronger than $\exists$, a weak expression). Weaker alternatives are not innocently excludable, and are trivially includable, therefore EXH application is trivial. In sum, when OP is DE, the expression is ambiguous between one without implicature, and one with an embedded implicature, if there is a TP boundary in between OP and $\exists$ for EXH to apply. When OP is non-monotonic, the meaning of EXH OP($\exists$) will depend on the specific effect of OP on the innocent ex/includability of alternatives, and therefore has to be determined on a case-by-case basis, which I leave out from this paper for the sake of space/relevance.

3.1.3 Eventivity blocking scaleless implicatures

In this section I highlight a previously unnoticed empirical parallel between belief predicates and NR modals. In particular, it appears that both groups of predicates

8 Here we might expect differences in the availability of implicatures under sentential negation, whose position has been observed to vary across languages, sometimes found above TP (Zanuttini 1997).

lose their NR properties when they are coerced into an eventive (non-stative) frame (see Horn 1978; Bervoets 2014; Özyıldız 2021; Jeretič & Özyıldız 2022 for typical NR predicates, see Horn 2017; Larrivée 2004; Jeretič 2021a,b for NR modals).

I show examples from French, which morphologically encodes past perfective (with 'passé composé'), which can combine with belief predicates as well as NR modals. In the following examples (from Jeretič & Özyıldız 2022), we can see that NR is available in the past imperfective, but not in the perfective, in (59a), diagnosed with a continuation that is only felicitous if it has a thought report as an antecedent: there is one if NR is derived, but not if it isn't. (59b) controls for the availability of the antecedent when negation is not matrix.

(59) Quand Joseph est entré dans une église pour la première fois,
When Joseph went into a church for the first time,

a. Il {pensait **pas**, #a **pas** pensé} que Dieu existait. Sa mère pensait ça aussi.
He did**n't** think$_{\{\text{IPFV, \#PFV}\}}$ that God existed. Her mom thought that as well.

b. Il {pensait, a pensé} que Dieu existait **pas**. Sa mère pensait ça aussi.
He thought$_{\{\text{IPFV, PFV}\}}$ that God did**n't** exist. Her mom thought that as well.

We now turn to NR necessity modals, whose behavior I analyze in Jeretič 2021a,b as triggering scaleless implicatures. In the imperfective, a wide scope interpretation is available, but not in the perfective, as shown by the oddness of a continuation targetting the strong meaning.

(60) Il {fallait pas, #a pas fallu} aller au bureau parce que quelqu'un a testé positif.
We weren't supposed$_{\{\text{IPFV, \#PFV}\}}$ to go to work as someone tested positive.

Jeretič (2021a, Ch4) shows that all applicable cases of modals analyzed as triggering scaleless implicatures behave in the same way when perfective-marked, taking this to mean that perfective disrupts the scaleless implicature computation.

Here we see a distributional parallel between NR and other types of scaleless implicatures, which provides support for analyzing them on a par. For an analysis itself, I direct the reader to Jeretič & Özyıldız 2022, who give an analysis of perfective disrupting NR within a scaleless implicature theory. This analysis can easily be extended to NR modals. See an alternative analysis for the modal facts, not directly extendable to belief predicates, in Jeretič 2021a,b.

3.2 Choosing the scaleless implicature analysis over previous ones

In this section I will briefly present the major previous accounts of NR, and show how they fare in light of the evidence presented in this paper.

3.2.1 Non-implicature accounts

Existing syntactic accounts of NR (Fillmore 1963; Collins & Postal 2014) do not come with sensitivity to semantic factors such as polarity or the QUD. Therefore, these must be incorporated as additional assumptions if one wants to account for the data discussed in this paper. For instance, for polarity sensitivity, one could say that *think* is a positive polarity item. However, PPIs are not known to be rescued in a negative environment by the QUD. I do not spend more time discussing the syntactic account as it faces immediate difficulties in accounting for the distributional facts presented in this paper, and no hybrid account of this type exists for us to evaluate.

I therefore turn to predictions of the influential and widely adopted presupposition-based view of NR (Bartsch 1973; Gajewski 2005, 2007). On this approach, *think* triggers an excluded middle (EM) presupposition, which is responsible for the NR interpretation, as shown in (61).

