Neg-raising without Excluded middle

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- Certain negated predicates (e.g. *think*, *believe*, *want*) invoke a reading where the negation is interpreted in the embedded clause. For example, (1-a) implies (1-b).

  (1) a. John doesn't think Bill left.
      b. John thinks Bill didn't leave.

- Most other predicates do not trigger such readings. (2-a) cannot be interpreted as (2-b).

  (2) a. John doesn't claim Bill left.
      b. John claims Bill didn't leave.

- There are two main family of approaches to Neg-raising.
  - Standard approaches to NR are (Bartsch, 1973; Gajewski, 2005, 2007; Homer, 2015; Romoli, 2012, 2013; Zeijlstra, 2018), which all at aim at explaining NR in semantic-pragmatic terms.
  - Syntactic approaches to NR have also been proposed (Fillmore, 1963; Horn, 1978; Collins & Postal, 2014), but face many more problems (see Mirrazi & Zeijlstra (2021)).

Overview

- In this talk, we argue that:
  - even though the semantic-pragmatic accounts are generally better equipped to account for NR effects, they face substantial challenges too.
  - a novel, modified version of the semantic-pragmatic approach, which takes NR inferences to be contextually determined rather than lexically encoded, can overcome these problems.

Pragma-semantic approaches to NR and their challenges

- The pragma-semantic approach takes NR readings to be the result of the interaction of the assertion and an excluded middle statement. This excluded middle statement is lexically encoded on a particular group of predicates known as Neg-Raising Predicates (NRPs from now on). This approach has two versions:
  - NRPs come with an excluded middle *presupposition* (Gajewski, 2005, 2007).
  - NRPs have excluded middle *alternatives* (Romoli, 2012, 2013).

The presuppositional approach

- *Excluded middle presupposition*: The speaker is opinionated about the truth or falsity of the embedded proposition.
- The NR reading is a logical consequence of this presupposition and the literal meaning of the sentence, as shown in (3).

(3) not [NRP [S]]
Assertion: $\neg$ NRP (S)
Presupposition: NRP (S) $\vee$ NRP $\neg$(S) (Gajewski 2005; p.14).
$\therefore$ NRP $\neg$(S)

The presuppositional approach

- Let's apply this account to (4-a) to get the NR reading in (4-b) .

(4) a. John doesn't think that Bill left.
b. John thinks that Bill didn't leave.

- With the excluded middle presupposition that the speaker thinks that either Bill left or Bill didn't leave, (4-a) entails (4-b) .

(5) **Assertion:** It's not the case that John thinks Bill left. (4-a)
Presupposition: John thinks Bill left $\vee$ John thinks Bill didn't leave.
$\therefore$ John thinks Bill didn't leave. (4-b)

Problems for the presuppositional approach

① Projection behavior of the excluded middle

- The excluded middle doesn't behave like other presuppositions. For instance, it doesn't project through conditionals (6-a) or questions (6-b) (Romoli, 2012; Križ, 2015), and it doesn't pass the so-called "*Hey, wait a minute*" test (7) (Križ, 2015).

(6) a. If Mary doesn't think that Bill should be hired, she will say so at the next faculty meeting.

b. Does Mary think that Bill should be hired?

(7) a. Mary doesn't think that Bill should be hired.

b. # Hey, wait a minute! I didn't know that she necessarily has an opinion about that.

Problems for the presuppositional approach

② Non-NR reading without a presupposition failure

- There are contexts under which NRPs receive a non-NR reading without resulting in a presupposition failure (Homer, 2015).

(8) a. Unlike many people nowadays, my great-grandparents didn't want to spend a lot of time on the internet.
b. $\not\rightsquigarrow$My great-grandparents wanted not to spend all their spare time on the internet.

(9) At a job interview. . .
a. I don't want to make a lot of money, you know.
b. $\not\rightsquigarrow$I want not to make a lot of money.

