Toward an Analysis of Negative Polarity Items

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Ever since Ladusaw (1979) brought them to the fore of semantic research, Negative Polarity Items (NPIs) have posed a challenge to formal semantics. The challenge is on two fronts: the empirical front, determining what the actual distribution of NPIs is, and the formal front, developing an analysis that predicts the properties of NPIs. The core data that gave NPIs their name involve the sensitivity of certain expressions like ever and any to the presence or absence of a negative word like the sentential negation not, a negative quantifier nobody, a negative adverb rarely, or a negative propositional attitude predicate doubt as illustrated in (1).

\[(1)\]
\[\begin{array}{l}
    a. \text{Men (\text{*ever}) saw (\text{*any}) dogs} \\
    b. \text{Men didn’t (\text{ever}) see (\text{any}) dogs} \\
    c. \text{Nobody (\text{ever}) saw (\text{any}) dogs} \\
    d. \text{Men rarely (\text{ever}) saw (\text{any}) dogs} \\
    e. \text{Men doubt you (\text{ever}) saw (\text{any}) dogs}
\end{array}\]

In (1a) we find that the words ever and any are infelicitous in a simple declarative sentence without negation. In (1b) we see that addition of negation to that sentence is sufficient to license use of those words, while in (1c) we see that replacing the subject Men with the negative quantifier nobody is as well, as is addition of the adverb rarely in (1d). Finally, embedding under the predicate doubt also suffices to license NPIs. While the above data are very clear, however, less obvious is what it is about not, nobody, rarely and doubt that licenses the NPIs. In this paper I will examine several current analyses of NPI licensing. I will show that each of these analyses is empirically inadequate, and will draw conclusions about what their inadequacies suggest as a better alternative analysis. This paper is thus laying the groundwork for an analysis of NPIs, but does not develop such an analysis.

The first semantic analysis of NPI licensing to meet with moderate success was that of Ladusaw (1979). Ladusaw posited that NPIs are licensed in Downward Entailing (DE) environments. An expression \(\phi\) constitutes a downward entailing environment if and only if substitution within \(\phi\) of an expression \(\alpha\) with another expression \(\beta\) that entails \(\alpha\) results in a new expression \(\psi\) that is entailed by \(\phi\). To illustrate, consider the sentences in (2).

\[(2)\]
\[\begin{array}{l}
    a. [\phi \text{Men didn’t see a } [\alpha \text{ dog}]] \\
    b. [\psi \text{Men didn’t see a } [\beta \text{ big dog}]]
\end{array}\]

The only difference between the sentences in (2) is that where (2a) contains the expression dog (= \(\alpha\) in our definition above), (2b) contains the expression big dog (= \(\beta\)). Under an appropriately cross-categorial concept of entailment, big dog (\(\beta\)) entails dog (\(\alpha\)): if something is a big dog, it
follows that it is also a dog. The entailment relation between the two sentences, however, is the reverse of the entailment relation between these two expressions: (2a) (= φ in our definition above) entails (2b) (= ψ). By the characterization given above, the expression dog (and big dog) thus occurs in a Downward Entailing environment. As the reader can verify, the same argument can be used to show that the object NP a dog, the VP see a dog and the subject NP men occur within DE environments as well, but that no other expressions in (2a) do.

As Ladusaw’s analysis predicts, the NPIs in (3a) are unacceptable since they fail to occur in a DE environment, but those in (3b), which do occur in a DE environment, are acceptable.

(3) a. *Men ever saw any dogs
   b. Men didn’t ever see any dogs

Furthermore, the analysis extends straightforwardly to the sentences in (1c,d,e), since the same substitution of big dogs for dogs in (4a,c,e) results in sentences (4b,d,f) that are entailed by the original.

(4) a. Nobody saw dogs
   b. Nobody saw big dogs
   c. Men rarely saw dogs
   d. Men rarely saw big dogs
   e. Men doubt you saw dogs
   f. Men doubt you saw big dogs

While Ladusaw’s analysis meets with some degree of success, there are several counterexamples that show it to be inadequate. The first glaring problem, noted in Linebarger (1980), is that while a matrix subject is in a DE environment in a simple negated clause, the negation never licenses an NPI in subject position.

