

Neg-Raising: negation as failure?

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1 Introduction

The phenomenon of neg-raising exemplified by the near-synonymy between the two syntactic constructions in (1) consists of the lower clause understanding of certain higher clause negatives. In other words, the negative reverses the polarity of the lower rather than of its own clause. The fact that (1b) is often used ‘in place of’ (1a) has prompted the idea that the two sentences are related in some way. The relation has been expressed in terms of a syntactic transformation. It has been said that negation in (1b) has raised to the main clause from a lower position it occupies also in the structure underlying (1a). As a result, (1b) has the two readings shown in (2).

- (1) a. Daniel thinks that Louise will not come.
- b. Daniel does not think that Louise will come.
- (2) a. It is not the case that Daniel believes that Louise will come.
- b. Daniel believes that it is not the case that Louise will come.

The original transformational rule was descriptive at best. Jespersen (1917) observed that the sentences in (1) have different negative force. (1b) conveys *Daniel’s* greater degree of uncertainty about the negation of the state of affairs in the nested clause. From the logical point of view, the sentences induce different inferences. As noted in Horn’s (1978) review, the weakness is ‘felt’ and used in certain languages so that (1b) represents a more polite form of expressing the same content as in (1a). However, the weakness is often not ‘felt’, and (1b) is used even when the stronger position is believed to hold.

This study proposes that neg-raising may be best understood as a cognitive phenomenon which arises while the human mind is processing the content of the sentence under the normal assumption of the closed world. The linguistic phenomenon is compared with the working of the inference rule of negation as finite failure. The parallelism allows us the

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possibility of understanding several aspects of the phenomenon, such as for the different scopings of negation, for the optionality of the linguistic phenomenon and for its sensitivity to intervening quantifiers/scope operators. Sentences containing instances of neg-raising are analysed as conveying an evaluative move, and negation is examined as expressing the failure in proving the truth of the proposition expressed by the nested clause. Thus, the effect of negation on the nested clause ‘p’ is obtained without having to ascribe a belief on ‘p’. The phenomenon of neg-raising is a lexicalisation of negation as failure. Yet, it does not follow that negation in natural language should be analysed as a proof-failure operator. Finally, a terminological note. This study refers to the phenomenon as ‘neg-raising’ since this is the attested terminology nowadays, independently from its transformational bias.

2 Background

The syntactic literature has proposed a couple of approaches to the phenomenon. Klima (1964) argues that the negation originates in the main clause and is not ‘relocated’. The deep structure of (1b) has NEGs in both main and subordinate clauses, which are negative abstract components. The syntactic rule of Neg-Absorption deletes the lower NEG and gives the intended surface structure. Presumably, the neg-raising reading is obtained by a rule of semantic interpretation that associates the negative with the sentence that it logically negates. The transformational approach is more common. Fillmore (1963: 220) was the first to devise a rule for the movement of NOT. According to this rule, a negation that originates in the nested clause can raise to the main clause if the main verb is a member of a particular subclass named neg-raising verbs, e.g. *think*, *suppose* etc. Restrictions on verbs make it possible to distinguish the ambiguity of (1b), which can be interpreted as both (2a,b), from the lack of ambiguity of (3a), which does not share a reading with (3b). The underlying structure of (1b) is supposed to be the tree directly underlying (2b), and its surface form is produced via the application of the optional movement rule of neg-raising. The required interpretation is then obtained by interpreting the negation in the position it occupies in the underlying structure.

- (3) a. Daniel does not claim that Louise came.
 b. Daniel claims that Louise didn’t come.

A further restriction is that the raising verb must not be already negated. (4) cannot be obtained via neg-raising. Then, the rule is said to apply cyclically, provided all the predicates crossed over by negation are of the neg-raising type. Lakoff (1970: fn.5) gives (5) to show that *not* is moved ‘step by step up the tree’.

- (4) Daniel did not not think that he is a nuisance, he just did not say it, unlike you.
 (5) a. I believe that John wants Bill not to lift a finger to help Irv.
 b. I believe that John doesn’t want Bill to lift a finger to help Irv.
 c. I don’t believe that John wants Bill to lift a finger to help Irv.

Sentence (1b) can also be interpreted as the denial of the sentence *Daniel thinks that Louise will come*, as in (2a), in which case it does not commit the speaker to any belief. This reading is less favoured. It is usually considered to be extraneous to the phenomenon. As shown in (6), negation on the matrix verb need not have sentential scope for qualifying as ‘raised’.

(6) At least two girls didn’t think that Louise would come.

Although the transformational approach is still tacitly accepted in some recent work, cf. (Haegeman 1995:311) and (Postma 1995), it has been questioned from the beginning, cf. (Jackendoff 1971) and (de Cornulier 1973) *inter alii*. For instance, de Cornulier (1973: 47-48) argues that a negative adverbial such as *never* does not have the same raising possibility as *not*. The ‘objections’ to the solidity of the original semantic motivation of the rule have prompted studies aiming at providing syntactic evidence supporting neg-raising, for instance R. Lakoff (1963) discusses data on tag-questions in English, criticised by Jackendoff (1971) and Cattell (1973).