Problems for the presuppositional approach

② Non-NR reading without a presupposition failure

- In many contexts, the universal (or even existential) projection of an excluded middle presupposition from the scope of negative indefinites is too strong:

(10) *It's the first day of school; before entering the (new) school your mom tells you:*
  a. Remember, nobody here thinks you're stupid.
  b. $\not\rightsquigarrow$ Everybody here thinks you're not stupid.
  c. $\not\rightsquigarrow$ Somebody here thinks you're not stupid.

  - ➢ For the NR reading to be true, not only everybody should have an acquaintance relation with you but also have an opinion about whether or not you're stupid.

Problems for the presuppositional approach

③ Neg-raising reading of non-NRP predicates

- In certain contexts, certain non-NRPs, like non-factive *know*, dubbed *cloud of unknowing*-predicates, nevertheless get a NR reading, as illustrated below.

(11) Trump: I can overturn the result of the election.
Constitutional lawyer: I don't know/ am not sure that's constitutionally possible, sir.

(12) a. Anthony: you know why?
b. Uncle Junior: I don't know that I give a f***. Sopranos, S1.Ep6

Problems for the presuppositional approach

③ Neg-raising reading of non-NRP predicates

- The examples below from Horn (2014) show that such predicates can also license strict NPIs in their complement, a general footprint of NR.

(13) a. I don't know that Santa comes around these parts until Christmas Eve.
⇝ I know that Santa doesn't come around these parts until Christmas Eve.

b. I can't say I've cooked myself a full meal in weeks, if not months.
⇝ I can say I've not cooked myself a full meal in weeks, if not months.

The implicature approach

- To circumvent problems concerning the presuppositional account of NR, Romoli (2012, 2013) proposes a scalar implicature account of NR.
- Instead of assuming NR reading is the result of the excluded middle presupposition, Romoli (2012, 2013) derives it as an implicature.
- NRPs have the excluded middle statement as a lexical alternative.

The implicature approach

(14) Alt(**think** p(x))={ **think**$_x$ p, **think**$_x$p $\vee$ **think**$_x\neg$p }={$\Box_x$p, $\Box_x$p$\vee\Box_x\neg$p }

(15) a. John doesn't believe that it is raining.

b. $\neg$**believe**$_j$ p

(16) a. Alt($\neg$**believe**$_j$ p)={ $\neg$**believe**$_j$ p, $\neg$(**believe**$_j$ p $\vee$ **believe**$_j\neg$p) }

b. $[\![\text{EXH}]\!]$($\neg$**believe**$_j$ p)= $\neg$**believe**$_j$ p $\wedge$ $\neg\neg$(**believe**$_x$ p $\vee$ **believe**$_j\neg$p) = $\neg$**believe**$_j$ p $\wedge$ (**believe**$_j$ p $\vee$ **believe**$_j\neg$p)

c. **believe**$_j\neg$p

The implicature approach

- Any scalar implicature account of NR has the advantage of not running into the projection problems of the presuppositional account (as mentioned in ①).
- as the generation of scalar implicatures depends on the contextual relevance of particular alternatives, the problem addressed in ② doesn't arise either.

Problems for the implicature approach

- Romoli's special implementation at the same time relies on two unmotivated assumptions:
  - The implicature calculation is based on the assumption that NRPs have excluded middle statement as a 'lexical' alternative. But this lexical alternative is hardly pronounceable and is not attested elsewhere (Križ, 2015).
  - Romoli's account cannot solve problem ③.

A New Implicature Approach

- We propose a new implementation of scalar implicature account that can solve problems ①-③, without the need for unmotivated assumptions like Romoli's.
- Our analysis has two components:
  - ***(Strict) duality***: $\neg\forall \Leftrightarrow \exists\neg$ under presupposition preservation
  - ***Strengthening of subdomain alternatives*** (Chierchia, 2013)
- The Exhaustivity operator can apply to a strict logical equivalences of an LF.
- We follow Buccola et al. (2021) in taking alternatives being objects at level of LF, and not necessarily linguistic objects (words/phrases).