(61) 'I do not think that it is raining.' $= \neg\mathsf{think}(\mathsf{raining})$
presupposes: $\mathsf{think}(\mathsf{raining}) \vee \mathsf{think}(\neg\mathsf{raining})$ $\therefore\ \mathsf{think}(\neg\mathsf{raining})$

A problem for the presuppositional account is that, as Romoli argues (also noted by Križ 2015), the EM presupposition does not have the same behavior as other presuppositions. Indeed, besides negation (which EM must project out of to derive NR), presuppositions generally project out of a variety of environments such as conditional antecedents, epistemic modals and questions. This is the case for the presupposition of *finish*, as shown in (62), but not of *think*, as shown in (63).[9]

(62) If Bill *finished* working, he will come.
Perhaps Bill *finished* working.
Did Bill *finish* working? $\rightsquigarrow$ *Bill was working.*

(63) If Jo *thinks* that Sue came, they will come.
Perhaps Jo *thinks* that Sue came. (Romoli 2013)
Does Jo *think* that Sue came? $\not\rightsquigarrow$ *Jo has an opinion on whether Sue came.*

A presuppositional account does not cover NR's polarity sensitivity. Instead, for a negated trigger embedded in a non-UE environment, it again predicts matrix projection, as shown for *finish* in (64). This is not observed with *think*, see (65).

(64) If Bill didn't *finish* working, he will come. $\rightsquigarrow$ *Bill was working.*

(65) If Jo doesn't *think* that Sue is here, they won't come.
$\not\rightsquigarrow$ *Jo has an opinion on whether Sue came.*

9 A solution is proposed in Wehbe 2022 with a ban against disconnected meanings, which blocks projection of EM from non-negative embedded environments (as in (63)), forcing local accommodation.

Let's imagine there is a mechanism forcing local accommodation of EM in (63) (e.g. see footnote 9). Then, it also forces local accommodation in (65), as observed. In this case, accommodation may occur under or above negation, which accounts for optional NR. However, what it does not capture is the role of polarity (see 3.1.2): why is NR obligatory in UE environments, but optional in non-UE ones?

3.2.2 Neg-raising as a scalar implicature (Romoli 2013)

Romoli (2013) proposes an account of NR as a scalar implicature. Its central assumption is that *think* has an excluded middle *alternative*, as shown in (66). When *think* is negated, this alternative is excluded, and NR is computed, as shown in (67).

(66) $Alt(\mathsf{think}(p)) = \{\mathsf{think}(p), \mathsf{think}(p) \vee \mathsf{think}(\neg p)\}$

(67) $\text{EXH}\ \neg\mathsf{think}(p) \equiv \neg\mathsf{think}(p) \wedge \neg\neg(\mathsf{think}(p) \vee \mathsf{think}(\neg p)) \qquad \equiv \mathsf{think}(\neg p)$

This account predicts, just like the scaleless implicature account, an implicature-like behavior, while also avoiding the projection problems mentioned in the previous section. Why then should one prefer the scaleless implicature analysis? The main reason is theoretical, and has to do with the types of alternatives invoked in each analysis. The EM alternative stipulated in Romoli 2013 is nothing like has been seen or proposed elsewhere. As discussed in 2.2.1, there are good reasons to take scalar alternatives to be lexical items.[10] The closest expression one can find in English for *think*'s EM is *have an opinion about*, as Romoli suggests, but this expression is arguably not an exact translation of the EM (see paragraph below), and also is syntactically different and more complex—this goes against the Katzirian view that scalar alternatives must be at most as complex as the item they are an alternative to. In this respect, the scaleless implicature analysis is superior to the scalar implicature one: it is based on the assumption that *think* has subdomain alternatives and lacks a scalar alternative. While still stipulative, subdomain alternatives have independently been proposed for a variety of phenomena: Krifka 1995; Chierchia 2013; Kratzer & Shimoyama 2002; Fox 2007; Sauerland 2004; Jeretič 2021a. Furthermore, the lack of any scalar alternative is predicted from the absence of one in the English lexicon, whether an EM-based one, or an existential doxastic attitude (i.e. a dual of *think*).[11]

10 See Buccola, Križ & Chemla 2021 for arguments for conceptual alternatives; they give no other clear example, however, of an alternative whose meaning isn't linked to a word in some language.

11 One could wonder whether a language which has a dual to *think* would allow for lack of NR. Močnik (2019) shows that Slovenian has an existential doxastic attitude *dopuščati*. Nevertheless, NR seems to be equally obligatory in Slovenian as it is in English, as in the following infelicitous dialogue: *A: Ne mislim/verjamem, da bog obstaja (I don't think/believe that god exists.) B: #Are you agnostic?* However, *dopuščati* might not be a good alternative to the belief verbs: it is morphologically more complex, less frequent, and could have a subtly different semantics (a consultant claims that negated *dopuščati* slightly differs in meaning from negated *believe/think*, despite NR).

Predictions in the restrictor of a universal quantifier While in some environments, the predictions of the scalar and the scaleless implicature analysis are aligned (e.g. under negated subjects, see 2.4.1), in others they are not. For example, when *think* is in the restrictor of *every*. Romoli (2013) discusses the prediction of his account in this configuration, which amounts to the inference shown below in (68).