As said, the transformational proposal finds some support in the near-synonymy between the sentences in (1). Evidence for the existence of the phenomenon has often been taken to be evidence for the transformational treatment proposed. Yet, it is not the existence of the phenomenon that is questioned by opponents to this approach. It is the transformational mechanism that is criticised. The absorption approach in Klima’s style was abandoned largely because it was incompatible with the Katz-Postal Hypothesis on the meaning-preserving nature of optional transformations (Lindholm 1969), whereas the neg-raising approach was not, modulo an account of the ‘weakening’ effect. However, the evaluation of the neg-raising approach depended on what one was prepared to put into the modulo statement. de Cornulier, for instance, argues that the neg-raising rule goes against the idea that transformations should be meaning preserving, and that this is a crucial point because in a case like neg-raising the transformation is justified mainly by the concern of accounting for a synonymy. He notes (de Cornulier 1973: 50) that the rule modifies presuppositions in the pair in (7) for one reading of (7a).

- (7) a. Je ne voudrais pas être Dieu.
‘I would not want to be God’
b. Je voudrais ne pas être Dieu.
‘I wish I weren’t God’

Nowadays this criticism should be qualified, because, for instance, a movement rule such as quantifier raising is meant not to be meaning preserving. On the contrary, it is still the case that the restriction on the subclass of verbs involved must be postulated. The proposal as such doesn’t capture the group as a natural class.

Note that the near-synonymy between (1a) and (1b) is only part of the motivation for the transformational analysis of neg-raising. Data on negative polarity items (NPIs) have also played a major role. In a sentence such as (8), *until* is said to be licensed because the negative originates in the same clause as the NPI, and it is subsequently raised.

(8) I didn't think that John would get here until tomorrow.

But, at the same time, data on neg-raising have been used in support of an analysis of *until* as strict negative polarity item, i.e. requiring clausemate licenser, and of negation as a stativiser operator. This may lead to a circular argumentation, as it seems suggested in this quotation.

Since the ability of a predicate to intervene between a negative and a lower-clause strict NPI is often taken as THE criterion for membership in the class of NR-governing predicates, and since—on pain of circularity—we cannot base the strictness of an NPI solely on its behavior with respect to NR predicates, the decision as to what counts as strict NPI is not an idle one.(Horn 1978: 138)

The data are contradictory, e.g. (9) from R.Lakoff (1969) show potential NPI licensing failures, or controversial, see for instance (Carden 1970).

- (9) a. *I didn't ever think that John would get here until tomorrow.
b. *I never thought that John would get here until tomorrow.
c. *At no time did I think that John would get here until tomorrow.

Next, a quantifier that appears in subject position of the embedded clause might interfere with the movement of negation from the lower clause to the upper one. If (10a) is derived from a structure with an abstract negative taking scope over the embedded clause, one can account for its shared reading with (10b). In case neg-raising does not apply, the negative is lowered into the embedded clause and (10c) is derived, modulo dialectal variations as described in (Carden 1970). Independent reasons would force the higher realisation of negation in (11) (Horn 1978: 182). However, the hypothesis of a clause initial abstract negative wrongly predicts NPI licensing in the embedded clause in (10b). Dahl (1979) shows that it is contradicted by cross-linguistic data.

- (10) a. Daniel does not think that all the boys came.
b. Daniel thinks that not all the boys came.
c. Daniel thinks that all the boys didn't come.

(11) I don't think that at most two girls came.

Finally, in keeping with more recent concerns with the motivation for transformations, it is not clear what motivates the raising of *not*. Negation is able to satisfy all requirements, if any, already from the lower position, as shown by its acceptability in such a position. No further feature checking seems needed, especially if one thinks that the raising move weakens the negativity rather than enhances it. It could be argued that the raising of *not* is not due to 'morphologic' reasons, in the minimalist sense, but to more logical reasons such as extending the scope of the element. Neg-raising would be a sort of Quantifier

Raising which takes place in surface structure. This would not be enough to account for the phenomenon, but at least it could look like the beginning of a description. However, this option would raise questions such as why does this instance of raising necessarily take place before the logical form, contrary to the other cases. Also, it should be clarified why the negative could raise only ‘half way’ in (6) where the neg-raising reading is the one where negation does not have sentential scope, and on the contrary it can go ‘higher’ in (10a) where it has sentential scope. And also, it should be explained why the same motivation for raising is not, or not as easily available for other negative adverbials.

Semantic and pragmatic analyses approach neg-raising in terms of inferences an agent is entitled to draw. Jackendoff (1971) says that a semantic rule might have to do the reverse than the syntactic one. The issue to tackle is how to produce the inference (1a) from (1b). On the other hand, Kas (1993) approaches the phenomenon in terms of raising of negation. He refers to Zwarts’ dissertation as the original proponent of the idea that neg-raising corresponds to the formal property of consistency, given in (12).

$$(12) \quad \neg f(X) \Leftarrow f(\neg X)$$

Zwarts (1993) refers to the consistency and completeness of the NP subject in order to characterise the cases where negation on the auxiliary takes sentential scope; see (13) where f is the subject NP and X the VP, and the data in (14). NPs of this type are self duals.

$$(13) \quad \neg f(X) \Leftrightarrow f(\neg X)$$

- (14) a. Louise didn’t read the book.
 b. It is not the case that Louise read the book.