Strict Duality

Strict Duality

- The literal meaning of **negated** NRPs is equivalent to: $\exists w \in W{:}\neg \mathrm{p}(w)$.
  (by strict duality: $\neg\forall w \in W{:}\mathrm{p}(w)$ $\mathrm{p} \Leftrightarrow_{strict} \exists w \in W{:}\neg \mathrm{p}(w)$)
- This weak existential reading can be further subject to strengthening.

Strict Duality

- Logical equivalence in a trivalent system, where the possible truth-values are {1,0,# } and presupposition failure is marked by the third truth-value, is defined as follows:

(17) **Strict equivalence**
p$\Leftrightarrow_{strict}$ q iff p $\Rightarrow_{strict}$ entails q and q $\Rightarrow_{strict}$ entails p

(18) $\Rightarrow_{strict}$ **entailment**
p $\Rightarrow_{strict}$ entails q iff $\forall w : [\![p]\!](w) = 1 \Rightarrow [\![q]\!](w) = 1$

Strict Duality

- Strict duality is presupposition-preserving.
- Consequently, Strict duality does not hold for all modals.
- Modals might carry presuppositions that block duality: e.g. factive *know*

Strict Duality doesn't always hold.

Assume $\Diamond K_p$ is the existential dual knowledge operator of $\Box K_p$.

- If the existential knowledge operator also carries the factivity presupposition that the embedded p is true, the dual rule is not valid.

  (19) $\underline{p(w) = 1}.\neg\Box K\ \underline{p(w)} \Leftrightarrow_{STRICT} \underline{\neg p(w) = 1}.\Diamond K\ \underline{\neg p(w)}$

- Even when $\Diamond K_p$ doesn't carry any presupposition, the strict duality is still not valid. In a world where the factivity presupposition is not satisified, $\neg\Box K$ p(w) is # but $\Diamond K\ \neg p(w)$ is true.

  (20) $\underline{p(w) = 1}.\neg\Box K\ \underline{p(w)} \Leftrightarrow_{STRICT} \Diamond K\ \neg p(w)$

Duality blocking predicates are never Neg-raisers.

- Since Strict duality does not hold for these predicates, no weak existential reading can be derived that can, in turn, be further strengthened.

  $\rightarrow$ **strictly non-NRPs**, like factives, never yield NR readings

- This means that is not NRPs that are special in allowing NR inferences; it is rather strictly *non*-NRPs that are special in not allowing them.

Strengthening of subdomain alternatives

Exhaustification

- Parallel to the implicature account of Free Choice (Fox, 2007; Bar-Lev & Fox, 2017), and Homogeneity (Bassi & Bar-Lev, 2018; Magri, 2014; Bar-Lev, 2020), we take strengthened readings to be the result of the application of an exhaustivity operator at LF.
- Modals trigger subdomain alternatives(Bassi & Bar-Lev, 2018; Jeretič, 2021; Staniszewski, 2021).
- Note that exhaustification of modals only involves domain alternative and not scalar alternatives

Innocent Exclusion + Innocent Inclusion–based Exhaustification

We adopt the definition of the exhaustivity operator (EXH) by Bar-Lev & Fox (2017)

(21) Innocent Exclusion + Innocent Inclusion–based exhaustivity operator:
$[\![\text{EXH}]\!]^{IE+II}(C)(p)(w) \Leftrightarrow \forall q \in \text{IE}(p,C)[\neg q(w) \wedge \forall \in \text{II}(p,C)[r(w)]$

(22) Given a sentence p and a set of alternatives C:
a. $\text{IE}(p,C) = \bigcap\{C' \subseteq C : C'$ is a maximal subset of C, s.t. $\{\neg q : q \in C'\} \cup \{p\}$ is consistent $\}$
b. $\text{II}(p,C) = \bigcap\{$C" $\subseteq$ C : C" is a maximal subset of C, s.t. $\{r : r \in$ C"$\} \cup \{p\} \cup \{\neg q : q \in \text{IE}(p,C)\}$ is consistent $\}$

Innocent Exclusion + Innocent Inclusion–based Exhaustification

- EXH takes a proposition (p), and a set of alternatives (C) as arguments, and returns the conjunction of all of the negated innocently excludable (IE) alternatives, and all of the asserted (assigned *true*) innocently includable (II) alternatives.
  - ➢ The IE alternatives are all those that can be assigned *false* consistently with the prejacent.
  - ➢ The II alternatives are those that can be assigned *true* consistently with the prejacent and the falsity of all IE alternatives.
- The NR reading is then derived via application of EXH, starting with the LF corresponding to the basic weak reading ($\exists w \in W$: $\neg$p(w)).