(5) *Any man didn’t see dogs

Additional problems stem from what could be called a blocking effect, where certain expressions that fail to license NPIs on their own can block licensing of an NPI by a higher potential licenser. This effect is illustrated in (6), where the potential licenser is no man and the blocker is the QP every woman.

(6) No man gave every woman anything.
   (no > any > every, *no > every > any)

When the NPI any takes scope below no but above every it is readily licensed, a fact directly predicted by Ladusaw’s analysis. However, if every takes scope between no and any the NPI becomes infelicitous, and this fact does not follow from Ladusaw’s analysis. As can be seen in (7), the position of the direct object in this sentence under this latter scope assumption is a DE position,
since (7a) entails (7b) under the scope ordering \( no > every > a. \)

(7) a. No man gave every woman a dog.
   b. No man gave every woman a big dog.

The two cases just examined show that not all DE environments license NPIs, and hence that Ladusaw’s condition cannot be seen as sufficient for NPI licensing. The examples in (8) below show that being in a DE environment is furthermore not a necessary condition, since the NPIs in (8b) occur in a non-DE environment and yet are felicitous.

(8) a. It surprises Bill who John (*ever) does something/*anything for
   b. It doesn’t surprise Bill who John ever does anything for

To see that the NPIs in (8b) are not in a DE environment, consider (9).

(9) a. It doesn’t surprise Bill who John bought flowers for.
   b. It doesn’t surprise Bill who John bought red flowers for.

Suppose Bill thinks buying flowers is a sign of friendship, but buying red flowers is a sign of love. John bought flowers for Mary, Sue and Jane. Bill was unsurprised that John did so. The flowers he bought for Jane, however, were red. Bill was surprised since he hadn’t thought John was in love with Jane. In such a situation, (9a) is true but (9b) is false, showing that (9a) does not entail (9b). If the embedded clause were a DE environment, however, then substitution of red flowers for flowers would have to result in (9a) entailing (9b). The lack of such an entailment thus shows that the embedded clause fails to constitute a DE environment. The fact that an NPI is licensed in (8b) even so shows that being in a DE environment is not a necessary condition for being licensed.

A final set of examples that Ladusaw’s analysis cannot handle come from questions. Both matrix and embedded questions are capable of licensing NPIs, as can be seen in the examples in (10).

(10) a. Did John ever see any dogs?
   b. Who ever saw any dogs?
   c. Mary wonders whether John ever saw any dogs
   d. Mary wonders who ever saw any dogs

However, questions fail to entail anything, and hence fail to constitute DE environments. And while it is possible to devise an ad hoc definition of DE for questions that would give the desired results in many cases, e.g. that a yes-no question A entails another yes-no question B iff a positive answer to A entails a positive answer to B, it is just as possible to devise an ad hoc definition that fails to work, e.g. a parallel definition based on negative rather than positive answers, and there is no independent justification for choosing among these and other alternatives other than that one (perhaps) gets the NPI facts right and the others do not. Additionally, as Guerzoni and Sharvit
(2007) have shown, not all questions license NPIs, only strongly exhaustive questions.

The failure of sentential negation to license NPIs in subject position I take to show that an NPI needs to be in the scope of its licensor. Given that it is in general possible for a clausal negation to scope over a subject quantifier as in example (11) below, the relevant scope relation must be fixed prior to generation of the representation that serves as input to semantic interpretation.

(11) Everyone isn’t here (yet)

Under a minimalist approach to syntax, an approach that could account for these effects would be a timing solution that requires an NPI to be licensed immediately upon entering the syntax (under an assumption of top-down processing).

The blocking effects of universal quantifiers show that being in the scope of a licensor is not by itself sufficient for licensing an NPI. Rather, the relation between an NPI and its licensor must be sufficiently local. Locality, however, needs to be defined in relative terms, perhaps as the most local expression capable of licensing polarity items of any kind, since long-distance licensing is readily possible for any/even-type NPIs. This could be implemented by employing a multiple-agreeing polarity probe blocked by intervening polarity probes.