Kas (1993: 101) also argues that the relation picked out by the matrix verb is consistent. (12) is to be interpreted as saying that negation \neg has scope over the nested clause X , and can be interpreted as having scope also over the complex $f(X)$, where f is the matrix VP and X its sentential complement. He argues that the relation is not complete because (1a) is only one of the two possible readings of (1b). Hence, it cannot be maintained that (1b) necessarily implies (1a). Note that an agent may not have an opinion for any arbitrary proposition, cf. (15), i.e. the system is not complete and the entailment from left to right in (13) cannot be proven. Still, the crucial question remains how does it happen that this inference seems to be more common and to be used for neg-lowering.

$$(15) \quad \text{Daniel does not think that Louise will come; he has no opinion either way.}$$

In the case of sentential/predicate negation variation, the subject NP is consistent and complete; whereas, in the case of neg-raising, only the inference marked by the leftward arrow in (13) is possible. The inference marked with a rightward arrow, which expresses the property of being complete, is not possible. It seems that consistency describes the functioning of the rule of neg-raising. It is less certain whether it describes the phenomenon.

Jackendoff (1971: 294) noted that (16a) does not share a reading with (16b), although (16b) entails (16a). If one accepts Jackendoff’s observation, then (12) does not suffice for identifying verbs that qualify as neg-raisers, but it must be completed by the overt list of these verbs. In fact, (12) tells us that the relation picked out by *imagine* is also consistent. Therefore, this property is not restrictive enough for characterising the relevant set.

- (16) a. Bill didn’t imagine that they had won.
 b. Bill imagined that they hadn’t won.

Bartsch (1973) argues that (1b) is not ambiguous, and that under certain pragmatic conditions it conveys the same information as (1a), because general felicity conditions supply the additional bit that makes (1a) stronger than (1b). So they can have the same meaning without having to have the same representation. She makes the assumption that the speaker has reached a conclusion with respect to the nested clause S and doesn’t hold contradictory beliefs, and thus posits the disjunction ‘a Believe S \vee a Believe \neg S’. Then, the assertion of (1b) is used to eliminate the first disjunct, and the second disjunct is derived. The crucial point is to define when one is allowed to assume this disjunction, i.e. what rules it out for predicates which are not neg-raisers. Epstein (1977), who proposes an account along the same lines, notes that predicates such as *be sure* are not neg-raisers but fit the condition ‘a Believe (\neg S)’ implies ‘a \neg Believe (S)’. He claims that neg-raising verbs represent propositional attitudes, hence the no-belief case is excluded as uncooperative. On the contrary, with *be sure* one can have thought long and hard over something and still not be sure about it. In this case positing the disjunction is not motivated. Then, Browne (1982) tries to have a gradation in the proof, and argues that neg-raising is a consequence of the inference from (1b) to (1a) obtained by examining a consequence and a rival conjecture. In (1b) insecurity sets up an inference in the opposite direction, as given in (17) where | is the ‘nand’ connective. In (15) neg-raising fails because ‘the second premise of the inference is denied by asserting the no-belief possibility’ (Browne 1982: 43).

- (17) A | B
 B is less credible
 A is more credible

In the following, the phenomenon is characterised as enthymematic inference. The default assumption of closed world plays a key role in this as in other linguistic phenomena, e.g. the interpretation of universal quantifiers. The neg-lowering reading arises during the processing of the content of the sentence, under the conditions normally assumed for human reasoning. It is not the case that neg-raising verbs are complete, but humans temporarily suspend the partiality of the system via the closed world assumption. This move makes evaluation possible without explicitly ascribing to the agent a belief on the content of the nested clause, because the case where the value of the nested proposition is unspecified is temporarily collapsed into the negative one. I explore possible cognitive reasons for neg-raising by drawing an analogy with negation as finite failure (Clark 1978).

3 Negation as failure

In logic programming, evaluating a query with respect to a particular program amounts to attempting to prove that the query follows from the program/database. The data in the database may be extensional, i.e. stored in explicit form, or intensional, i.e. sets of axioms from which new data can be derived using both the axioms and the extensional data. A characterising feature of databases which satisfy the open world assumption is the fact that negative data are listed explicitly. Answers to queries are looked up or derived from data and axioms. If there is no way to derive something, no negative answer can be given. The failure does not correspond to negation. Thus, three situations are possible, that is the value of a formula can be true, false or unspecified. A problematic point is that negative data may overwhelm a system.

In a relational database, if a certain instance of a relation R is not given, it can be assumed that it is in the complement of the relation. In a logic database, an instance not given can still be implied by a general rule. A closed world database arises from an assumption concerning negative data. In order to determine whether a negative fact can be derived from the database, one attempts to prove the positive fact true. If this attempt fails, the negative data is then assumed to be true. In short, under the closed world assumption certain answers are admitted as a result of failure to find a proof. The program is deemed to contain all the information that is relevant to solving any given query, and anything not explicitly stated as true, or derivable from the axioms, is taken to be false. Clark (1978: 294) proposes the negation as failure inference rule given in (18), whereby a negated fact can be inferred if every possible proof of such a fact fails.

$$(18) \quad \vdash \neg \vdash \phi \quad \text{infer} \quad \vdash \neg \phi$$

The proof that ϕ is not provable is constituted by the exhaustive yet unsuccessful search for a proof of ϕ . Clark proposes a way of connecting negation understood as failing to prove to its traditional truth functional semantics. The two are reconciled by treating the alternatives of the failed proof space as explicit disjunctions in first order deduction. Thus, a failure proof of $\neg\phi$ is taken as a valid first order inference that ϕ is false. A very important point is that the ‘negation as failure rule only allows us to conclude negated facts that could be inferred from the axioms of the completed data base’ (Clark 1978: 311). Another important point is that the rule of negation as failure holds only for programs which terminate. The query must have a form which makes it possible to implicitly constrain the search. On the one hand, there should be a candidate set of substitutions containing no variables for every variable in a negated atomic formula. On the other hand, each relation of the database should have computable finite extension.