Driving the Neg-raising reading

Let's assume the speaker's belief worlds consists of three worlds w_1, w_2 and w_3.

- The alternatives generated from replacing the domain variable with its subsets in the weak, existential reading are given in (23).

  (23) $\exists w \in \{w_1, w_2, w_3\}: \neg p(w)$, $\exists w \in \{w_1, w_2\}: \neg p(w)$, $\exists w \in \{w_1, w_3\}: \neg p(w)$, $\exists w \in \{w_2, w_3\}: \neg p(w)$, $\exists w \in \{w_1\}: \neg p(w)$, $\exists w \in \{w_2\}: \neg p(w)$, $\exists w \in \{w_3\}: \neg p(w)$

- ➢ No alternatives are IE.
- ➢ All alternatives are II.

Driving the Neg-raising reading

- Upon exhaustification, we will have (24), which is equivalent to the NR reading.

(24) $\text{EXH}^{IE+II}(\text{Alt}(\exists w{\in}\{w_1, w_2, w_3\}\colon \neg\text{p}(w)))(\exists w{\in}\{w_1, w_2, w_3\}\colon \neg\text{p}(w)) = \exists w{\in}\{w_1, w_2, w_3\}\colon \neg\text{p}(w) \wedge \exists w{\in}\{w_1, w_2\}\colon \neg\text{p}(w) \wedge \exists w{\in}\{w_1, w_3\}\colon \neg\text{p}(w) \wedge \exists w{\in}\{w_2, w_3\}\colon \neg\text{p}(w) \wedge \exists w{\in}\{w_1\}\colon \neg\text{p}(w) \wedge \exists w{\in}\{w_2\}\colon \neg\text{p}(w) \wedge \exists w{\in}\{w_3\}\colon \neg\text{p}(w) = \forall \boldsymbol{w}{\in}\{\boldsymbol{w_1}, \boldsymbol{w_2}, \boldsymbol{w_3}\}\colon \neg\mathbf{p}(\boldsymbol{w})$

Weak readings

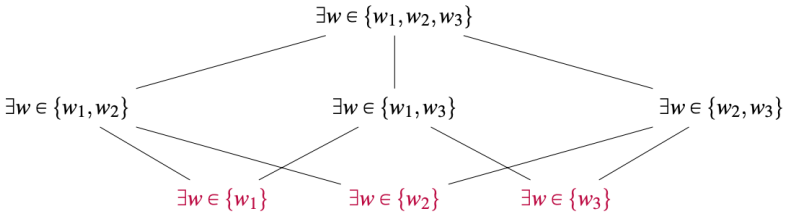
Driving the weak (non-NR) reading

- There are certain contexts where the NR reading does not arise, as in (25).

  (25) *It's the first day of school, before entering the school your mom tells you:*
  Remember, nobody here thinks you're stupid.

- Following Bar-Lev's (2018; 2020) account of non-maximal readings of definite plurals, we take the non-NR reading to be the result of pruning all the subdomain alternatives which involve singleton sets (i.e. $\{w_1\}$, $\{w_2\}$, $\{w_3\}$).

Driving the weak (non-NR) reading



- By applying EXH to this set of alternatives, we get the weak non-NR reading.

