

## Neg-raising without lexical excluded middle inferences: Resolving Horn Clauses and other problems

Zahra Mirrazi & Hedde Zeijlstra  
*UMass Amherst & University of Goettingen*

### 1. Introduction

*Neg-Raising* (NR) concerns the phenomenon, illustrated in (1), where certain negated predicates (e.g. *think*, *believe*, *expect*) can give rise to readings where negation seems to take scope from an embedded clause. For instance, (1a) may have a reading (1b), alongside the literal interpretation where indeed I do not entertain the thought that you are right.

- (1) a. I don't think you're right.  
b. I think you're not right.

Most other predicates do not give rise to such inferences. Negated predicates like *claim* lack readings where negation seems to take lower scope, as shown in (2). (2a) does not infer (2b).

- (2) a. She doesn't claim John is ill.  
b. She claims John isn't ill.

There are two main approaches to NR: a syntactic approach (Fillmore 1963; Horn 1978; Collins & Postal 2014) and a semantic-pragmatic approach (Bartsch 1973; Gajewski 2005, 2007; Homer 2015; Romoli 2012, 2013; Zeijlstra 2018). The syntactic account posits that negation is base-generated in the embedded clause, where it is semantically interpreted, and then syntactically moves into the matrix clause, where it is phonologically realized. The semantic-pragmatic approach takes NR readings to be the result of an excluded middle inference, either in terms of presuppositions (Gajewski 2005, 2007) or in terms of scalar implicatures (Romoli 2012, 2013; Križ 2015), that are restricted to NRPs.

#### 1.1. The syntactic approach

Collins & Postal (2014) have revived the position that NR involves syntactic movement of the negation from a lower clause into a higher clause, a proposal tracing back to Fillmore (1963), and also adopted in Horn (1972, a.o.). Ignoring *do*-support effects, the syntactic structure of (1a) would then be as in (3), and the reading (1b) would follow from interpreting the negation in its base position (<NEG> indicating a lower copy/trace of negation).

- (3) I do NEG think that you're <NEG> right.

For Collins & Postal (2014) NR follows as a result of their assumption that only base occurrences of negation are interpreted. Under this approach, the lowest copy of negation must be semantically interpreted, whereas the highest copy of NEG is phonologically realized (in this case as *n't*).

## 1.2. The semantic-pragmatic approach

The semantic-pragmatic approach (Bartsch 1973; Horn 1989; Gajewski 2005; Romoli 2013; Homer 2015; and Zeijlstra 2018, among others) takes NR readings to be the result of an excluded middle inference that is a special lexical property of NRPs. This approach has two versions: *the presuppositional approach* (Gajewski 2005, 2007), where NRPs come with an excluded middle presupposition, and *the implicature approach* (Romoli 2012, 2013), where NRPs have excluded middle alternatives. We will focus on the presuppositional approach.

The presuppositional approach to NR (Gajewski 2005, 2007) takes NRPs to come with an excluded middle presupposition. That is, the speaker is presupposed to be opinionated about the truth or falsity of the embedded proposition. The NR reading is then a logical consequence of this presupposition and the literal meaning of the sentence. Under the implicature approach, things work roughly in the same way albeit that this excluded middle inference is not taken to result from a presupposition but rather from an implicature

- (4) Assertion: It's not the case that John thinks Bill left.  
 Presupposition: John thinks Bill left or John thinks Bill didn't leave.  
 John thinks Bill didn't leave.

The major difference between the two approaches is that the syntactic approach alludes to syntactic movement of negative material, whereas the semantic-pragmatic approach is surface-oriented.

In this paper, we re-assess some of the criticisms addressed at the syntactic approach and argue that these are problematic for the semantic-pragmatic approach as well. We also address the claim that only the syntactic approach can account for the nature and distribution of so-called Horn Clauses and argue that Horn Clauses are actually problematic for both existing approaches. This then calls for a new approach to NR in terms of non-lexical implicature calculation of which we will present the outlines in this article (see also Mirrazi & Zeijlstra in prep. for a more detailed account).