4 Discussion

Clark’s negation as failure inference rule says that if we can prove that we are in the situation where we cannot prove ϕ , then it is as if we had proven $\neg\phi$. However, one cannot

prove situations in logic programming, only formulae. (18) means that if $\not\vdash_R \phi$ then infer $\vdash_R \neg\phi$, where R is a particular form of resolution.

The interpretation of a neg-raising sentence is represented provisionally as in (19). The \neg is the negation *not*, the ‘ T ’ is the neg-raising expression, e.g. the verb *think* or the predicate *be likely*. The subscript variable x is the subject of the neg-raising predicate, and ϕ is the nested proposition. Then, the fact that the inference is drawn under the closed world assumption is expressed by requiring $\neg T_x\phi$ to be compatible with $T_x\neg\phi$.

$$(19) \quad \frac{\neg T_x\phi / T_x\neg\phi}{T_x\neg\phi}$$

The subject x need not be inside the scope of negation. Example (6), where the negation on the auxiliary does not have sentential scope, can be represented as (20). There is an application of the non-monotone (19) to (20) each time x is instantiated.

$$(20) \quad \exists S(|S| \geq 2 \wedge \forall x(x \in S \Rightarrow \neg T_x\phi))$$

The information that ϕ is false is not logically derived. Its status is provisional. (19) should not be interpreted as a way of adding a disjunction to the derivation, similarly to Bartsch’ proposal. On the contrary, it means that the conclusion from the default assumption is drawn in the absence of any information to the contrary, and that it will have to be withdrawn in the light of new information of the type ‘ ϕ is true’. It is as if the information state were ‘frozen’ at that particular moment. There are no reasons to believe that ϕ is true, thus when the database is closed, ‘ ϕ is false’ is derived. If the information is processed incrementally, there is no way to compute the relevance of future information. Inferences are drawn on what is available and the conclusion is going to be kept as long as incoming information is compatible with $T_x\neg\phi$.

My hypothesis can explain the difference between predicates such as ‘believe’ and ‘be sure’. At the level of intuitions, it is traditionally accepted that one is stronger than the other. This difference can be mirrored by a difference in the the state of belief. By using ‘believe’ one commits oneself with respect to the current state of belief. By using ‘be sure’ one commits oneself also with respect to future information. It may be profitable to consider the treatment of default reasoning in update semantics (Veltman 1996). Discussing sentences in which modal qualification like ‘must’ or ‘might’ occur, Veltman argues that these are examples of non-persistent sentences. The property of persistence is defined as in (21), where σ, τ are information states.

$$(21) \quad \text{If } \sigma \Vdash \phi \text{ and } \sigma \leq \tau, \text{ then } \tau \Vdash \phi$$

In these non-persistent cases, the argument is ‘valid’ in a weaker than the logical sense (Veltman 1996: 224). Within the same framework, Westmoreland (1995) argues that epistemic *must* is an evidential—i.e. a lexicalised label providing information about the proposition—and contributes the information that the propositional content of the sentence is inferred rather than known. Neg-raising seems to me another case of lexicalisation of information

about an inference. The content which is inferred is marked as information that could be retracted. Neg-raising is close to an epistemic construction for updates concerning negative information. At a later moment, an agent may ignore the ‘provisional’ status of the update, but this is a different matter. Note that the update concerns a personal database. In the case of ‘believe’, the minimal requirement is that the proposition which is the object of the belief must be evaluated in the current information state of the speaker. ‘Minimal’ means that it is possible also to evaluate with updates, but this is not necessary. This means that, insofar as the speaker asks to take care only of his information state, and insofar as the hearer accepts the proposal, it is as if the information state were complete. The focus of the mental attention is local, and negation as failure can apply. The ‘non belief that ϕ ’ is equivalent to ‘belief that $\neg\phi$ ’. If locally it holds that $\not\vdash \phi$, then locally it holds that $\vdash \neg\phi$. On the other hand, ‘be sure’ minimally requires that the proposition be evaluated on a sequence of updates, the set of ‘reasonable’ updates. The focus of the mental attention includes the updates, and it is not possible to apply the negation as failure rule on a database that would be modified. It is not enough that $\not\vdash \phi$ holds locally, persistence is required. A state of belief is more stable than a state of certitude. In order to arise, the neg-raising phenomenon takes negation as failure and a predicate that creates a context where the rule can apply.

The rule does not allow one to overtly tell apart data that have been proved to be false and data that fail to find a positive proof and are therefore treated as ‘false’. However, as long as the hearer is prepared to accept that the evaluation is done locally in the current speaker’s database/information state, the difference is not relevant and the two cases are equivalent. The fact that the hearer is free to reject this is a first facet of the hedge (G.Lakoff 1972) expressed by neg-raising sentences. As an aside, one development of this idea may lead to the issue of the asymmetry between first and third person cases of neg-raising. The equivalence at the local level explains why (1b) is used when (1a) is believed to hold. The understood politeness conveyed by the use of neg-raising sentences, another facet of the hedge, can be captured by saying that they strongly suggest that the content of the subordinate clause has to be evaluated as false, but they do not force a logical proof upon the hearer.

In the remainder of this study, it will be argued further that the account of neg-raising in terms of reasoning under the default assumption of the closed world is a fruitful way of considering the natural language phenomenon. I shall do so by looking mainly at questions raised in the literature, and showing that they find their place and motivation in a single picture.