Driving the weak (non-NR) reading

(26) a. $\exists w \in \{w_1, w_2, w_3\}$: $\neg p(w)$, $\exists w \in \{w_1, w_2\}$: $\neg p(w)$, $\exists w \in \{w_1, w_3\}$: $\neg p(w)$, $\exists w \in \{w_2, w_3\}$: $\neg p(w)$

b. $\text{EXH}^{IE+II}(\text{Alt}(\exists w \in \{w_1, w_2, w_3\}: \neg p(w)))(\exists w \in \{w_1, w_2, w_3\}: \neg p(w)) = \exists w \in \{w_1, w_2, w_3\}: \neg p(w) \wedge \exists w \in \{w_1, w_2\}: \neg p(w) \wedge \exists w \in \{w_1, w_3\}: \neg p(w) \wedge \exists w \in \{w_2, w_3\}: \neg p(w)$

- Under this view, the (un)availability of strengthened (NR) readings for duality-allowing universal modals depends on which set of alternatives EXH applies over.
  - When EXH applies over the whole set of subdomain alternatives, we get the strengthened reading.
  - When EXH applies over the subset remained after pruning singleton sets, we get the weak reading.

Pruning alternatives

- Pruning is a mechanism to reduce the set of alternatives to only those that are plausible and relevant in a given context.

(27) a. **Maxim of Relevance:** Every utterance must be relevant to Q.
b. **Weakening:** Pruning can only weaken the meaning (Crnič et al., 2015).
c. **Minimal pruning:** Don't prune more than necessary to satisfy.

(Bar-Lev, 2020)

Pruning singleton alternatives

- Singleton set alternatives are normally pruned when modals express objectivity or evidentiality, as is the case with strong modals like *must* or *have to*.
- The reason is that the domain of quantification (and therefore the set of domain alternatives) of such strong modal has to include the actual world.
- Following Kratzer (2012), we argue that such singleton propositions are too specific to be cognitively viable. For an actual human to believe a singleton proposition, they have to be omniscient in a strong sense. Their beliefs have to be so specific that they are able to distinguish the actual world from all other possible worlds.

Neg-raising is not a lexical property

- The (novel) observation that (11), repeated below, has a NR reading, even though non-factive *know* doesn't always give rise to them, shows that the ability to trigger a NR reading must *not* be a lexical property of predicates.

  (28) Trump: I can overturn the result of the election.
  Constitutional lawyer: I don't know/ am not sure that's constitutionally possible, sir.

- Our approach to NR is the only approach that can account for this observation.

- All current theories of NR, including Križ's suggestion to take NRPs as involving not universal quantification over worlds, but homogeneous distributive predication over a plurality of worlds, take NRPs to be a special class of verbs with some unique *lexically*-encoded property enabling them to yield NR readings.

- Since the calculation of implicatures is context-dependent, we predict that every negated universal modal whose presuppositions do not block duality, like non-factive *know* and *be sure* in (11), can get a NR-reading, provided that the whole set of subdomain alternatives is contextually relevant.

Conclusion

- There are contexts under which NRPs receive a non-NR reading without resulting in a presupposition failure
- In certain contexts, some non-NRPs (e.g. non-factive know) can get a NR reading.

  $\rightarrow$ the ability to trigger a NR reading is *not* a lexical property of predicates.

- We propose a new implementation of scalar implicature account that solves these problems. Our analysis has two components:
  - **Strict duality**: $\neg\forall \Leftrightarrow \exists\neg$ under presupposition preservation
  - **Strengthening of subdomain alternatives**

- We predict that negated universal modals whose presuppositions don't block duality *can* get a NR reading.
- The (un)availability of NR readings for duality-allowing modals is reduced to whether EXH applies over the whole set of subdomain alternatives (strengthened reading) or over a subset after pruning singleton sets (weak reading).
- A non-NR reading is the result of pruning the subdomain alternatives which are singleton sets.

Thank you!

Appendices

Duality is a necessary step

- The question arises as to whether the duality is necessary, as applying EXH directly to $\neg\Box$ is shown to yield a strong $\Box\neg$ reading by Jeretič (2021), who provides an implicature account of the scopal interaction between negation and french necessity modals *falloir* and *devoir*.

Duality is a necessary step

- The wide scope interpretations of these modals over negation are accounted for via obligatory double strengthening from a $\neg\Box$ to $\Box\neg$, as shown below:

(29) a. S=$\neg\Box_{\{w_1,w_2\}}p$

b. Alt(S)=$\{\neg\Box_{\{w_1,w_2\}}p, \neg\Box_{\{w_1\}}p, \neg\Box_{\{w_2\}}p\}$

c. S'=EXH[Alt(S)][S]= $\neg\Box_{\{w_1,w_2\}}p$

(30) a. Alt(S')=$\{$EXH[Alt(S)][$\neg\Box_{\{w_1,w_2\}}p$],EXH[Alt(S)][$\neg\Box_{\{w_1\}}p$], EXH[Alt(S)][$\neg\Box_{\{w_2\}}p$]$\}$

$\{\neg\Box_{\{w_1,w_2\}}p, \neg\Box_{\{w_1\}}p \wedge \Box_{\{w_2\}}p, \neg\Box_{\{w_2\}}p \wedge \Box_{\{w_1\}}p\}$

b. S''=EXH[Alt(S')][S']

$\equiv \neg\Box_{\{w_1,w_2\}}p \wedge \neg(\neg\Box_{\{w_1\}}p \wedge \Box_{\{w_2\}}p) \wedge \neg(\neg\Box_{\{w_2\}}p \wedge \Box_{\{w_1\}}p)$

Duality is a necessary step

- We think Strict duality is a necessary step in strengthening, as direct strengthening of $\neg\Box$ runs into following problems:
- The first application of EXH does not have any semantic effect.
- There are alternatives containing universal quantification over singleton sets. We find this problematic. For implicature calculation, it is important to be able to assign True or False to alternatives. However, it is hard/impossible to assign a truth value False or True to sentences with universal quantification over singleton sets.

  (31) a#Every current Pope is Italian.
  b#Not every current Pope is Italian.
- Moreover, since $\neg\Box_{\{w_1\}}p$ is assigned true in case w_1 is a $\neg p$ world,

Duality is a necessary step

- We conclude that when the whole set of alternatives is relevant and plausible, exhaustifing the LF $\neg\Box$p is ruled out.
- When singleton alternative are pruned (as is necessary for strong modals), the exhaustification of $\neg\Box$p and $\Diamond\neg p$ outputs the same result: *a weak reading*. This explains why strong universal modals auxiliaries that are outscoped by negation (like *have to* or *need to*) do not give rise to strengthened NR readings.

The syntactic approach to NR

- Negation is base-generated in the embedded clause and then raises to the higher clause via syntactic movement (Fillmore 1963, Horn 1971 and Collins & Postal 2014).
- The lowest copy of NEG is semantically interpreted and the highest copy of NEG is phonologically realized. The syntactic structure of (1-a) would then be as in (32).

(32) John NEG think Bill <NEG> left.

Problems for the syntactic approach to NR

The classic syntactic approach has been challenged on several grounds.

- For one, NR involving negative indefinites cannot be accounted for in terms of simple semantic reconstruction.

  (33) Nobody thinks nuclear war is winnable.

- (33) lacks the reconstructed reading of (34):

  (34) NEG somebody thinks nuclear war is <NEG> winnable.

- (33) means that everybody thinks that nuclear war is not winnable, not that somebody thinks it's not, a reading that cannot be straightforwardly derived along the lines of the syntactic approach.
- For many other problems for the syntactic approach, see a.o. (Romoli, 2012, 2013; Zeijlstra, 2018).

Horn-clauses

- Despite these problems, Collins & Postal (2014) present one major argument that has not been countered in the literature so far, see (Romoli, 2012, 2013; Zeijlstra, 2018; Crowley, 2019): *Horn*-clauses.
- *Horn*-clauses are instances where subject-auxiliary inversion is licensed not by a negative quantifier in SPEC,CP, but rather by an NPI in SPEC,CP, which in turn is licensed by a negated NR-predicate, as in (35).