There have been several attempts to expand on Ladusaw’s analysis in the thirty some years since it was first proposed. Perhaps the most well known of these is the analysis of Kadmon and Landman (1993) (henceforth K&L). Whereas Ladusaw simply stipulates that NPIs are licensed in DE environments, K&L aim to give an explanatory account of why such environments should do so. Their analysis focuses on the word any, though similar accounts could be developed for other NPIs as well. The core of their analysis can be summarized in two parts: a semantic analysis of what any does, and a pragmatic condition on its use.

(12) Semantics: Any widens the domain it applies to. (Widening)

Restriction on occurrence: The interpretation of any with its widened domain has to entail that with its pre-widening domain. (Strengthening.)

While this analysis does give a slightly deeper explanation of how DE environments license any, deriving at least part of the analysis from an explicit lexical semantics for any, the restriction on occurrence still essentially constitutes a stipulation to the effect that any is licensed in DE environments, a generalization that we have already seen to be faulty. In addition, K&L fail to give a convincing account of NPI licensing in questions, since any such account will have to depend on establishing an entailment relation applicable to questions and there is no independent justification outside of NPI licensing for deciding upon such a relation.

In addition to the above objections to K&L’s proposed pragmatic restriction on the occurrence of any, the semantic half of their analysis can be shown to be equally problematic. If
NPIs widen the domain over which they quantify, it is predicted that a question employing any should be about a wider domain of elements than one without any. Chierchia (2005) analyzes domain widening by including in the domain of any $N$ not only clear instances of things satisfying $N$ but also marginal or unclear cases, including things that for all the speaker knows could be Ns irrespective of whether they in fact are Ns. With respect to a party with students and faculty, any students would on this analysis quantify over a set including not only all of the students but also all people who could for all the speaker knows be students. The problem that such a widening analysis poses is that it should make a conversation like the following possible:

(13) A: Did you meet any students last night?
   B: #Maybe, but I didn’t meet (the) students last night.

If the students were $a_1$, $a_n$, and $a_{n+1}$ and $a_{n+2}$ were marginal cases, then the question should be interpretable as asking whether the hearer met any of $a_1$, $a_n$, $a_{n+1}$, and $a_{n+2}$. Knowing that she didn’t meet $a_1$, $a_n$, $a_{n+1}$, and $a_{n+2}$ should make B’s response legitimate. The conversation, however, is infelicitous.

By allowing domain widening to include individuals not in the extension of the noun that any combines with, Chierchia probably misinterprets K&L. While K&L do take NPIs to widen the domain, I take them to intend that widening of the domain of an expression of the form any $N$ is up to the denotation of $N$, not beyond. Thus, any students still only talks about (presumed) actual students. Even with this assumption, though, the same objection can be raised using the above example just as well. All that is needed is for students in B’s response to involve a smaller domain than any students does in A’s question.

K&L could potentially dismiss (13) as a counterexample to their theory on the assumption that once any expands a domain it isn’t pragmatically possible to implicitly revert to a smaller domain. This would defuse the problem posed by (13) since it would require widening by any to remain in effect for all subsequent quantifications over sets of students. Reversing the order between students and any students, however, should on this assumption allow for and in fact require the first NP to employ a narrower domain than the second, and yet such a reversal still gives rise to inconsistencies where K&L predict they should not occur.

(14) #I didn’t meet students last night, though I wonder if I met any students.

In addition to the above empirical problems, K&L’s analysis also fails to explain intuitively felt differences that arise when an NPI is focused. The intuition of widening is strong with occurrences of any and ever that are focused, as in (15a), but in the parallel example without focus on the NPI in (15b) no such impression of widening arises.

(15) a. I didn’t see ANY dogs.
   b. I didn’t see any dogs/DOGS.

The problem this observation poses is clear. Much of the motivation for K&L’s analysis comes
from observations where one gets a clear sense that widening occurred. If a widening semantics for the NPI items is what is responsible for generating this sense, then it should be present whenever the NPI is employed, regardless of whether the NPI is focused or not. Unfortunately, it is far from clear how focus can give rise to widening on its own. An alternative semantics approach to focus such as that of Rooth (1986), for example, would allow a focused *any* to contrast with other determiners such as *every, some*, etc., but that approach does not allow for focus to alter its domain of quantification. Furthermore, even if some mechanism were provided which allowed contrast to generate differences in the size of a domain of quantification, the same approach should apply equally well to normal quantifiers such as *few*, and yet we have no intuition of widening associated with focusing *few*.