4.1 *Motivation of the phenomenon*

Neg-raising sentences express epistemic attitudes with respect to ϕ , when there is no way to logically prove that ϕ is true. If one assumes that machine efficiency considerations hold for humans too, and that they are relevant for human reasoning, then computational considerations can be invoked as psychological motivation for the high surface positioning of

negation. As pointed out by Clark, considering something false if one fails to prove that it is true is a ‘solution to negation’ which has the great advantage of being easily implemented. There is no need to store negative information. It seems a practical solution for humans too, since it is a way to compute the consequences produced by negative information, and at the same time it allows one to evade a problematic issue on the ontological level, namely the status of ‘negative facts’.

Then, logical strength considerations can also be invoked for the low interpretive positioning of the negative. The effect of negation is ‘cached in’ in the nested clause because this amounts to maximising the inferences which can be drawn from the information available and the assumptions. The lower negation is logically stronger. This approach allows one to reconcile neg-transportation data with Jackendoff’s (1969) idea that the surface position of negation is always included in the interpreted scope and with Jespersen’s generalisation on the early positioning of negation.

Finally, the characterisation of neg-raising as a cognitive phenomenon points at plausible reasons for the existence of the phenomenon in natural language. Its presence is recorded even in a language such as Esperanto whose prescriptive grammar originally dictated that speakers should not neg-raise (Horn 1978).

4.2 *The raised negative*

From the modelling of the phenomenon as negation as failure, it follows that the negative involved in it can only affect truth values, and no other component of the meaning of the sentence. *not*, and its equivalents in other languages, can be interpreted as contradictory negation, i.e. the negation of sentence *S* is true if and only if *S* is not true.

Note also that the contradictory of *all N VP* is *not all N VP*, and this is the neg-raising reading one gets when *all* is in subject position in the nested clause, as shown in (22). In this case constituent negation can be reconstrued as contradictory negation. A similar reconstruction is not available for quantifiers such as *at most two N*.

- (22) a. He thought that not all the onlookers were aware of the danger.
b. He didn’t think that all the onlookers were aware of the danger.

Löbner (1987: fn.13) suggests that neg-raising takes place in order to avoid direct negation of a universal, which yields the negation of an existential as result. As pointed out by Sandu (1994), there are logical reasons to believe that it is not the case that negation can move freely across a string of quantifiers changing them into their duals, as proposed in a theory of negation of the operator-lowering type (Seuren 1984). Whether this is plausible in the case of neg-raising might be better tested via psycholinguistic experiments.

By analysing neg-raising as a lexicalisation of negation as failure I do not imply that natural language negation itself should be interpreted as a proof-failure operator. Indeed, negation is required to combine with verbs which mark a process of evaluation for the phenomenon to arise, or more generally verbs with similar modal-like properties. In the following subsection, both evaluative dimension and mid-scalar characterisation (Horn 1978) are argued

to follow—together with the ban on factives (Kiparsky and Kiparsky 1971)—because these verbs do not ‘affect’ the result of the process. Their semantic lightness has long been noted cross-linguistically even in normative grammars.

4.3 *Class of predicates*

The analogy with the non-monotonic inference rule of negation as finite failure makes it possible to model the phenomenon so that the typology of verbs involved in it can be derived. The predictions are that the verbs convey an evaluative move and not an assertion, because neg-lowering does not alter the content of the completed database. This non-committal stance has been known for long. Furthermore, no feature expressing a commitment or bias of the agent against or in favour of something is allowed. This has been characterised by Horn (1978) as the mid-scalar property. A predicate F embedding a proposition ϕ is a ‘mid-scalar’ predicate if and only if $F\phi$ and $F\neg\phi$ is a contradiction (Horn 1978: 195). The predicate cannot convey the agent’s expectations, which would bias the outcome of the evaluation.

In his detailed overview of neg-raising, Horn (1978: 187) provides the classification of neg-raiser expressions repeated here in (23). The class in (23.1a) gathers together the most widespread categories of neg-raising predicates. Instances of the classes (23.1) and (23.2) have already occurred in the discussion, (23.3a) and (23.3b) are momentarily left aside, but they are tackled in the next subsection.

- (23)
1. (a) [OPINION] *think, believe*
 (b) [PERCEPTION] *seem, appear, look like*
 2. [PROBABILITY] *be probable, be likely*
 3. (a) [INTENTION/VOLITION] *want, intend*
 (b) [JUDGMENT/(WEAK) OBLIGATION] *be supposed to, ought*

The existence of similarities among neg-raisers across languages has long been known. Because of the lack of universality of neg-raiser predicates, G.Lakoff (1970) argued that the meaning of a verb cannot be used in predicting his participation in neg-raising. According to him, these predicates cannot form a natural semantic class. Ransom (1985) points out that the considerable controversy over which predicates are neg-raisers is due also to the disagreement on the major criteria taken in consideration. If synonymy between (1a) and (1b) is taken to be the major test, *believe, likely, happen* and also *be true* pass it, but not *manage*. If the cooccurrence with strict negative polarity items such as *until tomorrow* is taken to be the major test, *believe, likely, happen* and *manage* pass it, but not *be true*.

The idea of a lexically governed phenomenon is mentioned by G.Lakoff (1970: 159,162). However, he argues that the phenomenon cannot be properly characterised as lexically governed because semantically similar expressions may behave differently with respect to neg-raising. Horn and Bayer (1984) propose that the phenomenon is a case of short-circuited implicature. In other words, the required inference lowering the negation is in

some way ‘precompiled’ and stored into the semantics of certain expressions. This move is intended to get around the problematic issue of the holes in the class of neg-raisers. The phenomenon acquires a sort of idiomatic-like status as regards to the elements that induce it, but not so much as regards to its functioning. Independently from the theoretical value of this solution, one should note that it still suffers from some empirical shortcoming. As a matter of fact, not all the uses of the verbs belonging to the class of neg-raisers allow the raising, as noted by Horn (1978). They do so only when they are used in particular senses. Our proposal allows us to formalise the functioning of the phenomenon, and also to account for its distribution. The apparent discontinuity in the arising of neg-raising is explained when one consider that the uses that allow the raising effect are precisely those expressing the operation of evaluation. The French data in (24) show that *trouver* in the sense of ‘think’ is a neg-raiser, whereas in the sense of ‘find out’ it is not, cf. (Lindholm 1969) on similar variations for English *believe*.

- (24) a. Je n’ai pas trouvé que Daniel avait l’air fatigué.
 ‘I didn’t think that Daniel looked tired’
- b. A la fin de mes recherches, je n’ai pas trouvé que le Maître était fils unique.
 ‘At the end of my investigations, I didn’t find that the Master was an only son’

Similarly, the variation in the neg-raising properties of ‘believe’ in different languages can be connected with its different uses as evaluative and as assertive predicates.

4.4 *Deontic modals and predicates of volition*

In the literature, see (Horn 1989) *inter alii*, examples such as the Italian (25) are given in order to show that deontic modals may allow neg-raising, at least in some languages. The same is said for predicates of volition, see the French examples in (26).

- (25) a. Non devi ascoltare.
 ‘You mustn’t listen’
- b. Devi non ascoltare.
 ‘You must not listen’
- (26) a. Je ne veux pas écouter.
 ‘I don’t want to listen’
- b. Je veux ne pas écouter.
 ‘I want not to listen’

At first glance, what makes sentences containing deontic modals resemble neg-raising cases is that the modality does not seem to be affected by the presence of negation. In logic, the denial of necessity implies possibility. Therefore, *non devi ϕ* in (25a) is expected to mean ‘you can’ *non ϕ* , i.e. $\neg \Box \phi \Rightarrow \Diamond \neg \phi$. Instead, (25a) still conveys a necessity. It really seems

that negation does not belong where it occurs. The ‘logical’ reading paraphrased as *you can not listen* is hard to obtain for (25a) even with strong stress on the modal. Usually, negation is required to be yet a clause higher for this reading to be available, as in (27).

- (27) Non è (vero) che devi ascoltare.
‘It is not the case that you have to listen’

The analysis I have proposed accounts for the change in the polarity of the subordinate clause while other things remain equal. Following Ransom’s (1985) terminology, (28) and (29) are cases where the higher negation affect the polarity of the subordinate clauses but not their evaluation modality. With both affirmative and negative higher predicates, the complement proposition is interpreted as probably the case but with some alternatives, i.e. as having Determined Evaluation. Remember the hedge conveyed by neg-raised sentences with epistemic verbs.

- (28) a. Daniele pensa di essere partito.
‘Daniel thinks he left’
b. Daniele pensa di partire.
‘Daniel thinks he will leave’
- (29) a. Daniele non pensa di essere partito.
‘Daniel doesn’t think he left’
b. Daniele non pensa di partire.
‘Daniel doesn’t think he will leave’

In the remainder of this subsection, I would like to discuss two particular issues which might seem to set predicates of volition and deontic modals aside from opinion predicates, but which may also have a different explanation. First, negation can raise or stay put rather freely in sentences containing predicates of the type (23.1) and (23.2). On the other hand, it has been noted that there is no such ‘freedom’ in raising with predicates of volition and deontic modals. Sentences as (30b) or (31b) are hardly interpretable in the non-raised form. The problematic issue here seems to be that *not talking with one’s mouth full* or *not eating* can hardly be interpreted in terms of a precise dual. In general, the obligation cannot bear on the absence of the event expressed by the nested predicate. The issue seems to be whether one can put the causality of a ‘negative event’ under the control of a modal. This point seems to bring us back to the issue of the ontological status of negative information.

- (30) a. Non devi parlare con la bocca piena.
‘You mustn’t talk with your mouth full’
b. #Devi non parlare con la bocca piena.
‘You must not speak with your mouth full’

- (31) a. Tu ne dois pas manger.
 ‘You mustn’t eat’
 b. # Tu dois ne pas manger.
 ‘You must not eat’

Second, it should be noted that some data are potentially misleading. The different behaviour recorded in the Italian examples (32) and (34)–(35) might lead to believe that neg-raising may be not stable in cases containing predicates of the type (23.3). The sentences in (32) contain an opinion predicate, and the presence of *mica*, which most of the time can be translated as a negation strengthener, doesn’t interfere with the neg-raising phenomenon. As a short aside, note that the nature of *mica* is not well defined. It has a double distribution. When it cooccurs with *non*, as in example (32b), it looks like a sort of discontinuous negative component. When it occurs autonomously, and is preposed to the predicate, as in (33), it acts as a full negative.