## 2. Problems for both accounts

### 2.1. Neg-raising under the scope of negative quantifiers

It has been argued that the syntactic approach to NR makes incorrect predictions about NR constructions involving negative existentials (see, e.g. Horn 1989; Gajewski 2007; Zeijlstra 2018). Under the common assumption that negative quantifiers like *nobody*, are the realization of a negated indefinite (NEG  $\exists$ -body), the syntactic approach assigns the underlying structure (5) to the sentence (6).

- (5) Nobody supposes that nuclear war is winnable.  
 (6) NEG  $\exists$ -body supposes that nuclear war is <NEG> winnable.

The predicted NR reading would then be that somebody supposes nuclear war is not winnable. However, the NR reading of (6) seems to be 'everybody supposes that nuclear war is not winnable'.

The pragma-semantic approach to NR accounts for the attested NR reading of (5) by assuming that the presuppositions of quantificational structures are universal (Gajewski 2007). In other words, the sentence (5) presupposes that everyone has an opinion about whether or not

nuclear war is winnable. The attested Neg-raising reading is then a logical consequence of this presupposition and the literal meaning of the sentence.

- (7) Assertion: Nobody supposes that nuclear war is winnable.  
 Presupposition: everybody either supposes that nuclear war is winnable or supposes that nuclear war is not winnable  
 Everybody supposes that nuclear war is not winnable

However, the universal projection of an excluded middle presupposition from the scope of negative indefinites is sometimes too strong. Consider the following context: It's the first day of school; before entering the school your mom truthfully utters the sentence (8).

- (8) Remember, nobody in this school thinks you're stupid.

For the NR reading to be true under the presuppositional account, everybody should have an opinion about whether or not you're stupid, which cannot be the case in the scenario. Now let us imagine that you have managed to impress your teacher on the first day of school, and now they think you're very smart. The rest of school still either don't know you at all or have not formed any opinion about whether or not you're stupid. Your mom can still truthfully utter (8) on the second day of school. (8) can also be truthfully uttered in a context where everyone in the school thinks you're very smart, because you've won a national math competition and become quite famous.

We conclude that neither the syntactic nor the pragma-semantic approach to NR can account for the full range of readings available under the scope of negative existentials.

## 2.2. Neg-raising readings with non- Neg-raising predicates

We now present a novel observation that some non-NRPs nevertheless get a NR reading in certain contexts, as illustrated below (where the lawyer must know what is constitutionally possible).

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

Once the NRP has a strict NPI in its complement, such a sentence even necessarily takes a NR reading (an observation overlooked in Horn 2014):

- (10) a. I can't say I've cooked myself a full meal in weeks, if not months.  
 b. I can say I've not cooked myself a full meal in weeks, if not months.

This is a problem for both syntactic approach and the pragma-semantic approach, including the scalar implicature approach (Romoli 2012, 2013). All these theories take NRPs to be a special class of verbs with some unique lexically-encoded property enabling them to yield NR readings. As predicates like *know* and *say* are not NRPs, they are predicted to never give rise to NR readings.

## 2.3. Horn Clauses

Despite the above-presented problems for both types of approaches, Collins & Postal (2014) present various arguments why the syntactic approach to NR must nevertheless be in the right track, of which the existence of so-called *Horn Clauses* is the strongest, and the only one that has not been countered in the literature yet (see Romoli 2012, 2013; Zeijlstra 2018; Crowley

2019). Horn Clauses are instances where subject-auxiliary inversion is licensed not by a negative element in Spec,CP, but rather by an Negative Polarity Item (NPI) in Spec,CP, which in turn is licensed by a negated NRP. Examples are in (11)-(12).

- (11) I don't think that ever before have the media played such a major role in a kidnapping.  
 (12) I don't suppose that under any circumstances would she help me

Normally, subject-auxiliary inversion under negation (a.k.a. Negative Inversion) applies in a strictly local fashion, i.e., the specifier of the raised auxiliary should contain a negative (or downward entailing) element. Therefore, Collins & Postal (2014) take the existence of Horn Clauses to be strong evidence for a syntactic approach to NR: Only under such an approach can the negation in the main clause have appeared in Spec,CP at an earlier stage of the derivation, as in (13), where <NEG> denotes a lower copy.

- (13) I do NEG think [<NEG> anywhere] did he mention my book <[NEG anywhere]>.

Collins & Postal (2014)'s proposal straightforwardly accounts for the contrast between (11)-(12) and (14)-(15): as *say* and *regret* are not NRPs, syntactic NEG-movement is impossible in (14)-(15). Consequently, these predicates cannot embed Horn Clauses. NEG-movement is indeed impossible in (14)-(15).

- (14) \*I don't say that ever before have the media played such a major role in a kidnapping.  
 (15) \*I don't regret that under any circumstances would she help me.

As said, as of date no alternative semantic-pragmatic accounts for Horn Clauses have been formulated. Nevertheless, we are hesitant to draw the conclusion from that that Horn Clauses necessitate a syntactic approach to NR. Apart from the above-mentioned arguments (for which Collins & Postal have to provide additional counterarguments, a challenge they take up in their monograph), there are actually reasons to dispute the strength of the Horn Clauses argument itself.

The reason for this is that Collins & Postal's analysis of Horn Clauses turns out to suffer from at least three insurmountable problems. First, it cannot exclude non-existential NPIs, such as universal quantifiers, from appearing in Horn Clauses. Whereas (16a) is fully acceptable, (16b) is not. The structure in (16c) that derives (16b) should, in principle, be possible in Collins & Postal's system.

- (16) 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 (2014) offer to rule out (16c) is postulating a condition that bans negated non-existentials from participating in Horn Clauses. Even though such a solution correctly rules out examples like (16b), such a condition lacks any independent motivation. In addition, it may not even be restrictive enough, as Horn Clauses are only available with existential NPIs and not with just any existential, as shown in (17):

- (17) a. I don't think that anywhere did he mention my book.  
 b. \*I don't think that somewhere did he mention my book.  
 c. \*I don't think that in old works did he mention my book.

The second problem for Collins & Postal (2014) is that the set of predicates that, when negated, can license Horn Clauses is not restricted to NRPs. Horn (2014) points out that non-factive

*know*, *be aware*, and some other predicates, which he dubs *Cloud of Unknowing* predicates, license Horn Clauses too:

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

However, in (18), there is no semantic reflection of negation in the embedded clause, i.e. (18) lacks a NR reading. To resolve this, Collins & Postal (2018) propose that when a negation raises in a main clause with a *Cloud of Unknowing* predicate, the underlying structure of (18) contains two additional negations, of which one must raise into the matrix clause, followed by phonological deletion of these two lower negations:

(19) [I do NEG1 know NEG2 [<NEG2> that NEG3 ever before had all three boys napped simultaneously]]

It must be said that such a mechanism, where a downward entailing element may license the phonological deletion of two lower negations, is central in Collins & Postal's work. For instance, they argue that it is also what underlies the NR reading behind examples like (5):

(20) Nobody NEG1 supposes NEG2 [that <NEG2> nuclear war NEG3 is winnable]]

However, the only motivation for adopting such a more baroque treatment of NR lies in the absence of any simpler alternative available. That is, (19)-(20) can only be maintained if the semantic-pragmatic approach cannot be (fully) correct, and the only strong piece of evidence for that claim that has so far survived the scrutiny of time are Horn Clauses.

Note, however, that (19) is not the only available parse for (18). (21), which does yield a NR reading, is in principle an available parse as well, given that in (19) NEG-movement is allowed.

(21) [I do NEG1 know [that <NEG> ever before had all three boys napped simultaneously]]

Collins & Postal (2018) rule out the availability of (21) by stipulating a condition that states that if a negation raises into a clause containing a negated *Cloud of Unknowing* predicate, this predicate must be under the scope of a distinct negation (Collins & Postal 2018, (70)). That is the case in (19), but not in (21). Apart from the fact that such a condition is purely stipulative, this condition also turns out to be empirically flawed. Note that (22) under that condition should be fine with a NR reading, as here the predicate is indeed outscoped by a distinct negation (*nobody*), contrary to fact:

(22) Nobody doesn't know that ever before had all three boys napped simultaneously.

Hence, the existence of Horn Clauses with *Cloud of Unknowing* predicates remains problematic for the syntactic approach to NR.

Finally, a similar problem as with *Cloud of Unknowing* predicates arises with many other predicates, for instance with *accept*. Crucially, these predicates are not NRPs, but when negated, they still can license subject-auxiliary inversion with an NPI in Spec,CP, (23).

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

For (23), Collins & Postal (2014) argue that here the NPI *any of those problems* takes matrix scope and that therefore examples like (23) are different from real Horn Clauses (and require a different treatment). But the claim that *any of those problems* in (23) takes matrix scope is false. If it were the true, (23) should be felicitous in a scenario where we know that Mary solved

some problems, but we don't know which ones (e.g., when solving some problems is a requirement for passing a test, and we only know that Mary passed the test).

In sum, Collins & Postal's claim that Horn Clauses provide evidence in favour of the syntactic approach to NR both overgenerates and undergenerates, and thus should not count as a viable explanation for this phenomenon. Nevertheless, as of date, no existing alternative account for Horn Clauses has been proposed that does not require movement of negation. In this paper, we argue that a novel, modified version of the semantic-pragmatic approach to NR fills this gap and provides a full explanation for the overall distribution and readings of Horn Clauses.

### 3. A modified version of the semantic-pragmatic approach to Neg-Raising

We propose a new implementation of scalar implicature account that can account for the problems discussed above. Our analysis has two components:

- (24) a. Strict duality:  $\neg\forall \Leftrightarrow_{\text{strict}} \exists\neg$  iff  $\forall$  and  $\exists$  have the same presuppositions  
 b. Strengthening of subdomain alternatives by exhaustification (Chierchia 2013)

We propose that an exhaustivity operator (EXH) can apply to a strictly logical equivalent of a given LF, provided that the dual quantifier in the logical equivalent is not expressible (due to a lexical gap). (25) shows the definition of logical equivalence in a trivalent system, where the possible truth-values are  $\{1,0,\#\}$  and presupposition failure is marked by  $\#$ .

- (25) a.  $p \Leftrightarrow_{\text{strict}} q$  iff  $p \Rightarrow_{\text{strict}} q$  and  $q \Rightarrow_{\text{strict}} p$   
 b.  $p \Rightarrow_{\text{strict}} q$  iff in every world where  $p$  is true,  $q$  is true as well.

Given the dual rules, EXH can apply to the dual of a negated universal modal,  $\neg\forall w.p(w)$ , which is  $\exists w.\neg p(w)$  iff (i)  $\neg\forall w.p(w) \Leftrightarrow_{\text{strict}} \exists w.\neg p(w)$ , and (ii)  $\exists w.\neg p(w)$  is not an alternative containing a lexical dual of the modal. This is indeed the case for non-factive epistemic modals, such as *think*. However, the strict duality equivalence is not valid for all modals. Modals might carry presuppositions that block strict duality, such as factive *know*.

Assume  $\exists_{kp}$  is the existential dual knowledge operator of  $\forall_{kp}$ . When the existential knowledge operator also carries the factivity presupposition that the embedded  $p$  is true, strict duality does not hold ( $p(w): \neg\forall_k w.p(w) \Leftrightarrow_{\text{strict}} \neg p(w): \exists_{kw}.\neg p(w)$ ).

This means that it is not NRPs that are special in allowing NR inferences; it is rather strictly non-NRPs that are special in not allowing them. Since strictly non-NRPs, i.e. predicates that never yield NR readings, carry a presupposition or a modal commitment that is incompatible with their dual form, no weak reading can be derived that can be further strengthened.

This brings us to the second component, strengthening of subdomain alternatives. An existential reading, like the one that is entailed by negated NRPs, can be further subject to strengthening. 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. We adopt the definition of the exhaustivity operator (EXH) by Bar-Lev & Fox (2017), according to which 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 innocently includable (II) alternatives. The NR reading is then derived via application of EXH, starting with the LF corresponding to the basic weak reading ( $\exists w.\neg p(w)$ ). To see how this

works exactly, 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 (26).

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

Upon exhaustification, we will have (27), which is equivalent to the NR reading.

$$(27) \quad \text{EXH}^{\text{EI+II}} (\text{Alt}(\exists w \in \{w_1, w_2, w_3\}: \neg p(w))) = \exists w \in \{w_1, w_2, w_3\}: \neg p(w) \ \& \ \exists w \in \{w_1, w_2\}: \neg p(w) \ \& \ \exists w \in \{w_1, w_3\}: \neg p(w) \ \& \ \exists w \in \{w_2, w_3\}: \neg p(w) \ \& \ \exists w \in \{w_1\}: \neg p(w) \ \& \ \exists w \in \{w_2\}: \neg p(w) \ \& \ \exists w \in \{w_3\}: \neg p(w) = \forall w \in \{w_1, w_2, w_3\}: \neg p(w)$$

We argue that strict duality is a necessary step in strengthening  $\neg\forall$  to  $\exists\neg$  as directly applying EXH to  $\neg\forall$  requires assigning truth value T or F to alternatives containing universal quantification over singleton sets (e.g.  $\neg\forall\{w_2\}: p(w)$ ), which are infelicitous alternatives.

As for contexts where the NR reading may not arise, as in (8), we 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 are singleton sets (i.e.  $\{w_1\}$ ,  $\{w_2\}$ ,  $\{w_3\}$ ). Pruning is a mechanism to reduce the set of alternatives to only those that are plausible and relevant in a given context.

By applying EXH to the set of alternatives remained after pruning singleton sets, we get the weak non-NR reading, as shown in (28).

$$(28) \quad \text{EXH}^{\text{EI+II}} (\text{Alt}(\exists w \in \{w_1, w_2, w_3\}: \neg p(w))) = \exists w \in \{w_1, w_2, w_3\}: \neg p(w) \ \& \ \exists w \in \{w_1, w_2\}: \neg p(w) \ \& \ \exists w \in \{w_1, w_3\}: \neg p(w) \ \& \ \exists w \in \{w_2, w_3\}: \neg p(w): \neg p(w) \ \& \ \exists w \in \{w_3\}: \neg p(w)$$

Under this view, the (un)availability of strengthened NR readings for duality-allowing modals is reduced to whether EXH applies over the whole set of subdomain alternatives (yielding the strengthened reading) or over the subset remained after pruning singleton sets (yielding the weak reading). We argue that the singleton set alternatives are normally pruned when the modal expresses objectivity or evidentiality, because access to facts in a possible world is implausible. Therefore, strengthened NR readings are predicted to be impossible in such contexts.

## 4. Problems revisited

### 4.1. Neg-raising under the scope of negative quantifiers

Under our approach, the attested NR reading only arises when the surface LF  $\neg\exists x\forall w: p(w)$  has a strict logical equivalent as  $\forall x\exists w: \neg p(w)$ . This is only the case when the context entails that every  $x$  entertains the possibility of  $\neg p$ , that is when every  $x$  has an opinion about  $p$ . This logical equivalent  $\forall x\exists w: \neg p(w)$  can be further strengthened to yield a NR reading to  $\forall x\forall w: \neg p(w)$ .

Since the calculation of implicatures is context-dependent, the NR readings do not arise when the context does not entail every  $x$  has an opinion about  $p$ . The surface reading  $\neg\exists x\forall w: p(w)$  is compatible with scenarios some or no  $x$  is opinionated about  $p$ , as long as

there is no  $x$  that holds the belief that  $p$  is true. As NRPs in our approach do not come with an excluded middle presupposition, no presupposition failure predicted to arise.

#### 4.2. Neg-raising readings with non- Neg-raising predicates

The (novel) observation that (9) 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 is not a lexical property of predicates.

In the absence of factivity presupposition, strict duality between the two knowledge operators is valid ( $\neg\forall_{KW}.p(w) \Leftrightarrow_{\text{strict}} \exists_{KW}.\neg p(w)$ ). Therefore, the LF containing the existential knowledge operator  $\exists_{KW}.\neg p(w)$  can be strengthened to  $\forall_{KW}.\neg p(w)$  in appropriate contexts.

Our approach to NR is the only approach that does not postulate a distinct lexical property responsible for NR readings. The ability of predicates to give rise to NR readings follow from the predicates' normal presuppositions and contextual factors. We predict that every negated universal modal whose presuppositions do not block duality, such as non-factive *know* and *be sure* in (9), can get a NR reading, provided that the whole set of subdomain alternatives is contextually relevant and plausible, a prediction that seems born out (cf. Homer, 2015 for *should*).

#### 4.3. Horn Clauses

Under a duality-based approach like ours, any universal predicate that allows duality, gives rise to an equivalent LF where negation scopes below this predicate. This includes both NRPs and Cloud of Unknowing predicates, like non-factive *know*, but also predicates such as *accept*. This opens up the way to understanding Horn Clauses. Let's see why.

As a starting point, we follow Büring (2004), who shows that Negative Inversion, i.e., T-C movement followed up by fronting a negative phrase, is fine as long as the clause will receive a sentential negation reading. To see this, take the following examples:

- (29) a. With no job Kim is happy.  
b. With no job is Kim happy.

What (29) shows is that fronting of negative elements is not something that is obligatory in syntax, but rather an instance of movement that may optionally apply in syntax, but that gives rise to particular semantic effects. More specifically, Büring (2004) shows that in Negative Inversion cases the existential quantifier that binds the event variable ends up in the scope of an anti-additive context.

If Negative Inversion is semantically licensed, it is essentially a condition applying to LFs that must be met: Negative Inversion is licensed when nothing at LF disrupts the anti-additivity of the negation that outscopes the existential quantifier that binds the event variable. In constructions where a negative phrase is inverted this condition is trivially met. In (30a) the negative phrase itself is anti-additive. In (30b), the fronted phrase is not anti-additive, but following von Stechow & Iatridou (2007) *only* must be split up into a negation and exceptive counterpart. At LF the existential quantifier that binds the event variable does appear in an anti-additive context.

- (30) a. None of them did she find useful  
b. Only Mary did she find friendly = Nobody except Mary did she find friendly



A consequence of this analysis is that fronted negative indefinites can only appear in Negative Inversion contexts if the indefinite, which intervenes between the negation and the existential quantifier that binds the event variable, does not disrupt the anti-additivity introduced by the negation. For this reason, only negative/negated indefinites can be fronted. Other negative fronted phrases are not anti-additive and cannot trigger Negative Inversion:

- (31) a. \*Not everything did she find useful  
 b. \*Not Mary did she find friendly

But even among negative / negated indefinites, differences can be attested with respect to Negative Inversion, as shown in (32). Only the negative quantifier *nowhere* and the negated NPI *not anywhere* are anti-additive; *not somewhere* and *not to a place in France* are not, since here the indefinite gives rise to a specificity effect. Therefore, only the former can license Negative Inversion:

- (32) {Nowhere / Not anywhere / \*Not somewhere / \*Not to a place in France} did she go.

Hence, when negation takes scope below an existential dual of a NRP, it can license subject-auxiliary inversion, as long as nothing disrupts the anti-additive context introduced by this negation. Given the fact that subject-auxiliary inversion is to be followed up by fronting material into Spec,CP, this material may not disrupt the anti-additivity either. Consequently, this embedded Spec,CP can only contain an existential/indefinite (as non-existentials disrupt anti-additivity) that may not give rise to any non-anti-additive inferences either. As shown in (32), this is only the case for NPIs, as other existentials/indefinites give rise to specificity effects and/or existential import. Therefore, every Horn Clause must contain an NPI in this embedded Spec,CP, which is licensed by the negation scoping below an existential dual of the matrix predicate. As only NRPs, Cloud of Unknowing predicates and predicates such as *accept* allow strict duality to apply, this explains the full pattern of Horn Clauses without alluding to syntactic movement. This also naturally captures Horn's (2018) conjecture that the crucial factor in Horn Clauses is that 'in the sequence [a NEG-Fs that p] [it] is not the requirement that F be a NR predicate per se 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  $\neg p$ , where  $F' = F$  or  $F' < F$  on a relevant scale.'

## 5. Concluding remarks

In this article we have argued that both existing semantic-pragmatic accounts and syntactic accounts for NR face serious problems. These problems also include the existence of Horn Clauses, which have been argued to be maybe the strongest arguments for the syntactic approach to NR. This then calls for a new approach to NR. We sketch the outlines of such an approach in terms of non-lexical implicature calculation (see also Mirazzi & Zeijlstra in prep. for a more detailed account). Crucially, for us, the emergence of NR readings is the result of a two-step procedure where first strictly logical equivalents of LFs corresponding to utterances with negated necessity modals are generated. The strictly logical equivalent of a given LF, which contain an unpronounceable existential dual of the uttered modal, in turn may undergo contextually determined exhaustification. The output of this is the NR reading. In the remainder of this article, we have shown that under such an approach the problems for existing NR accounts are naturally resolved.

## References

- Bar-Lev, Moshe. 2018. *Free choice, homogeneity, and innocent inclusion*. PhD Dissertation, Hebrew University of Jerusalem.
- Bar-Lev, Moshe. 2020. An implicature account of homogeneity and non-maximality. *Linguistics and Philosophy*. <https://doi.org/10.1007/s10988-020-09308-5>
- Bar-Lev, Moshe, & Danny Fox. 2017. Universal free choice and innocent inclusion. *Semantics and Linguistic Theory* 27, 95–115.
- Bartsch, Renate. 1973. “Negative transportation” gibt es nicht. *Linguistische Berichte* 27, 1-7.
- Bassi, Itai, & Moshe Bar-Lev. 2018. A unified existential semantics for bare conditionals. In *Sinn & Bedeutung* 21, 125–142.
- Büring, Daniel. 2004. Negative inversion. *NELS* 2004.
- Chierchia, Gennaro. 2013. *Logic in grammar: Polarity, free choice, and intervention*. Oxford: OUP.
- Collins, Chris, & Paul Postal. 2014. *Classical neg raising: An essay on the syntax of negation*. Cambridge, MA: MIT press.
- Collins, Chris, & Paul Postal. 2018. Dispelling the cloud of unknowing: More on the syntactic nature of neg raising. In: *Pragmatics, truth and underspecification: Towards an atlas of meaning*, ed. Laurence Horn & Kenneth Turner, Current Issues in Semantics and Pragmatics (CRiSPI), 54–81. Leiden: Brill.
- Crowley, Paul. 2019. Neg-raising and neg movement. *Natural Language Semantics* 27, 1–17.
- Fillmore, Charles. 1963. The position of embedding transformations in grammar. *Word* 19, 208–231.
- von Fintel, Kai & Sabine Iatridou 2007. Anatomy of a modal construction. *Linguistic Inquiry* 38, 445-483.
- Fox, Danny. 2007. Free choice and the theory of scalar implicatures. In: *Presupposition and implicature in compositional semantics*, ed. Chris Potts, 71–120. Dordrecht: Springer.
- Gajewski, Jon. 2005. *Neg-raising: Polarity and presupposition*. PhD Dissertation, MIT.
- Gajewski, Jon. 2007. Neg-raising and polarity. *Linguistics and Philosophy* 30, 289-328.
- Homer, Vincent. 2015. Neg-raising and positive polarity: The view from modals. *Semantics and Pragmatics* 8, 1–88.
- Horn Laurence. 1972. *On the semantic properties of logical operators in English*. PhD Dissertation, UCLA.
- Horn, Laurence. 1978. Remarks on neg-raising. *Syntax and Semantics* 9: 129–220.
- Horn, Laurence. 1989. *A natural history of negation*. Chicago: UCP.
- Horn, Laurence R. 2014. The cloud of unknowing. In *Black book*, ed. Jack Hoeksema & Dicky Gilbers, 178–196. Groningen: University of Groningen.
- Križ, Manuel. 2015. *Aspects of homogeneity in the semantics of natural language*. PhD Dissertation, Universität Wien.
- Magri, Giorgio. 2014. An account for the homogeneity effect triggered by plural definites and conjunction based on double strengthening. In: *Pragmatics, semantics and the case of scalar implicatures*, ed. Salvatore Pistoia Reda, 99–145. Dordrecht: Springer.
- Mirrazi, Zahra & Hedde Zeijlstra. In prep. Contextual Neg-Raising: Duality and exhaustification. *IATL* 36.
- Romoli, Jacopo. 2012. *Soft but strong. neg-raising, soft triggers, and exhaustification*. PhD Dissertation, Harvard University.
- Romoli, Jacopo. 2013. A scalar implicature-based approach to neg-raising. *Linguistics and Philosophy* 36, 291–353.
- Zeijlstra, Hedde. 2018. Does neg-raising involve neg-raising? *Topoi* 37, 417–433.