(68) Everyone who thinks the world ended is scared. $^{?}\rightsquigarrow$ *Not everyone who has an opinion about whether the world ended is scared.*

Here, I will give an argument that suggests that empirically, this inference is not present. I will then show that the scaleless implicature analysis makes a different prediction, and which, I argue, appears to be empirically correct.

Romoli (2013) gives evidence for the presence of this inference with an ingenious use of Hurford's constraint, a property of disjunctions where disjuncts cannot stand in an entailment relation. In the absence of the inference in (68), a disjunction between the sentence and the negated inference would violate Hurford's constraint and be infelicitous; if present, it should be felicitous.[12] Such a disjunction is in (69).

(69) Either every student who thinks I am right will support me or every student who has an opinion on the matter will. (Romoli 2013)

The judgment on this sentence is unclear, and Romoli leaves it open. First, I argue this test has a confound: the expression 'have an opinion' is not necessarily an exact translation of the excluded middle statement: it is conceivable to have a belief about p without having an opinion about p, as example (70) below shows, where *think* is uttered in a context in which belief and opinion diverge.

(70) *Alex heard a rumor that Biden won, but doesn't care about the outcome of the election.* 'Alex thinks Biden won, but has no opinion on the matter.'

However, in contexts where the belief is subjective, it converges with opinion, as revealed by the oddness of claiming unopinionatedness of a subjective belief in (71).

(71) Alex thinks the president is great, #but has no opinion on the matter.

The predicate 'have an opinion' thus seems to track subjective beliefs, and is a good translation of the excluded middle in those cases only. Romoli's example is ambiguous: the prejacent 'I am right' could refer to either a factual belief or an opinion. The objective non-opinion reading is brought out in the following example.

(72) Alex thinks I am right, but has no opinion on the matter.

12 The presence of EXH is known to rescue a Hurford disjunction: *Jo ate some or all of the vegetables* is felicitous, thanks to an embedded scalar implicature, in contrast with *#Jo ate broccoli or vegetables*.

Therefore, in sentence (69), *think* could simply be understood as an objective belief, which breaks the entailment relation with *have an opinion*, invalidating the test based on Hurford's constraint. I therefore attempt to replicate Romoli's test, but removing this particular confound and using *think* in the context of a subjective belief. In addition, I remove some complexity and add contextual support.

(73) A: So many people in your country seem to be emotional these days. Who would you say is feeling most emotional? B: #Well, either everyone who thinks the president is great, or everyone who has an opinion about him.

In contrast with (69), the disjunction uttered by B is pretty clearly odd. This is predicted by Hurford's constraint if the disjuncts stand in an entailment relation. So there shouldn't be any implicature of the type in (68). Now that I've argued that Romoli's inference is absent, I will show that the scaleless implicature analysis makes a different, and accurate, prediction, namely the one in (74).

(74) Everyone who thinks the world ended is scared.
$\rightsquigarrow$ *Not everyone who admits the possibility the world ended is scared.*

In this sentence, translated in (75), the domain of *think* has a bound variable, so we use the generalized definition of a subdomain alternative of a quantifier over a variable domain, and obtain the set of alternatives in (76).

(75) $S = \forall x.[\forall w \in \mathrm{DOX}(x).\mathsf{end}(w)] \rightarrow \mathsf{scared}(x)$

(76) $Alt(S) = \{\forall x \in D.\forall w \in f(\mathscr{P}(\mathrm{DOX}(x))/\varnothing).\mathsf{end}(w) \rightarrow \mathsf{scared}(x) \mid f$ is a choice function defined on $\mathscr{P}(\mathrm{DOX}(x))/\varnothing$ for all $x \in D\}$

There are no IE alternatives. We can see this by attempting to exclude the strongest alternatives, i.e. the singleton-based ones (since universal quantification in a conditional antecedent gets stronger as the domain shrinks), as shown below.

(77) Conjunction of the negation of each singleton-based alternative:

$$\begin{array}{ll}
\neg(\mathsf{e}(w_1) \rightarrow \mathsf{s}(x_1) \wedge \mathsf{e}(w_3) \rightarrow \mathsf{s}(x_2)) & \equiv [\mathsf{e}(w_1) \wedge \neg\mathsf{s}(x_1) \vee \mathsf{e}(w_3) \wedge \neg\mathsf{s}(x_2)] \\
\wedge\neg(\mathsf{e}(w_2) \rightarrow \mathsf{s}(x_1) \wedge \mathsf{e}(w_3) \rightarrow \mathsf{s}(x_2)) & \wedge\ [\mathsf{e}(w_2) \wedge \neg\mathsf{s}(x_1) \vee \mathsf{e}(w_3) \wedge \neg\mathsf{s}(x_2)] \\
\wedge\neg(\mathsf{e}(w_1) \rightarrow \mathsf{s}(x_1) \wedge \mathsf{e}(w_4) \rightarrow \mathsf{s}(x_2)) & \wedge\ [\mathsf{e}(w_1) \wedge \neg\mathsf{s}(x_1) \vee \mathsf{e}(w_4) \wedge \neg\mathsf{s}(x_2)] \\
\wedge\neg(\mathsf{e}(w_2) \rightarrow \mathsf{s}(x_1) \wedge \mathsf{e}(w_4) \rightarrow \mathsf{s}(x_2)) & \wedge\ [\mathsf{e}(w_2) \wedge \neg\mathsf{s}(x_1) \vee \mathsf{e}(w_4) \wedge \neg\mathsf{s}(x_2)] \\
\equiv \forall w \in \mathrm{DOX}(x_1).\mathsf{e}(w) \wedge \neg\mathsf{s}(x_1) \vee \forall w \in \mathrm{DOX}(x_2).\mathsf{e}(w) \wedge \neg\mathsf{s}(x_2) &
\end{array}$$

The result is in contradiction with S. Excluding any subset of these alternatives would be arbitrary, and therefore disallowed. So there are no IE alternatives. We now show that including S's strongest alternatives is consistent with the utterance, and furthermore yields the inference paraphrased in (74).[13]

13 Note: we ignored the alternatives to 'everyone' (subdomain and the scalar 'someone'), because these alternatives are weaker than the utterance, or than at least one other alternative considered above. At the exclusion step, they will create further contradiction, and at the inclusion step, further redundancy.

(78) Conjunction of each singleton-based alternative:

$$(\mathsf{e}(w_1) \to \mathsf{s}(x_1) \wedge \mathsf{e}(w_3) \to \mathsf{s}(x_2)) \;\wedge\; (\mathsf{e}(w_2) \to \mathsf{s}(x_1) \wedge \mathsf{e}(w_3) \to \mathsf{s}(x_2))$$
$$\wedge\; (\mathsf{e}(w_1) \to \mathsf{s}(x_1) \wedge \mathsf{e}(w_4) \to \mathsf{s}(x_2)) \;\wedge\; (\mathsf{e}(w_2) \to \mathsf{s}(x_1) \wedge \mathsf{e}(w_4) \to \mathsf{s}(x_2))$$
$$\equiv [\exists w \in \textsc{dox}(x_1).\mathsf{e}(w)] \to \mathsf{s}(x_1) \wedge [\exists w \in \textsc{dox}(x_2).\mathsf{e}(w)] \to \mathsf{s}(x_2)$$
$$\equiv \forall x.[\exists w \in \textsc{dox}(x).\mathsf{end}(w)] \to \mathsf{scared}(x)$$

Based on intuition, the inference in (74) seems available. Inspired by Romoli (2013), I run the same Hurford disjunction test for this inference.

(79) A: Who is scared? B: Either everyone who thinks the world ended, or everyone who admits the possibility that it did.

This sentence appears to be felicitous; it can only be if the first disjunct is exhaustified to license an inference corresponding to the negation of the second disjunct, which breaks the entailment relation between the two, avoiding Hurford's constraint. A possible confound is that *think* can take *admit the possibility* as an alternative and exhaustify with respect to it. A Hurford-based test suggests that this can't even happen in the opposite direction (namely that *admit the possibility* excludes a *think*-based alternative), as shown by the infelicitous disjunction below.[14]

(80) #Either you admit the possibility that the world ended, or you think it ended.

4 Conclusion

I have argued for a novel analysis of NR as a scaleless implicature. This analysis is attractive in that it captures the parallels between other purported cases of implicatures and the NR inference, namely QUD sensitivity and polarity sensitivity. Furthermore, it supersedes the scalar implicature approach proposed by Romoli (2013) in that it does not make ad hoc assumptions about the alternatives of *think*, and instead places it in a typology of quantifiers that have subdomain alternatives but lack a scalar alternative, and furthermore makes a more accurate prediction in the restrictor of *every*.

This paper specifically focused on data with *think*; it appears that the data is replicable with other belief predicates like *believe*, but not with all other NR predicates, including desire verbs in particular. This paper is thus one of the first (other than Staniszewski 2019) explicitly proposing an analysis of NR restricted to some NR predicates, and thus suggesting that different analyses of NR should coexist in a theory of language.

14 The felicity of (79) and oddness of (80) can be replicated with "you think the world might have ended" as another possible expression of epistemic possibility.

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