  (35) [I don't think that [anywhere did he mention my book]]

Horn-clauses

- Since Negative Inversion (subject-auxiliary inversion under negation) applies in a strictly local fashion, Collins & Postal (2014) take the existence of *Horn*-clauses as strong evidence for a syntactic approach to Neg-raising.
- Only under a local approach can the negation in the main clause have appeared in SPEC,CP at an earlier stage of the derivation, as in (36), where $< ... >$ denotes a lower copy.

  (36) I do NEG think that [$<$NEG $>$ anywhere] did he mention my book [$<$NEG anywhere$>$]

***Horn*-clauses** Collins & Postal's analysis suffers from at least three major problems.

- ❶ It cannot exclude universal quantifiers from appearing in *Horn*-clauses. Whereas (37-a) is fully acceptable, (37-b) is not. The structure in (37-c) that derives (37-b) should, in principle, be possible in Collins & Postal's system.

(37) a. Not everywhere did he mention my book
b. *I don't think that everywhere did he mention my book
c. *I do NEG think that [<NEG> everywhere] did he mention my book [<NEG everywhere>]

➢ The only solution that Collins & Postal offer is to rule out (37-c) by postulate a condition that bans negated non-existentials from triggering *Horn*-clauses (cf. Collins & Postal (2014)).

Horn-clauses

- ❷ The second problem for Collins & Postal (2014) is that the set of negative predicates that can license *Horn*-clauses is not restricted to negated NR-predicates. Horn (2014) points out that non-factive *know, be aware*, and some other predicates, which he dubs *Cloud of Unknowing predicates*, license *Horn*-clauses as well, as shown in (38).

  (38) I *(don't) know that ever before had all three boys napped simultaneously

- ➢ But in (38), there is no semantic reflection of negation in the embedded clause, i.e. (38) lacks a NR-reading.

Horn-clauses

- To resolve this problem, Collins & Postal (2018) stipulate that *Cloud of Unknowing*-predicates cannot be outscoped by a raised negation. This would then rule out the NR-reading of (38).
- For them, the underlying structure of (38) must contain two additional negations, one of which is raised into the matrix clause, and both of them being phonologically deleted:

  (39) I do NEG_1 know NEG_2 [$<\text{NEG}_2>$ that NEG_3 ever before had all three boys napped simultaneously]]
- However, apart from such an escape hatch being purely stipulative, Collins & Postal (2018) predict that (40) should still be fine with a NR-reading (41), contrary to fact.

  (40) Nobody doesn't know that ever before had all three boys napped

Horn-clauses

- ❸ Finally, the same problem as with *Cloud of Unknowing*-predicates arises with many other predicates, for instance with *accept*. Crucially, these predicates are not NR-predicates, but when negated, they still can license subject-auxiliary inversion with an NPI in SPEC,CP, ((42)).

  (42) I *(didn't) accept that any of those problems had she ever really solved.

- For (42), Collins & Postal (2014) argue that here the NPI *any of those problems* takes matrix scope and therefore, examples like (42) are different from real *Horn*-clauses.
- However, the claim that *any of those problems* in (42) takes matrix scope is false. If it were the case, (42) should be felicitous in a

Horn-clauses

- In sum, Collins & Postal's proposal suffers from several insurmountable problems.
- At the same time, as of date, no existing alternative account for *Horn*-clauses has been proposed that does not require movement of negation.
- Our novel approach can actually account for the overall distribution and readings of *Horn*-clauses.

Accounting for *Horn*-clauses via Duality

- As a starter, Negative Inversion is not obligatory in syntax, but an optional instance of movement that triggers particular semantic effects (cf. (Büring, 2004)).

  (43) a. With no job is Kim happy.
  b. With no job Kim is happy.

- This suggests that Negative Inversion involves LF licensing, and not negative feature-driven syntactic movement.

Accounting for *Horn*-clauses via Duality

- T-C movement followed up by fronting a negative phrase is fine as long as the clause will receive a sentential negation reading, i.e., if the existential quantifier binding the event variable ends up in an Anti-Additive context.
- Under a duality-based approach, any universal predicate that allows duality, gives rise to an equivalent LF where negation scopes below this predicate.