- (32) a. Non credo che Daniele venga.
 ‘I don’t think that Daniel will come’
 b. Non credo mica che Daniele venga.
 ‘I really don’t think that Daniel will come’
- (33) Ma quando avevo 14 anni mica ero tanto contento, non ci volevo andare. (l’Unità 4/1/1997)
 ‘But when I was 14 I wasn’t all that happy, I didn’t want to go’

On the contrary, *mica* interferes in (34) and (35), which contain occurrences of deontic modals.

- (34) a. Non devi uccidere.
 ‘You must not kill’
 b. # Non devi mica uccidere.
 ‘It is not the case that you will have to kill.’
- (35) a. # Non devi sposarti.
 ‘You must not marry’
 b. Non devi mica sposarti.
 ‘It is not the case that you will end up getting married’

(34a) is used to convey an impersonal necessity, which is often represented by the formula $\Box\neg\phi$. The presence of *mica* in (34b) makes the sentence unfelicitous. It is as if negation could not lower inside the scope of the necessity operator in the above formula. Furthermore, the nomic character of the statement is lost. (34b) is about a particular event, and it is used to reassure the hearer that in the given circumstances what is expected from her/him is not a murder, far from there. (35b) is also used to convey the denial of a personal obligation, as represented by $\neg\Box\phi$. From the pragmatic oddity of the prescription of

never getting married one can derive the oddity of (35a). Cinque (1976) argues that *mica* has a presuppositional content. In imperative sentences, its use would force the expectation, from the speaker, that the hearer would certainly do ϕ , had the former not asked the latter not to do so. In Cinque’s opinion, this is why *mica* cannot be used in very general commands and in orders that exclude such an expectation, see the contrast in (36).

- (36) a. Non uscire mica, eh!
 ‘Beware, don’t go out’
 b. ??Non desiderare mica la roba d’altri.
 ‘Beware, thou shalt not covet thy neighbour’s goods’

This characterisation might help in clarifying the contrast between (32) and (34)–(35) if we take (34a) and (35a) to be able to express either a general obligation or a command, i.e. as requiring either repeated or unique satisfaction. The effect of *mica* would then be that of ruling out the interpretation according to which repeated satisfaction is required. This is so because *mica* alters the presupposition about one particular event, and not an abstract class of events. If this is so, the contrast is no really relevant for the issue of neg-raising. On the one hand, the sentences in (32) concern particular events, hence the presence of *mica* does not reduce the set of possible interpretations for (32b). On the other hand, some interpretation available for (34a) and (35a) is no longer available because of the presence of *mica*. The remaining interpretation as denial of personal obligation, which is a subcase of obligation, gains prominence.

4.5 *Optionality*

The neg-raising rule is a minor rule whose application is optional. Sentence (1b) can be interpreted with negation applying to the matrix predicate. The character of ‘optionality’ of the phenomenon can also be accounted for within the analysis under discussion. The closed world assumption is a default, therefore in general it applies, but not necessarily so. It can always be dropped, preventing negation as failure to apply and allowing the alternative inference that there are unspecified cases. However, even if I don’t share Bartsch’ and Epstein’s analysis of (1b) as unambiguous, I think that it is usually interpreted as unambiguous because of the default assumption, and that such an assumption must be overruled overtly. One should note how important it is to rule out the neg-lowering reading explicitly for the logically sound reading to become prominent: contrast the primary readings of (37a) and (37b).

- (37) a. Two girls don’t think that Daniel will come.
 b. Two girls don’t think that Daniel will come; they have no opinion either way.

Furthermore, (37b) can be used naturally only for answering back to a previous statement. It brings in a correction in a piece of information already provided, or that one would have

a tendency to deduce. Any compatibility with $T_x\neg\phi$, required in (19), is crossed out by stating overtly that $\neg T_x\neg\phi$ (together with $\neg T_x\phi$). Hence, (19) does not apply and the conclusion $T_x\neg\phi$ cannot be drawn.

In short, ‘optionality of neg-raising’ may not be the best term for describing the possibility of having both sentences in (37), and potentially two interpretations for (37a). Rather, (37b) is a case where the preconditions for neg-raising do not obtain.

4.6 *Scope of the ‘lowered’ negation*

Clark discusses restrictions on the use of the failure inference rule. At first sight, its application to an atomic formula with no variables would mean, in linguistic terms, that the lowered negation must have clausal scope, so that the whole clause is treated as an atomic formula. This is to say also that, were the auxiliary negation to lower from the matrix to the embedded clause, the embedded predicate negation would be expected to be equivalent to the embedded sentence negation. As already mentioned, Zwarts (1993) has shown that predicate and sentence negation scopings are not always equivalent, and has given a description of the logical connections among them by reference to the semantic nature of the subject noun phrase.

Data supporting the requirement of a sentential scope for the lowered negation are the putative impossibility of having neg-raising reading with a quantifier as subject of the nested clause. Sentence (38) has a reading (39b), but not a reading (39a). However, the nested clause in (39b) is the contradictory of the nested clause in (38), as already pointed out in subsection 4.2. Here semantic sentential scope of negation mismatches the usual syntactic sentential scope.

(38) I don’t believe that everybody think that Daniel came.

(39) a. I believe that everybody don’t think that Daniel came.

b. I believe that not everybody thinks that Daniel came.

The issue of why a complex-NP should block neg-raising also falls out directly from the analysis. In (40) the whole NP *the rumor that ...* is the ϕ under evaluation.

(40) #Daniel doesn’t believe the rumor that Louise will come.

4.7 *Mood effects*

Example (41) from Spanish show effects of mood on neg-raising. Only (41b), with the embedded verb in subjunctive mood, is said to have a neg-raising reading (Rivero 1971).

- (41) a. Cree que no es inteligente.
 ‘He believes that he is not intelligent’
 b. No cree que sea inteligente.
 ‘He doesn’t believe that he is intelligent’
 c. No cree que es inteligente.
 ‘He doesn’t believe that he is intelligent’

Facts are less clear cut in French or Italian, where the subjunctive is not strictly required, see the French neg-raising pair in (42). However, subjunctive in Romance in general favours a non-committal reading, which is a feature of neg-raising sentences.

- (42) a. Je ne pense pas que Louise est venue.
 ‘I don’t think Louise came’
 b. Je ne pense pas que Louise soit venue.
 ‘I don’t think Louise came’

Tense also seems to play a role, if future is taken to be a tense. The Italian sentences in (43) are not synonymous. The neg-raising reading is not available for (43a).

- (43) a. Non crederò che Luisa sia venuta.
 ‘I won’t think Louise came’
 b. Crederò che Luisa non sia venuta.
 ‘I will think that Louise didn’t come’

5 The open issue of a syntactic rendering

This last section discusses a question for which no final answer is provided, so far, namely the possibility of rewording in syntactic terms the ‘lowering’ of negation. Yet, I outline arguments that motivated the positions adopted in this study, and which look like promising directions for future research.

In this study, neg-raising is analysed as a primarily cognitive phenomenon. The Italian piece of data in (44), where *non* ‘licenses’ the NC-term *niente* (nothing) in postverbal position in the nested clause, brings me to discuss the issue of whether it is still possible to give it a syntactic rendering. In fact, were it not possible to ‘relocate’ the negative, by a lowering move possibly of restructuring type or by referring to the original foot of a chain, a syntactic treatment of negative concord would also be weakened. Thus, the independent issues of the motivation of a syntactic transformation, and of the desirability of a downward movement, will be left aside, and the discussion will focus on where could be located the here unspecified ‘entity’ which would mark the lower clause scope of negation in a representation of a neg-raising sentence.

- (44) Non penso che mangino niente.
 ‘I don’t think they will eat anything’

There are a couple of natural candidates for hosting the mark of the narrowed negation's scope. One is a sigma projection in the vein of (Laka 1990), which is assumed to host sentence operators such as emphasis and truth-value operators. This projection is reminiscent of the judgement operator proposed by Bierwisch (1980) and could be seen as a sort of syntactic realisation of that idea. The other is the Comp phrase, because this projection includes the whole ϕ . The fact that negation cannot 'split up' ϕ could be obtained, in this hypothesis, by saying that negation cannot lower below Comp. In order to check whether Comp acts as a barrier to lowering, one can test sentences with negative polarity items (NPI) in the matrix. A snag is that neg-raising verbs take S as direct object, so there aren't many places in which to insert NPIs. (45) looks like a potential example.

(45) I didn't ever think that Daniel solved the problem on his own.

But adding the NPI alters the relevant interpretation. It causes a shift in perspective from a thought about a fact to a quantification over events of thinking about that fact. The fact seems to be too deeply nested to be affected by the negation. Or rather, *ever* forces the negation to apply too high, maybe because it slips a quantifier between \neg and T . There is no other way of sequencing the whole, because *ever* must take narrow scope with respect to negation. The same effect is recorded in Italian, see (46) with the NC-term *mai*.

(46) Non ho mai pensato che Luisa cantasse.
'I never thought Louise would sing'

According to the analysis presented in this study, negation must affect the truth value of the subordinate clause, and not modify temporal information. For this reason, the lowering is not possible in (45) or (46).

A counterexample to the hypothesis of Comp as a barrier is provided by the fact that (47a) is equivalent to the neg-lowered sentence in (47b), where negation is below the nested Comp, as shown by its having constituent scope. The case of (47) would be more easily treated in the sigma phrase hypothesis, since here the subject constituent negation yields the expected contradictory interpretation, see above subsection 4.6. Thus, the constituent negation interpretation is computed from the negative polarity of the embedded clause, with no need to lower the negation down to the subject.

(47) a. Daniel does not think that everybody came.
b. Daniel thinks that not everybody came.

In short, there is no clear evidence in favour of the hypothesis that in a case of neg-raising the syntactic scope of negation is restricted to the lower Comp. Whereas, (47) qualifies rather as evidence against it. Furthermore, the interpretations as sentential or constituent negation of the 'raised' negative cast doubts on the possibility of a syntactic rendering.

6 Summary

This study hypothesises that neg-raising is a cognitive phenomenon which arises while the human mind is processing the content of the sentence under the normal assumption of closed world. A ‘neg-raised sentence’ conveys an epistemic attitude towards the proposition expressed by the subordinate clause. The hedge consists in making it clear that a certain conclusion is compatible with the current information state, but cannot be proven. The closed world assumption plays a crucial role, inasmuch as it formalises how a conclusion can be reached on the basis of partial information without going through a belief ascription step. The parallelism with the negation as failure rule allows us the possibility of understanding several aspects of the phenomenon, such as the different scopings of negation, the typology of verbs involved, the apparent optionality of the phenomenon and its sensitivity to intervening quantifiers/scope operators. The paper also contributes to the discussion on the thorny issue of negative information inasmuch as the negation as failure rule offers a practical solution to the prospective case of negative data overwhelming a system while the theoretical issue of the ontological status of ‘negative facts’ need not be tackled.

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