To account for the intuitions that led K&L to their analysis, there needs to be something in the semantics of NPIs that gives rise to a widening effect when and only when focused. One potential path to developing such a solution would be to distinguish the way in which domains of quantification are determined for NPIs and for normal quantifiers like *few*. If domain specification is part of the semantics of an NPI, for instance, but determined entirely pragmatically for other quantifiers, then focus on an NPI would be expected semantically to give rise to a contrast in the domain of quantification, while focus on other quantifiers would not. Of course, presence of a contrast does not by itself entail widening, and this is potentially problematic. If a narrowed domain were possible, a discourse like that in (16) should be acceptable with or without the addition of the PP in parentheses, contrary to fact.

(16) John saw three students yesterday. However, he didn’t see ANY students #(from MY class)

The acceptability of the second sentence with that PP, however, is just what would be expected if *any* could be associated with a narrower domain (the set of students in my class) than a contrasting antecedent (*three students*). The question this raises, then is whether an explanation can be given for the impossibility of associating an NPI with an implicitly narrowed domain. A pragmatic account would seem plausible here based on the assumption that a domain can only be contrasted with another domain if it can be plausibly identified. Expansion of a domain can be analyzed as the dropping of restrictions implicitly associated with a previous domain. Shrinking of a domain, however, requires adding new restrictions to a previous domain, and for this it is plausibly necessary to be able to identify the exact restriction to be added, something that the semantics of an NPI item by itself fails to accomplish.

As we saw earlier, K&L’s analysis does not give a principled account of why NPIs are licensed in questions. Van Rooy (2003) builds on K&L’s analysis of *any* as a domain widening expression and aims to give such a principled explanation. Van Rooy proposes that an NPI is licensed in a question if it increases the average informativity of answers, analyzed as increasing the entropy of the question. To see what is meant by informativity and entropy, consider the following example asked of a simple coin flip.

(17) Will this coin come up heads?
If the coin flip is known to be unbiased, the chance of it coming up heads is identical to the chance of it coming up tails. The two answers are then equally informative and equal to the average informativity of all (both) answers to the question. If the coin flip is biased, however—say the chance of its coming up tails is 90% and of its coming up heads is 10%—then the informativity of the two answers differs. “Yes” becomes highly informative (having strong satisfaction conditions), while “No” becomes much less informative (having weak satisfaction conditions). Van Rooy connects informativity to NPIs as follows.

“[S]uppose that we turn [a question] Q into Q’ by making use of an NPI. This NPI weakens the satisfaction conditions for the positive answer, q’, and strengthens the satisfaction conditions for the negative answer ¬q’. This can not only result in turning settled Q into unsettled Q’, but also in changing biased Q into less, or even un-, biased Q’. What is important is that in both cases the entropy of the question increases: E(Q’) > E(Q).”

\[ E(Q) = \sum_{q \in Q} P(q) \times -\log_2 P(q) \]

(Entropy of a question is the sum of the probability of a complete answer times the informativity of that answer for all complete answers to the question.)

To illustrate, consider the following minimal variants of (17).

(18) a. Will this coin (ever) come up heads?
    b. Will a/any coin come up heads?

If the NPIs in the questions in (18) expand a domain (presumably the domain of times in (18a) and that of coins in (18b)) beyond that implicit in (17), then a “Yes” answer becomes more likely and hence less informative for the NPI version of the question than for the non-NPI version of the question only if the question is negatively biased. If the question with the NPI is negatively biased, this will mean that the domain expansion has the potential to make it less biased. If we assume that NPIs have to make a question less biased, this could explain why NPIs in questions are often felt to create a negative bias.