Accounting for *Horn*-clauses via Duality

- Duality-allowing predicates includes both NRPs and Cloud of Unknowing predicates like non-factive *know*, but also predicates such as *accept*.
- All these predicates allow duality to apply, even if the dual readings are not further strengthened into NR readings.
- This is in line with Horn's 2014 conclusion that the possibility or likelihood of ¬p is an important factor in licensing Horn-clauses – due to duality, ¬p is evaluated.

Accounting for *Horn*-clauses via Duality

(44) The crucial factor in licensing embedded subject-aux ("Horn clauses") and strict NPIs when these occur under higher negation in the sequence [**a** NEG-Fs that **p**] is not the requirement that F be a NR predicate perse but the existence of a robust association between **a** being in a NEG-F relation to **p** and **a** being in an *F'* relation to p' where *F'=F* or *F'<F* on a relevant scale. Horn (2014)

➢ Such an LF introduces an Anti-Additive context that, unless this Anti-Additivity is disrupted, involves the embedded clause as well.

Accounting for *Horn*-clauses via Duality

- Given duality, negated (NR-)predicates should thus allow subject-auxiliary inversion, as long as scopally nothing intervenes between the negation and lower C' that disrupts Anti-Additivity:
- At the same time, the question remains open as to why *Horn*-clauses require the presence of an NPI in the embedded clause. Why would (37-b), repeated below, be out?

  (45) *I don't think that everywhere did he mention my book.

Accounting for *Horn*-clauses via Duality

- The reason lies in the requirements for Negative Inversion / subject-auxiliary inversion itself.
- Since C' must end up in an Anti-Additive context, Negative Inversion is only allowed if the material in embedded SPEC,CP is Anti-Additive (or at least Strawson Downward Entailing, cf. (Büring, 2004)) as well.
- This, essentially means that duality can license subject-auxiliary inversion, if the material in SPEC,CP does not disrupt Anti-Additive either. In (45), the relevant LF would contain *everywhere*, which breaks this criterion.

Accounting for *Horn*-clauses via Duality

- In order to not being able to disrupt Anti-Additivity the non-negative material in SPEC,CP, must consist of:
  - an existential/indefinite that
  - does not give rise to any non-Anti-Additive inferences itself.

Accounting for *Horn*-clauses via Duality

➢ As the reader can check in (46), this is *only* the case for negated NPIs. Other existentials/indefinites give rise to specificity effects or existential import of some sort.

(46) a. Not anywhere did she go. ⟶ Nowhere did she go.
b.*Not somewhere did she go. ⟶ Nowhere did she go.
c.*Not to a place in Franc did she go. ⟶ Nowhere in France did she go to.

Accounting for *Horn*-clauses via Duality

- Consequently, to ensure that the embedded C' ends up in an Anti-Additive environment, every *Horn*-clause must contain an NPI in its embedded SPEC,CP.
- This explains the full pattern of *Horn*-clauses without alluding to syntactic movement.
- Horn-clauses also provide another argument for the necessity of duality step.

Pragma-semantic approaches to NR and their challenges
A New Implicature Approach
Strict Duality
Strengthening of subdomain alternatives
Weak readings
Neg-raising is not a lexical property
Conclusion
Appendices

NR as the literal meaning

- Weak necessity modals like *should* and *supposed to* are existential quantifiers over possible worlds.
- In UE environments, this weak existential reading is strengthened to $\forall$ via EXH^{IE+II}.
- There is no strengthening under negation $\Rightarrow \neg\exists$ (NR reading).

Problems for the NR as the literal meaning approach

- There are several problems with this account:
  - To be extendable to the phenomenon of NR broadly, *believe* and *think* also need to be treated as existential quantifiers over possible worlds.
  - It cannot account for the observation that *cloud of unknowing* predicates can also give rise to NR readings.
  - It cannot account for the observation in **??** that NR readings are not generated when negated NRPs are further embedded under DE.
  - Non-NR readings (as shown in (8)-(10)) are counterintuitively derived as cases of "strengthening" under negation.

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