While van Rooy’s analysis again aims to give a deeper explanation to the question of how NPIs are licensed, it suffers from many of the same difficulties facing Ladusaw and K&L. In particular, the idea that an NPI widens a domain and has to increase informativity reconstructs Ladusaw’s DE restriction and K&L’s strengthening requirement, and it consequently faces the same problems that Ladusaw and K&L face. What’s more even for questions, where van Rooy makes a clear advance in empirical coverage over previous analyses, the predictions of the analysis are not upheld. In particular the analysis faces three problems.
The first problem is that the analysis requires a bias where none need exist. Consider an event of a single, unbiased 6-sided die that was rolled 3 times. A person who was not present to witness the rolls could well ask six questions in succession: Was a 1 ever rolled? Was a 2 ever rolled? … Was a 6 ever rolled? These questions are not taken to have a necessary negative bias. The questioner can very easily be taken to have no information or expectations about what numbers came up. Furthermore, if the first question was answered with a “no”, the default bias of the next questions would be positive at least until a “yes” was reached and yet the questions would be no less felicitous. Similarly, it is readily possible to ask a question with an NPI when the answer is known by the speaker to be positive and the person being addressed knows this to be the case. A teacher helping her class prepare for an exam might, for example, ask her students “Has a US president ever been to China?” without thereby negatively biasing the question.

Of course, van Rooy’s intuition is not without foundation. We do in fact find it very easy to associate a question containing an NPI with a negative bias. However, this negative bias has to be seen as something on the order of an implicature – perhaps generated automatically but capable of being cancelled or overridden.

At least as problematic for van Rooy’s analysis is the fact that it makes no distinction among question types and yet the form of a question affects whether an NPI can be licensed. In particular, while questions with fronted wh-expressions uniformly license NPIs, those with only in situ wh-expressions do not, as can be seen in (19).

(19) a. What did John ever see?
   b. John (*ever) saw what?

In terms of informativity, there is no obvious difference between the fronted What did John see? and the in-situ John saw what?, but without such a difference the contrast in acceptability of NPIs can receive no explanation.

This problem looks similar to the issue of NPIs in subject position not being licensed by co-clausal negation, and the solution should probably be sought along similar syntactic lines. Support for this idea comes from observation that an in situ wh-word can actually license an NPI that is structurally lower than the wh-word but not one in a structurally higher position, as can be seen in the contrasts in (20).

(20) a. What has anyone done for me?
   b. #Anyone has done what for me?
   c. What has he done for anyone?
   d. (?)He has done what for anyone?
   e. Who has he done anything for?
   f. #He has done anything for who?

The third problem with van Rooy’s account is that it fails to account for the status of NPIs in
wh-questions embedded under *surprise*. As can be seen in (21), this is an environment in which NPIs are infelicitous, and yet the informativity effects in this environment are no different than they are in any other embedded environment.

(21) I’m surprised by what John (*ever) did.
    What John (*ever) did surprises me
    It surprises me what John (*ever) did.

Guerzoni and Sharvit (2007) use examples like these to argue that for a question to license an NPI it must be strongly exhaustive, i.e. the context has to make use not only of the positive answers to the question but also of the negative ones. They further show that there is no straightforward way of unifying licensing in DE environments with licensing in strongly exhaustive questions, suggesting that potentially different mechanisms are responsible for NPI licensing in these two environments. We can add to their results the observation that the blocking effects of universal quantifiers witnessed earlier do not appear to hold in questions, as the following example shows.

(22) a. Has everyone ever been to China?
    b. What country has everyone ever been to?

Question (22a) is acceptable for asking either whether there is some time in the past at which everyone went to China or whether for every person there is a time at which he went to China. Similarly, (22b) can be a question about what country everyone visited simultaneously or (more plausibly) what country is such that everyone has been to that country at some time. That is, the relative scope between *everyone* and the NPI *ever* is irrelevant, meaning that if there is a syntactic association between the NPI and the question it is an association that is insensitive to the blocking effects of universal quantifiers. This of course does not give us a direction to search for how and why NPIs can be licensed in questions, but it does suggest that that question is properly dealt with separately.

The above discussion has led to the following suggestions for an analysis of NPI items. First, NPIs need to be syntactically licensed, and the mechanisms employed must be capable of being blocked by universal quantifiers. Though NPIs do not directly require widening of a domain, they do include domain specification in their semantics, giving rise to domain contrast effects under focus. Finally, licensing of NPIs by strongly exhaustive questions is a separate phenomenon for which an independent explanation is needed. Turning these suggestions into a concrete analysis will undoubtedly lead to unforeseen difficulties, but that is a task for another occasion.

References:

