Some Remarks on Polarity Items

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This article is concerned with Negative and Positive Polarity Items (henceforward NPIs, PPIs). In the first chapter, I give an overview of the phenomenon, using examples from different languages. In the second chapter I summarize the two main lines of explanations which have emerged to explain the distribution of NPIs, the first based on syntax, the second based on semantics. Finally, I will develop a theory of NPIs and PPIs, drawing mainly on the semantic approach. Among other things, I introduce the notion of polarity lattices as ordered sets of alternatives to polarity items, develop a recursive notion of polarity items, and explain the distribution of polarity items in assertions, directives and questions.

1. Polarity Items and Universal Grammar

1.1. The Phenomenon of Negative Polarity Items

In many languages, there is a set of expressions which typically occur in a specific class of contexts, most prominently the scope of negation, and therefore called NEGATIVE POLARITY ITEMS (NPIs). The following sentences should exemplify some typical NPIs in the scope of negation:

(1) a. He hasn't seen *any* students.
    b. *He has seen *any* students.
(2) a. He hasn't *ever* been to Yemen.
    b. *He has *ever* been to Yemen.
(3) a. She didn't *lift a finger* to help him.
    b. *She *lifted a finger* to help him.
(4) a. It's not worth *a red cent.*
    b. *It's worth *a red cent.*

The (b) sentences in these examples are either ungrammatical, or have a literal meaning quite distinct from the idiomatic reading of the (a) sentences, or might be used as a denial of an immediately preceding negated sentence, or could be used ironically (all these cases are marked with a '*' in this article).

NPIs seem to occur in many, possibly all, languages. To give just two examples, one from a non-Germanic language, French, and one from a non Indo-European language, Igbo (West Africa, Kwa):

(5) a. Je n'ai pas compris *un traître mot.*
'I didn't understand a single word' (lit: a treacherous word)
b. Il y avais pas *un chat.*
'There was no soul there' (lit: no cat)

(6) a. ànyí àmághi onye *óbula* n'ébe à.
we know.NEG person any here
'we don't know any person here'
b. ànyí mà onye (**óbula)* n'ébe à.
we know person (any) here

As far as I know, there is no study which takes into account a wider range of languages. Also, it is difficult to get information about NPIs in grammatical descriptions of particular languages.[1] Besides for English, there are detailed studies for Dutch (Zwarts 1981, Hoppenbrouwers 1983) and German (Welte 1975, Kürschner 1983), and some information about Japanese can be found in McGloin (1976). However, it is well-known that the marking of negation in some languages is a grammaticized construction with a negative polarity item. This holds, e.g., for French, were negations like *ne...pas* or *ne...personne* contain something like an NPI as second part. This also holds for German, where for example *nie* 'never' can be traced back to Old High German *ni* (negation) + *io* 'ever', and *nicht* 'not' to *ni* + *wiht* 'a little'.

There is another class of items, which seems to behave in the opposite way -- namely, POSITIVE POLARITY ITEMS (PPIs), also called AFFIRMATIVE POLARITY ITEMS. Examples are *already*, *rather*, and *bags of money.* (We will neglect PPIs for a while, but return to them in chapter 3.)

(7) a. Bill has already arrived in Munich.
b. *Bill has not already arrived in Munich.

(8) a. John has bags of money.
b. *John doesn't have bags of money.

This article will be based mainly on German and English data. The following list exemplifies a larger set of German NPI expressions; many more can be found in Welte (1975) and Kürschner (1983).

(9) a. Es ist nicht der Fall, daß er *jemals* im Jemen war.
'It is not the case that he was ever in Yemen.'

b. Es stimmt nicht, daß er in *irgendwelche* Affären verwickelt ist.
'It is not true that he is involved in any affairs.'

c. Er hat ihr k-*ein Haar gekrümmt.*
'He didn't bend a hair on her head.'

d. Er hat k-*einen Finger gerührt.*
'He didn't lift a finger.' (lit.: move a finger)

e. Er hat k-*einen Mucks* von sich gegeben.
'He didn't utter a peep.'

f. Sie hörte k-*einen Ton.*
'She didn't hear a sound.'

g. Da bringen mich k-*eine zehn Pferde* hin.
'Wild horses could not drag me there.' (lit.: no ten horses)

h. K-*ein Schwein* hat geguckt.
'No-one peeped.' (lit.: 'no pig')

i. Er hat k-*eine müde Mark* in der Tasche.
'He hasn't a red cent in his pocket' (lit.: 'no tired Deutschmark')

j. K-*ein Hahn kräht nach* ihr.
'Nobody cares a hoot about her.' (lit.: 'No cock crows for her')

k. Er hat seit Wochen k-*einen Tropfen* Alkohol angerührt
'He hasn't touched a drop of alcohol for weeks'

l. Es *fällt* ihr *im Traum* nicht *ein*, ihm zu helfen.
'It would not occur in a dream to her to help him.'

m. Wir werden es *in hundert Jahren* nicht wissen.
'We will not know it in hundred years.'

n. Ich habe k-*eine Sekunde* daran gezweifelt.
'I didn't doubt it for a second.'

o. Du hast hier nichts *zu suchen*!
'You have no business being here!'
(lit.: You don't have anything to look for here')

p. Sie *zuckte* nicht *mit der Wimper.*
'She didn't bat an eyelash.'

q. Sie *braucht* nicht zu kommen.
'She need not come.'

r. Er kommt auf keinen grünen Zweig.
'He has no economic success.' (lit.: 'He doesn't arrive at a green twig')

s. Du kannst wohl nicht *bis drei zählen.*
'You are rather dull.' (lit.: 'You cannot count up to three')

t. Dieser Artikel ist nicht *das Papier wert, auf dem er gedruckt ist.*
'This article is not worth the paper it is printed on.'

1.2. Licensing Contexts for Negative Polarity Items

In the section above, we looked at some NPIs in the context of a negation element. However, as already mentioned, NPIs can occur in many other contexts as well. This will be exemplified with some German data.

We do not need to exemplify the scope of NEGATION as a licensing context; look at the section above for examples.

A licensing context which seems to be related to negation is the scope of some QUANTIFIED NPS like *wenige Leute* 'few people' or *weniger als zehn Leute* 'less than ten people':

(10) Wenige / weniger als zehn / *viele / *mehr als zehn Leute sind jemals in den Jemen gereist.
'Few / less than ten / many / more than ten people have ever made a trip to Yemen.'

We find NPIs also in the scope of some DETERMINERS, as *jeder* 'every':

(11) a. Jeder, der jemals im Jemen war, will wieder hin.
'Everyone who ever has been to Yemen wants to go there again.'

b. *Wenige / *manche, die jemals im Jemen waren, wollen wieder hin.
'Few / some people who ever have been to Yemen want to go there again.'

NPIs can also live inside the scope of some MODAL OPERATORS such as *kaum* 'hardly':

(12) Er wird kaum / *sicher auf einen grünen Zweig kommen.
'He hardly / surely will have economical success.'

Another context for NPIs is the PROTASIS (the antecedent or *if*-clause) OF CONDITIONAL SENTENCES:

(13) a. Wenn du mich jemals besuchst, dann bring Sherry mit.
'If you ever visit me, then bring me sherry.'
b. Wenn du mir ein Haar krümmst, schrei ich um Hilfe.
'If you bend a hair on my head, I will scream for help.'

Related to that are certain types of GENERIC SENTENCES where we find the English NPI *any* as part of the subject position:

(14) Any tourist who visits Yemen enjoys the country.

Furthermore, NPIs occur in the object position of so-called ADVERSATIVE PREDICATES, which express a certain negative attitude of the subject referent towards the fact or act represented by the embedded clause:

(15) a. Er weigerte sich, einen Finger zu rühren.
'He refused to lift a finger.'
b. Er war überrascht, daß sie jemals an ihn gedacht hatte.
'He was surprised that she had ever thought of him.'
c. Es tut ihr leid, daß sie eine Spur von Reue gezeigt hat.
'She regrets that she showed signs of remorse.'
d. *Sie glaubt, daß er einen Finger gerührt hat.
'She thinks that he lifted a finger.'

Another context which nourishes NPIs is RHETORICAL QUESTIONS or BIASED QUESTIONS which suggest a negative answer:

(16) a. Haben wir ihr denn ein Haar gekrümmt?
'Did we bend a hair on her head?'
b. Hat er denn jemals etwas gesagt?
'Did he ever say anything?'

But NPIs can be observed also in normal INFORMATION QUESTIONS:

(17) a. Kennen Sie irgendjemanden im Jemen?
'Do you know any person in Yemen?'

b. Haben Sie jemals Marihuana geraucht?
'Did you ever smoke Marihuana?'
c. Hat er je einen Finger gerührt?
'Did he ever lift a finger?'
d. Hast du ihr ein Haar gekrümmt??
'Did you bend a hair on her head?' (with special emphasis)

Furthermore, we meet NPIs in the STANDARD CLAUSE OF COMPARATIVE AND EXCESSIVE ('too') CONSTRUCTIONS, but not with equative and assecutive ('enough') constructions:

(18) a. Der Jemen ist schöner, als ich jemals gedacht habe.
'Yemen is more beautiful than I ever imagined'
b. Ich bin zu müde, um auch nur einen Finger zu rühren.
'I am too tired to even lift a finger'
c. *Der Jemen ist so schön, wie ich jemals gedacht habe.
'Yemen is as beautiful as I ever imagined'
d. *Ich bin stark genug, um einen Finger zu rühren.
'I am strong enough to lift a finger'

NPIs also occur in the scope of GRADING PARTICLES like *nur* 'only' is around. They occur in the focus of *nur* as well as outside of its focus (indicated here by brackets):

(19) a. Nur Leute, die jemals im Jemen waren, wissen das zu schätzen.
'Only people who have ever been in Yemen appreciate that'
b. Nur Otto war jemals im Jemen.
'Only Otto has ever been in Yemen'

A final context in which we find NPIs are clauses subordinated by some TEMPORAL CONJUNCTIONS, namely *lange nachdem* 'long after', *bevor* 'before' and *sobald* 'as soon as':

(20) a. Er schrieb Gedichte noch lange nachdem er irgendwelche Hoffnungen hatte, sie zu veröffentlichen.
'He wrote poems long after he had any hope of getting them published'
b. Der Esel schrie stundenlang, bevor er sich vom Fleck rührte.
'The donkey screamed for hours before it budged an inch'

c. Die Mutter schrie das Kind an, sobald es einen Mucks machte.
'The mother shouted at the child as soon as he uttered the slightest sound.'

This list of NPI contexts should not be read as claiming that every NPI can occur in every context. It is well-known that some NPIs only occur under negation. Edmonson (1981) proposed a hierarchy NEGATIVE > INTERROGATIVE > CONDITIONAL > COMPARATIVE, with NPIs most likely occurring towards the left side. Furthermore, I suspect that the list of NPI contexts, though quite impressive, is still not complete; we will have to watch out for other environments where NPIs can pop up. But even so, it is difficult to see a common principle which explains why the known NPI contexts license NPIs. Before outlining the current theories, I will discuss a particularly interesting phenomenon which can be treated similarly to NPIs, although its relation to NPIs has escaped notice until now, as far as I can tell.

1.3. Partitives as Negative Polarity Items

There are languages which show a case alternation in some grammatical contexts, especially in the scope of negation. For example, in Russian and some other Slavic and Baltic languages there is an alternation between accusative / nominative and genitive (see e.g. Brooks 1967, Lisauskas 1976, Gundel 1977), and in Finnish there is an alternation between accusative / nominative and partitive (see e.g. Dahl and Karlson 1975, Raible 1976, Heinämäki 1984). We find a similar phenomenon in French with the use of *de* + common noun under negation. Here, I will concentrate on Finnish.

There are several triggers for the switch to the partitive case in Finnish. The most prominent ones are the scope of negation and imperfective aspect. An attempt to explain the use of the partitive as an marker of imperfective aspect can be found in Krifka (1989, 1989a). Here I will concentrate on the non-aspectual use of the partitive.

Summarizing the observations of Heinämäki (1984), we can note the following contexts for the non-aspectual use of the partitive. I start with two examples in which the partitive is used in the scope of negation.

(21) a. Minä näin Annelin.
I saw Anneli.ACC
'I saw Anneli'

b. Minä en nähnyt Annelia.
I NEG saw Anneli.PART
'I didn't see Anneli'

(22) a. Raili hiihti päivän.
R. skied day.SG.ACC
'Raili skied for a day'

b. Raili ei hiihtänyt päivää.
R. NEG skies day.SG.PART
'Raili didn't ski for a day.'

An exception to this use of the partitive is that the accusative occurs in negated questions with a suggested affirmative answer:

(23) Eiköhän juoda kuppi kahvia?
NEG-Q drink cup.ACC coffee
'How about drinking a cup of coffee?'

With certain modal operators, like *tuskin* 'hardly', *turha* 'needless', *vaikea* 'difficult', *mahdotonta* 'impossible', *tarpeetonta* 'needless', *epäviisasta* 'unwise', and certain quantifiers like *harva(t)* 'few', an accusative can, but need not, change to a partitive:

(24) a. Pirkko tunnisti minut / *minua.
P. recognized I.ACC / I.PART
'Pirkko recognized me'

b. Tuskin Pirkko minut / minua tunnisti.
hardly P. I.ACC / I.PART recognized
'It is unlikely that Pirkko recognized me'

Furthermore, the partitive can occur in Yes/No-questions. In this case, the speaker seems to assume that the answer is negative. Also, questions with partitives are considered to be more polite.

(25) a. Minä näin Anjan / *Anjaa katsomossa.
I saw A.ACC / A.PART audience-in
'I saw Anja in the audience.'

b. Näitkö Anjan / Anjaa katsomossa?
saw.you.Q A.ACC / A.PART audience-in
'Did you see Anja in the audience?'

Interestingly, a question with the NPI *koskaan* 'ever' forces an indefinite accusative to switch to a partitive:

(26) Oletko koskaan rekentanut saunaa / *saunan?
have.you.Q ever built sauna.PART / sauna.ACC
'Have you ever built a sauna?'

These examples make it at least plausible to explain some of the distribution of partitives by the assumption that the partitive is an NPI. Consequently, we can use the hypothesis that partitives can be NPIs as a heuristic tool to detect other contexts which favor partitives, for example the protasis of conditionals. This is an example which shows that the notion of polarity items might prove useful in the study of languages.

2. Theoretical Approaches to Negative Polarity Items

In this chapter, I will discuss the two main lines of explanations of NPI contexts, the syntactic tradition and the semantic tradition.

2.1. Syntactic Explanations

The basic assumption of the syntactic approach is that NPIs are triggered by a negation element which stands in a certain syntactic configuration to the NPI. This theory was brought forward in Klima's treatment of negation in English (Klima 1964). He assumed that an NPI has to stand 'in construction with' (roughly: be c-commanded by) an 'affective element', that is, a negation. See also Jackendoff (1968) for this type of treatment.

The problem is that not every NPI occurs in the scope of a negation. The remedy proposed by Baker (1970) was to distinguish between two types of NPI contexts: Either an NPI is licensed directly by a negation, or the proposition which immediately contains the NPI ENTAILS a proposition which then directly licenses the NPI. For example, Baker explains why *be surprised* creates an NPI context by saying that *a is suprised that p* entails the sentence *a does not expect that p*, which contains a negation and, therefore, directly licenses NPIs. (Arguments like this one have been influential in the development in Generative Semantics, as they suggested that there is no strict borderline between syntactic rules and semantic rules, like entailment.)

The latest proponent of the syntactic-based explanation is Linebarger (1980, 1987).[2] Similarly to Baker, she distinguishes between direct licensing and derivative licensing. However, she refines both types of licensing mechanisms:

- First, the direct licensing does not apply to some deep or surface structure representation, but to the logical form (LF) of the sentence, where LF is the representation level in Government and Binding theory. NPIs are said to be licensed in a sentence S if, in the Logical Form of S, the NPI is in the immediate scope of a negation operator ('immediate' meaning that no other propositional operator intervenes between the negation operator and the NPI). Linebarger calls this the 'Immediate Scope Constraint'.
- Second, Linebarger has to invoke another principle to explain the remaining NPI contexts. She assumes that an NPI in a sentence S contributes the following conventional implicature: (i) We can infer from S a proposition NI (the "Negative Implicatum"). In the Logical Form of some sentence expressing NI, the NPI is directly licensed by a negation element. (ii) The truth of NI guarantees the truth of S.

Without going into the interesting arguments for the syntactic approach here, I want to point out some serious problems with it. My general impression is that the basic rule of direct licensing is very strict, but is in need of additional rules which are completely un-syntactic to cover the many remaining cases. So one could suspect that the theory is immunized by the additional rules. This suspicion is confirmed, as the additional rules often are quite problematic. A general problem from a logician's point of view is that from every proposition p follows $\neg\neg$p, so NPIs should occur everywhere. Linebarger has to stipulate that spurious entailments like this one cannot induce derivative licensing -- which is surely not a convincing treatment. Another problem is that Linebarger wants to explain why NPIs occur in the protasis of conditionals by analyzing a sentence *if p then q* as a material implication $p \rightarrow q$ and the fact that this is equivalent to $\neg p \vee q$. However, it is highly questionable whether natural language conditionals can be represented by material implication (see e.g. Kratzer 1987). Finally, Linebarger tries to explain why questions are NPI contexts by saying that they only occur in questions in which the speaker clearly presupposes that the answer is negative, especially rhetorical questions. But we have seen that NPIs can occur in normal questions as well.

2.2. Semantically-Based Explanations

The general view in the semantic tradition is that negation is only one trigger for NPIs among others, and that the class of triggers has to be characterized semantically.

The semantic tradition can be traced back to the work of Horn (1972) on semantic scales and Fauconnier (1975a, 1975b, 1978) on scale reversals. Fauconnier identified the phenomenon of semantic scales with so-called 'quantificational superlatives'. For example, sentence (27.a) normally is used to express (27.b):

(27) a. Mary can solve the most difficult problem.
b. Mary can solve every problem.

The reason for that is that speakers assume a rule: If Mary can solve problem x, and y is a problem which ranks lower on the scale of difficulty than x, then Mary can solve problem y as well. It follows that if Mary can solve the problem which ranks highest in difficulty, she can solve all other problems as well.

Now, negation is a scale reverser. For example, we can derive from the rule cited: If Mary CANNOT solve problem x, and y is a problem which ranks HIGHER on the scale of difficulty, then Mary cannot solve problem y either. Conversely, if Mary cannot solve the problem which ranks LOWEST in difficulty, she CANNOT solve any other problem. Therefore sentence (28.a) can be used to express (28.b):

(28) a. Mary cannot solve the easiest problem.
b. Mary cannot solve any problem.

NPIs, then, can be analyzed as 'quantificational superlatives', denoting the lower end of scales (cf. also Schmerling 1971, who claimed that NPIs denote 'smallest units'). To get this interpretation, then, they need an operator, such as negation, which reverses the scale.

This type of explanation was developed and applied to a range of phenomena by Ladusaw (1979, 1983); see also Zwarts (1981) and Hoeksema (1983, 1986). According to Ladusaw, NPIs only occur in DOWNWARD-ENTAILING (DE) contexts. A context is DE if an expression occuring in it can be replaced by a semantically stronger (that is, more restricted) expression *salva veritate* (without change of truth of the whole sentence). Correspondingly, a context is called UPWARD-ENTAILING (UE) if an expression in it can be replaced by a semantically weaker expression *salva veritate*. The following sentences exemplify UE and DE contexts; we assume that *Italian ice cream* is semantically stronger than *ice cream*:

(29) a. *X* in *Mary ate X* is UE, as it follows from *Mary ate Italian ice cream* that *Mary ate ice cream*.

b. *X* in *Mary didn't eat X* is DE, as it follows from *Mary didn't eat ice cream* that *Mary didn't eat Italian ice cream*

Obviously, DEness is a semantic notion. Ladusaw defines it as a property of operators α. His definition runs as follows:

(30) An expression α is downward-entailing (or polarity reversing) iff
$\forall X,Y[X \leq Y \rightarrow \alpha'(Y) \leq \alpha'(X)]$

Here, α' is the denotation of α, and $\leq$ is set inclusion ($\subseteq$) with predicates or entailment ($\Rightarrow$) with propositions (which can be analyzed as set inclusion as well if we analyze propositions as sets of possible worlds). $X \leq Y$ means that X is stronger than or equally strong as Y. An expression α, then, is DE if it holds that the stronger X is, the weaker $\alpha'(X)$ is, and vice versa.

With the principle that NPIs only occur in DE contexts, Ladusaw can derive, among others, the following contexts as supporting NPIs:

NEGATION. See (29.b) for an example. The reason for the DEness is that we have: if $p \Rightarrow q$ then $\neg q \Rightarrow \neg p$ as a general rule (contraposition).

QUANTIFIED NPS which allow for NPIs in their scope, like *no persons*, *few persons* or *less than three persons*, create DE contexts. For example, *less than three persons ate ice cream* makes a stronger claim than *less than three persons ate Italian ice cream*, although *ate ice cream* is weaker than *ate Italian ice cream*. Quantified NPs of this type are called MONOTONE DECREASING (Barwise and Cooper 1981). When they are analyzed as Generalized Quantifiers, it can be formally derived that they are DE. For example, if we analyze *less than three persons* as a second order predicate Q, $Q = \lambda X[\#(X \cap \mathbf{person'})<3]$,[3] where # is the cardinality function and **person'** the set of persons, then we have for every P, P', if $P \subseteq P'$, then $Q(P') \rightarrow Q(P)$, as this equals $\#(P' \cap \mathbf{person})<3 \rightarrow \#(P \cap \mathbf{person'})<3$, which is true for $P \subseteq P'$.

DETERMINERS which allow for NPIs in their scope, like *every* or *no*, create DE contexts. For example, *every person came* makes a stronger claim than *every tourist came*, although *person* is weaker than *tourist*. Determiners like *every* and *no* are called ANTI-PERSISTENT. In the Generalized Quantifier theory, *every* can be analyzed as a second order, two-place relation D, $D = \lambda Y \lambda X[Y \subseteq X]$ (applied to noun representation like **person'**, this yields $\lambda Y \lambda X[Y \subseteq X](\mathbf{person'}) = \lambda X[\mathbf{person'} \subseteq X]$, which is a quantifier). Now we have for every P, P', if $P \subseteq P'$ then $D(P') \subseteq D(P)$, as this equals $\lambda X[P' \subseteq X] \subseteq \lambda X[P \subseteq X]$, which is true in case $P \subseteq P'$.

BEFORE. Without going into the precise semantics of *before*, we can see with examples that this temporal operator (in contrast with, for instance, *after*) is DE. For example, *John left before he had ice cream* implies *John left before he had Italian ice cream.*

Although all this looks quite promising, there are some serious problem with Ladusaw's account. One is that some of the NPI contexts are not really DE, as shown by Jacobs (1985) and Heim (1987). They explicitly discuss the protasis of conditionals, which fails to be a DE context in the general case (cf. Lewis 1973). Look at the following example:

(31) a. If you go to Yemen, you will enjoy it.
b. You go to Yemen and get sick there. $\rightarrow$ You go to Yemen.
c. (from a and b, and the assumption that the protasis of conditionals is DE, should follow, but doesn't):
If you go to Yemen and get sick there, you will enjoy it.

According to Heim, we cannot choose any old strengthenings of the protasis *salva veritate*, but only those which do not interfere with the truth of the apodosis (the *then*-part of a conditional clause). In our example, we can assume as a background rule that, if one is sick, one normally doesn't enjoy a stay in a foreign country. Therefore the strengthening *and get sick there* reduces the chances of enjoying the stay, and hence the chance that the apodosis is true. Therefore the whole sentence makes in fact a STRONGER claim now: It says that you will enjoy your stay in Yemen even if you get sick there.

Which strengthenings, then, are the relevant ones to determine NPI contexts? Answering this question seems to be a Herculean task, as we have to capture formally the possible influence of certain background assumptions, and for that we have to take into account all the world knowledge. But Heim presents a manageable solution. She restricts the admissible strengthenings to those which are INDUCED BY ALTERNATIVE ITEMS IN THE POSITION OF THE NPI. Take the following example:

(32) If you ever go to Yemen, you will enjoy it.

As we have seen, the protasis of (32) cannot be strengthened in just any way *salva veritate*. However, if we only consider strenghthenings of the protasis by replacing the NPI *ever* with alternative expressions of an appropriate type -- Heim proposes for *ever* adverbials like *twice*, *several times* etc. -- we can assume that the result is still a consequence of (32) and our background assumptions. For example, from (32) and our background assumptions follows *If you go to Yemen twice, you will enjoy it.* In fact, this is a weaker sentence than (32) - it allows for the possibility that you get hooked on that country only at your second stay. We have to refine the original notion of DEness in two respects to use it for the definition of NPI contexts: First, we have to say that a context is DE with respect to a certain position (the NPI position); secondly, we have to know the class of alternative expressions (which are expressions denoting something of the same sort as the NPI). Heim calls the DEness which is restricted to these alternative expressions LIMITED DENESS.[4]

Another case where NPIs occur in a context which does not allow for general strenghtening is the standard phrase of comparatives, as pointed out by Jacobs (1985). Example (33.a) shows that the standard clause of comparatives is not strictly downward-entailing. However, as we already have seen, NPIs occur in this context (cf. 33.b):

(33) a. Mary has visited more Asian countries than two of her colleagues
-/-> Mary has visited more Asian countries than four of her colleagues.
b. Mary has visited more Asian countries than John could ever dream of.

Again, the notion of limited DEness should give us the right analysis in these cases.

Let us conclude this exposition of the semantic approach. I think that the semantically-based explanation of NPI contexts is impressive and even a paradigm case for the explanation of linguistic facts by the means of formal semantics. However, there still remain some problems.

A basic problem is that the NPI contexts are characterized by the general semantic principle of DEness, but it is not clear WHY DE operators allow for NPIs. So Ladusaw's generalization must be backed up by an explanation as to how DEness has the property of licensing NPIs.

Another problem is that the notion of DEness, as Ladusaw presents it, is restricted to set inclusion for non-propositional items. But set inclusion is not always a good model for Fauconnier's hierarchies. As an example, consider the sentence *John doesn't have x*, which should be DE in x. It surely is; from *John doesn't have ice cream* it follows: *John doesn't have Italian ice cream.* However, the hierarchy which seems to matter in cases like *John doesn't have a red cent* are amounts of money. So, for example, from *John doesn't have five cents* it follows that *John doesn't have ten cents*. But the extensions of the predicates *five cents* and *ten cents* are not related to each other by set inclusion; they are simply disjoint: No object to which *five cents* applies is such that *ten cents* can be applied, and vice versa. So the $\leq$-relation in (30) may not always be understood as set inclusion or entailment.

Furthermore, there are other cases which can hardly be said to be downward-entailing and nevertheless do license NPIs. Linebarger (1987) discusses, among others, adversatives. Ladusaw gives no precise semantics for them, but argues with some examples that they are DE. Take *be surprised;* from *Mary is surprised that John bought a car* should follow *Mary is surprised that John bought a Mercedes.* This may sound reasonable at first sight, but Linebarger gives several circumstances under which this inference does not go through. For example, imagine that Mary knows that John bought a car (and is surprised about that), but doesn't know that he bought a Mercedes (and hence cannot be surprised about that).

Another problem is to explain why the NPI items do not behave uniformly with respect to different contexts -- especially, why some of them only occur in the scope of negation.

Finally, there are NPI contexts for which Ladusaw does not have, in my view, a convincing treatment at all -- most notably, questions. Ladusaw (1979) tries to explain the occurrence of NPIs in questions by a principle that the speaker should pose the question in a way such that the question can be answered without major revisions of the form of the question. When the speaker puts a question like *Did John ever lift a finger to help?*, then we can derive through this principle that the expected answer is *No, he didn't ever lift a finger to help*, because this is the only answer without major revisions of the form of the question. Thus, Ladusaw wants to explain why NPIs occur in biased questions and rhetorical questions. However, it remains unexplained why NPIs can also occur in neutral questions, as shown in (17).

3. A Lattice-Theoretical Approach to Polarity Items

3.1. Introduction

In this chapter, I will sketch a theory of polarity items which should overcome the problems mentioned in the last section. It is by and large in the semantic tradition, but adopts certain ideas of the syntactic tradition as well, and is embedded in a pragmatic theory of informativity.

The discussion will be rather informal. However, I cannot avoid presupposing some knowledge of formal semantics, especially intensional logics. In general, I give the semantic representations of natural language expressions in boldface with a prime at the end; for example, the meaning of *boy* is **boy'**. In cases where the internal semantic structure does not matter, I do so as well for complex constructions; for example, the meaning of *a little boy* would be given as **a.little.boy'**. Semantic representations are typed. Types are based on the types **t** (truth values), **e** (entities), and **s** (possible worlds), and whenever σ, τ are types, then $(\sigma)\tau$ is a type as well, with the set of functions from σ-denotations to τ-denotations as possible denotations; I will write $\sigma\tau$ if σ is a simple type symbol. Instead of intensional logic as propagated by Montague (1970), I will use the more perspicuous notation of two-sorted type theory (cf. Gallin 1975, Zimmermann 1989), in which we can quantify explicitly over possible worlds. For example, instead of writing ` Φ ('it is necessary that Φ') I will write $\forall i[\Phi(i)]$ (for every possible world i, $\Phi(i)$).

The monotonicity phenomena we are going to discuss are based on the ordinary set theoretic relations and operations. However, these relations and operations must be generalized to be applicable to a wider range of types (see, e.g., Partee and Rooth 1983 for that enterprise). Therefore we introduce some set-theoretic symbols into the representation language with a "generalized" interpretation. I will use subscripts to indicate the types of expressions at their first occurrence; σ,τ stand for types, u stands for a variable and α, β stand for constants or variables. The following definitions can be seen as meaning postulates for admissible models of the representation language.

(34) a. Union:
$\alpha_t \cup \beta_t := \alpha \vee \beta$
$\alpha_{(\sigma)\tau} \cup \beta_{(\sigma)\tau} := \lambda u_\sigma[\alpha(u) \cup \beta(u)]$, where u is free for α, β
b. Intersection:
$\alpha_t \cap \beta_t := \alpha \wedge \beta$
$\alpha_{(\sigma)\tau} \cap \beta_{(\sigma)\tau} := \lambda u_\sigma[\alpha(u) \cap \beta(u)]$, where u is free for α, β

According to (34.a), the union of two semantic representations of type **t** (that is, two truth values) is their disjunction. If α, β are of a type based on **t**, their union is traced back to the union of their values. Take as an example the disjunction of two sets, $\alpha_{et} \cup \beta_{et}$; this is $\lambda u_e[\alpha(u) \cup \beta(u)]$, which is $\lambda u[\alpha(u) \vee \beta(u)]$, which is equivalent to ordinary set union. Take as a second example the union of two properties; we have $\alpha_{set} \cup \beta_{set} = \lambda u_s[\alpha(u) \cup \beta(u)]$, which is $\lambda u_s[\lambda u'_e[\alpha(u)(u') \vee \beta(u)(u')]]$. This is a function which assigns to every possible world u a set (that is, a function from entities to truth values) which is the union of α (evaluated at u) and β (evaluated at u).
Quite similarly, we can generalize the other set relations and operations:

(34) c. Complement:
$-\alpha_t := \neg\alpha$
$-\alpha_{(\sigma)\tau} := \lambda u_\sigma[-\alpha(u)]$, where u is free for α.

d. Subset:
$\alpha_t \subseteq \beta_t := \beta \rightarrow \alpha$
$\alpha_{(\sigma)\tau} \subseteq \beta_{(\sigma)\tau} := \forall u_\sigma[\alpha(u) \subseteq \beta(u)]$, where u is free for α, β
(equivalently, $\alpha \subseteq \beta$ iff $\alpha \cup \beta = \beta$)

e. Proper Subset:
$\alpha \subset \beta :\Leftrightarrow \alpha \subseteq \beta$ and not $\beta \subseteq \alpha$.

f. Overlap:
$\alpha_{(\sigma)t} \infty \beta_{(\sigma)t} := \exists u_\sigma[\alpha(u) \wedge \beta(u)]$, where u is free for α, β.

g. Subtraction:
$\alpha_{(\sigma)\tau} \setminus \beta_{(\sigma)\tau} := \lambda u_\sigma[\alpha(u) \cap -\beta(u)]$, where u is free for α, β.

h. Element:
$\alpha_\sigma \in \beta_{(\sigma)t} :\Leftrightarrow \beta(\alpha)$

i. Set:
$\{\alpha_1, \alpha_2, .. \alpha_n\} := \lambda u[u=\alpha_1 \vee u=\alpha_2 \vee .. \vee u=\alpha_n]$,
where u and the α_i are of the same type and u is free for α_i, $1 \leq i \leq n$.

With these tools, we are well equipped to tackle the problems of polarity items.

3.2. Polarity Lattices

First, I think that Heim's improvement on Ladusaw's theory made it clear that we should not base the explanation of NPI contexts on general DEness, but instead on DEness RESTRICTED TO SPECIFIED SORTS. Heim's rule of limited DEness required the selection of expressions 'of the appropriate type', that is, of the same sort as the denotation of the NPI; so we must know this sort. We can safely assume that it is part of the grammatical knowledge of the speakers of a language to be able to identify the sort an NPI is related to. For example, it is part of the grammatical knowledge of a speaker of German that *einen Finger rühren* is related to the sort of work actions, and *auf einen grünen Zweig kommen* is related to the sort of economical successes.

The notion of a sort can be related to Fauconnier's notion of a scale, as we can assume that the elements of a sort are ordered. However, it is not necessary that they stand in a linear ordering, as suggested by Fauconnier. The only general assumption we have to make is that the denotation of the NPI is the smallest element on that ordering. That is, the sort can be constructed as a LATTICE, with the NPI interpreted as applying to the least element. More specifically, I assume that for every NPI *A* (with denotation **A'**) there is a structure $\mathbf{L_A}$, which is defined as follows:

(35) $\mathbf{L_A} = \langle \mathbf{A'}, L_A, \leq_A \rangle$ is an NP LATTICE iff:

a. if $\mathbf{A'}$ is of type σ, L_A is of type σt;[5]

b. $\leq_A$ is a quasi-order (preorder) relation on L_A (i.e., $\leq_A$ is reflexive and transitive);

c. $\mathbf{A'} \in L_A$, and L_A contains at least one more element; and

d. $\mathbf{A'}$ is the unique Y such that for every $X \in L_A$, $Y \leq_A X$.

We will call L_A the LATTICE SORT, $\leq_A$ the LATTICE ORDERING,[6] and $\mathbf{A'}$ the NPI REPRESENTATION. (35.d) says that $\mathbf{A'}$ is the least element of L_A with respect to $\leq_A$. The irreflexive relation corresponding to $\leq_A$ will be rendered as $<_A$; that is, we have $x <_A y$ iff $x \leq_A y$ and not $y \leq_A x$. We can define the notion of a positive polarity lattice, or PP lattice, which is just like an NP lattice with the exception that $\mathbf{A'}$ is the greatest element:

(36) $\mathbf{L_A} = \langle \mathbf{A'}, L_A, \leq_A \rangle$ is a PP LATTICE iff (a), (b), (c) as in (35), and (d) $\mathbf{A'}$ is the unique Y such that for every $X \in L_A$, $X \leq_A Y$.

Let us go through some simple examples. They all imply polarity items of type **set** (properties of individuals, that is, functions from possible worlds to sets of individuals), and therefore lattice sorts of type **(set)t** (sets of properties of individuals).

First, the meaning of the NPI *a drop of wine* can be analyzed as a property **a.drop.of.wine'**. Its NP lattice is $\langle \mathbf{a.drop.of.wine'}, L_{a.drop.of.wine}, \leq_{a.drop.of.wine} \rangle$. We have for all properties X, if $X \in L_{a.drop.of.wine}$ then X is the property of being a quantity of wine of a certain size. Furthermore, we can assume that if x is a quantity of wine, then at least one of the properties in $L_{a.drop.of.wine}$ applies to x. In a formula, with i as a variable over possible worlds and **wine'** as the property of being wine: $\forall i,x[\mathbf{wine'}(i)(x) \leftrightarrow \exists X[X \in L_{a.drop.of.wine} \wedge X(i)(x)]]$. Therefore $L_{a.drop.of.wine}$ can be called **exhaustive** with respect to **wine'**. As for the ordering relation, we assume that $X \leq_{a.drop.of.wine} Y$ iff it necessarily holds that for any x, y such that x has the property X and y has the property Y, x is smaller than or equal to a quantity of wine y. That is, $\forall X,Y[X \leq_{a.drop.of.wine} Y \leftrightarrow \forall i,x,y[[X(i)(x) \wedge Y(i)(y)] \rightarrow [\mathbf{wine'}(i)(x) \wedge \mathbf{wine'}(i)(y) \wedge$ x is a smaller or equal quantity than y]]]. Finally, **a.drop.of.wine'** applies to quantities of wine which are smaller than a certain (small) limit; roughly: $\forall i,x[\mathbf{a.drop.of.wine'}(i)(x) \rightarrow \mathbf{wine'}(i)(x) \wedge$ x is smaller than some quantity ε]. Obviously, then, **a.drop.of.wine'** is the least element of the lattice.

We do not specify how many elements the lattice $L_{a.drop.of.wine}$ should have, except that there must be more than one; however, the idea is that there be sufficiently many.

Perhaps the most natural assumption here is that $L_{a.drop.of.wine}$ is a partition of quantities of wine into equivalence classes, and that $\leq_{a.drop.of.wine}$ is antisymmetric and connected.

Also, we do not specify how small the limit ε has to be which defines the least element in the lattice. As the idiomatic expression *a drop of wine* cannot be used in the positive sense to specify some amount of wine, we should assume that ε can be deliberately small. This idea could be worked out in some form of game-theoretical semantics (cf. Saarinen 1979, Hintikka 1983), where the speaker (proponent) gives the hearer (opponent or Nature) the opportunity to choose as small a value as she likes. This would involve a more dynamic view of lattice sorts. In order to avoid additional complications, we will stick here to the static view and assume that negative polarity lattices come with a fixed (small) NPI representation.

Our second example is quite similar; it is the NPI *a red cent.* Its NP lattice is <**a.red.cent'**, $L_{a.red.cent}$, $\leq_{a.red.cent}$>. For every $X \in L_{a.red.cent}$, it holds that X is a property of amounts of money; and if we claim exhaustiveness, for every amount of money x and world i there should be a property X in $L_{a.red.cent}$ such that X(i)(x). We furthermore have $X \leq_{a.red.cent} Y$ iff for every world i, it holds that for every x with X(i)(x) and y with Y(i)(y), x is a smaller or equal amout of money than y; and **a.red.cent'** is the property of being an amount of money which is smaller than some arbitrarily small amount.

Our third example is a PPI, *bags of money*. Its lattice sort and ordering relation can be considered the same as the lattice sort and ordering relation of *a red cent*. However, the PPI representation **bags.of.money'** denotes the property of being an amount of money which is **larger** than some arbitrarily large amount.

Our next example is the NPI *lift a finger*. Let us assume that verbal predicates in general apply to events. In the NP lattice <**lift.a.finger'**, $L_{lift.a.finger}$, $\leq_{lift.a.finger}$>, we assume $X \in L_{lift.a.finger}$ iff X is a property of events which are acts of labor. We have X $\leq_{lift.a.finger}$ Y iff it necessarily holds that for every event x with property X and event y with property Y, x involves labor which is less than or equal to y. And **lift.a.finger'** is the property which applies to all acts of labor which involve less labor than an arbitrarily small limit. A plausible assumption here is that $\leq_{lift.a.finger}$ is not connected, as there might be different classes of labor which cannot be compared with each other.

Our last example is *any boy*, which will be analyzed as a nominal predicate as well. We can represent *any boy* similar to *a boy* as **a.boy'**, a property applying to (single) boys. The only difference is that *any boy* is an NPI and thus related to an NP lattice. Its lattice sort $L_{any.boy}$ is defined as $\lambda X[X \subseteq \textbf{a.boy'}]$, that is, it contains every subproperty of **a.boy'**. The ordering relation $\leq_{any.boy}$ is reverse set inclusion restricted to elements of the lattice. Evidently, **a.boy'** is the most inclusive property in $L_{any.boy}$, and therefore $<$**a.boy'**, $\lambda X[X \subseteq$ **a.boy'**], $\leq_{any.boy}>$ qualifies as an NPI lattice.

The last example of a polarity lattice is special insofar as the ordering relation is related to inclusion. I will call such lattices **inclusion lattices**. It suffices to characterize inclusion lattices by their lattice sort and the polarity item representation. Let us represent inverse inclusion by an un-indexed $\leq$, that is, $X \leq Y$ iff $Y \subseteq X$. The ordering $\leq$ can be read as 'be at most as specific as'; it is a generalization of the hyperonymy relation in lexical semantics. Note that I use $\leq$ in a different way than Ladusaw. The corresponding strict order is $<$ (inverse proper set inclusion). Then we can define inclusion lattices of both polarities as follows:

(37) $\mathbf{L_A} = <\mathbf{A'}, L_A>$ is an NP INCLUSION LATTICE iff
  a. $\mathbf{A'}$ is of a type σ which is based on t, L_A is of type $(\sigma)t$;
  b. $\mathbf{A'} \in L_A$, and there is at least one additional element in L_A;
  c. for every $X \in L_A$, $\mathbf{A'} \leq X$ (that is, $X \subseteq \mathbf{A'}$).

(38) $\mathbf{L_A} = <\mathbf{A'}, L_A>$ is a PP INCLUSION LATTICE iff (a), (b) as in (37), and (c) for every $X \in L_A$, $X \leq \mathbf{A'}$ (that is, $\mathbf{A'} \subseteq X$).

The ordering of inclusion lattices can be associated with a very general relation, namely set inclusion. In contrast, the ordering relations of non-inclusion lattices seem to be rather idiosyncratic. They are related to orderings such as quantities of matter, monetary value, or amounts of labor. However, we can associate most, if not all, of these orderings with a general ordering relation as well. There are reasons to assume that the domain of individuals is structured by a PART RELATION (see e.g. Link 1983, Krifka 1989, 1989a). For example, we can assume that quantities of wine are subject to a part relation, and that this part relation is associated with the relations on which $\leq_{a.drop.of.wine}$ is based. Proof: If x and y are quantities of wine, and x is a proper part of y, then x is an amount of wine which is equal to or smaller than y. Hence, if X, $Y \in L_{a.drop.of.wine}$, $x \in X(i)$, and $y \in Y(i)$, then it may be the case that $X <_{a.drop.of.wine} Y$, but it cannot be the case that $Y <_{a.drop.of.wine} X$. -- Similarly, the ordering relations of monetary value and amount of labor are associated with the part relation. For example, if x and y are acts of labor, and x is a part of y, then x will involve equal or less labor than y. So, even non-inclusion lattices are not totally unrestricted, but have to be in tune with a general relation, the part relation of individuals.

3.3. Basic Polarity Items

In this section, I will investigate in greater detail the nature of basic polarity items, that is, polarity items whose polarity property cannot be reduced to other polarity items. We will concentrate on the following questions: Which elements do polarity sorts consist of? What is the ordering relation in polarity lattices? And which expressions are used as the polarity item? We will concentrate here on NPIs.

As for the polarity sorts, the IDIOMATIC POLARITY ITEMS are particularly interesting. It is often not easy to characterize a polarity sort, although one cannot help, as a speaker of a language, to have the idea that polarity items evoke a certain natural class of entities, events, attitudes or the like. They are covert semantic categories of the language under investigation. Take some German examples. *Ein Haar krümmen* is related to the class of physically harmful actions (for which there seems to be no general word in German). *Einen Mucks von sich geben* is related to the class of utterances. *Mit der Wimper zucken* is related to the class of reactions to disturbing stimuli. *Bis drei zählen können* is related to levels of intelligence. *Etwas (an x) zu suchen haben* is related to the reasons to be at place x. And *ein Hahn kräht nach x* is related to the intensities x is wished to be back.

Concerning the ordering relation, I have suggested that the idiosyncratic orderings of idiomatic polarity items are typically associated with the general part relation on individuals. To see this with a less obvious example, take *mit der Wimper zucken*: If x and y are reactions to a disturbing stimulus, then x together with y should be a 'stronger' reaction to it. So x and y together is a stronger reaction than its parts x or y.

Now let us turn to the polarity items themselves. Here, several classes can be distinguished. We start with idiomatic NPIs. Of course, idomaticity phenomena are never totally predictable. However, there are some obvious recurrent patterns.

Many of the idiomatic NPIs denote, in their literal sense, entities which are considered as PARTS OF TYPICAL ENTITIES in the lattice. For example, an act of work will often have the moving of a finger as a part; therefore it is plausible that *einen Finger rühren* is the NPI of that lattice. And batting one's eyelashes will often be part of the reaction to a disturbing stimulus; therefore *mit der Wimper zucken* is a good NPI for that. In general, these NPIs can be considered as cases of METONYMY.

A second class of idiomatic NPIs are WORDS WITH A VERY GENERAL MEANING. One example is *sound*, as in *he didn't hear a sound*, or the equivalent in German, *Ton*. Another example is *thing*, as in *he didn't know a thing*.

A third type are NPIs which denote SMALL ENTITIES of a given sort. Some German examples are *Tropfen*, which is related to fluids, and *Bissen*, which is related to edible stuff. The bending of a hair can be considered to be a particularly small harmful action; therefore *ein Haar krümmen* is a good expression to denote the NPI of that lattice.

Related to that are NPIs associated with established scales and denoting either VERY LOW OR VERY HIGH VALUES on that scales. Examples are *eine Sekunde* (as in *er zögerte keine Sekunde*, 'he didn't hesitate a second') and *hundert Jahre* (as in *wir werden es in hundert Jahren nicht wissen* 'we will not know it in hundred years'). Whether we choose low or high values depends on the construction; for example, as *in* is a DE operator (cf. Krifka 1989, 1989a), we can analyze *in hundert Jahren* as an NPI. In the next section, I will work out a theory for such derived NPIs.

Finally, there are idiomatic NPs which denote, in their literal reading, something which is similar to the elements of the lattice, but which is considered either to be LESS WORTH than these elements, or perhaps occurs more frequently. An example is *Schwein*, used as an NPI for people.

In general, the development of idiomatic NPIs should be seen as a case of grammaticization: The expressions loose their literal meaning and are used in contexts which are more and more grammatically predictable. Complex negations, like in French, are the last stage of this process.

Let us now look at NON-IDIOMATIC POLARITY ITEMS. These are polarity items which are generated from non-polarity items by syntactical or morphological means. An example is *any boy*, which is construed from the common noun *boy* and the determiner *any*. Contrary to normal use, then, I will not say that *any* itself is an NPI, but that it is a grammatical device to form an NPI. The case of *any* has already been dealt with in the last section.

There is no real counterpart to *any* in German. The closest perhaps are determiners based on *irgend-*, which yield noun phrases such as *irgendein Junge*. These phrases clearly act as NPIs; however, they also occur in non-NPI contexts and behave differently to *any* there, insofar as they often lack a 'free choice' reading (see chapter 3.4). They are felt to stand in contrast to phrases based on *ein bestimmter* 'a certain', as e.g. *ein bestimmter Junge*. With these phrases, the speaker indicates that he has a specific individual in mind. The simplest analysis of the NP lattice of *irgendein Junge* is, then, a set with two elements, the NPI representation **a.boy'** (which is similar to the NPI representation of *any boy* or the interpretation of the non-NPI *a boy*) and the represention of *ein bestimmter Junge*. What this representation should look like is a rather difficult problem which cannot be treated in this article. Let us assume here a function SP that depends on the context of utterance which, when applied to a nominal property, yields an element of it (roughly, the individual the speaker has in mind). Then *ein bestimmter Junge* can be rendered as a property applying to at most one object in every possible world, namely as $\lambda i,x[x=SP(i)(\mathbf{a.boy'})]$. The NP lattice of *irgendein Junge* can be reconstructed as an inclusion lattice with the lattice sort {**a.boy'**,

$\lambda i,x[x=SP(i)(\mathbf{a.boy'})]\}$. For every context for which $SP(i)(\mathbf{a.boy'})$ is defined at all, we have $\mathbf{a.boy'} < \lambda i,x[x=SP(i)(\mathbf{a.boy'})]$, provided that $\mathbf{a.boy'}(i)$ applies to more than one element for some i, so *irgendein Junge* has a proper NP lattice in any such context of utterance. Note that in this representation, *any boy* and *irgendein Junge* have the same NPI representation but different lattice sorts. The lattice sort of *irgendein Junge*, in addition, is context dependent, as it depends on the value of SP. Finally, the lattice of *irgendein Junge* seems to be special insofar as it contains only two elements. Let us call polarity lattices with only two elements **pair lattices**.

Another example of non-idiomatic NPIs are expressions containing *ever* (German *jemals*). I think that *ever* basically makes the temporal interpretation of a sentence independent of a possible reference time. As it is well known, sentences are interpreted normally with respect to some time which can be specified by linguistic means or by the non-linguistic context. *Ever* seems to prevent such a context-dependent interpretation. To see this, look at the following example:

(39) When I left home yesterday, I didn't (*ever) remember to close the windows.

Why is *ever* bad in this example? The *when* clause explicitly gives a reference time for the following main clause, but *ever* prevents this clause from picking up that reference time. If clauses are analyzed as containing a free time variable which picks up the reference time, as claimed in Partee (1984), then *ever* can be analyzed as a narrow-scope existential quantifier which binds that variable, thus making it inaccessible for the reference time parameter of the context. Let us assume that *ever* combines with a clause Φ (an analysis which says that it combines with a VP would be possible as well), and let $\Phi'[t]$ be the semantic representation of Φ, a proposition with a free time variable t, specialized for the reference time. Let us render *ever* as $\lambda p,i\exists t[p(i)]$ (we take p as a variable over propositions, that is, of type **st**). Then *ever* Φ (we do not care for word order here) has the semantic representation $\lambda i\exists t[\Phi'[t]](i)$, the set of possible worlds in which Φ' holds at least for one time. Furthermore, *ever* Φ should be an NPI with an inclusion lattice, where $\lambda i\exists t[\Phi'[t]](i)$ is the NPI representation and $\{\Phi'[t], \lambda i\exists t[\Phi'[t]](i)\}$ is the polarity lattice. That is, it is a pair lattice, with $\Phi'[t]$ as the other element, where t should pick up the current reference time in which the sentence *ever* Φ is uttered. It is a proper NPI lattice, as we have for every t, $\lambda i\exists t[\Phi'[t]](i) < \Phi'[t]$, that is, the set of worlds for which Φ' holds at an unspecified time properly includes the set of worlds for which Φ' holds for a specified time t, provided that Φ' holds for more than one time in at least one possible world.

There is an NPI which might be considered as similar to *ever*, namely *anytime*. However, these two adverbials are used differently: *anytime* occurs in a 'free choice' reading, which is not possible for *ever*:

(40) You can come anytime / *You can ever come.

I will discuss the nature of free choice readings in chapter 3.4. We can predict the possibility of a free choice reading if *anytime* is analyzed like other expressions formed with *any*. In this case, *anytime* Φ should be analyzed as an NPI with the representation $\lambda i \exists t[\Phi'[t]](i)$ and a lattice sort which consists of propositions p for which there is some time t such that $p = \Phi[t]$. Thus, *ever* Φ and *anytime* Φ have the same semantic representation but different NP lattices.

Let us now turn to PARTITIVES. Partitives in NPI contexts, which we observed in Finnish (cf. 1.3), should also be treated as cases of non-idiomatic NPIs. We can analyze the semantic effect of partitive marking as follows: If a nominal predicate α has the semantic representation α' (a property, type **set**), then the partitive form of α, α*–PART*, has as its semantic representation $\lambda i,x\exists y[\alpha'(i)(y) \wedge x \leq_p y]$, where $\leq_p$ stands for the part relation for individuals. That is, a partitive predicate applies to entities which are parts of the entities the corresponding non-partitive predicate applies to. We furthermore assume that the partitive marking can create an NP inclusion lattice. The simplest such lattice is a pair lattice: $\mathbf{L}_{\alpha\text{-PART}} = \langle \alpha', \lambda i,x\exists y[\alpha'(i)(y) \wedge x \leq_p y]\rangle$. The lattice sort, then, consists of the representations of α and α*-PART*, and the NPI representation is the representation of α*-PART*. If we assume that at least one element α' applies to has a proper part, we have a proper NP lattice, as it then holds that $\lambda i,x\exists y[\alpha'(i)(y) \wedge x \leq_p y] < \alpha'$.

In concluding this section on different basic NPIs, I want to come back to the fact that idiomatic NPIs often occur in a more restricted class of contexts than non-idiomatic NPIs. For example, we have seen that some of the idiomatic NPIs only occur in the context of a negation. This can be explained by assuming that the negation, or some other NPI licenser, has become a part of the idiom. The new idiom, then, is not an NPI anymore: although it contains a negation or some other operator which can license an NPI, it has become semantically opaque, that is, its meaning cannot be deduced from the meanings of its parts. Thus, the distribution differences of different NPIs can be explained as different stages of idiomatization. That implies that the non-idiomatic NPIs occur in the widest class of contexts, and this seems to be generally true.

3.4. A Recursive Notion of Polarity Items

Baker (1970) showed that although PPIs do not occur in the scope of a simple negation, we find them in the scope of TWO negations:

(41) a. I would *rather* be in Montpellier.
b. *I wouldn't *rather* be in Montpellier.
c. There isn't anyone in the camp who wouldn't *rather* be in Montpellier.

Schmerling (1971) observed a similar phenomenon with NPIs:

(42) a. *There was someone who did *a thing* to help.
b. There was no one who did *a thing* to help.
c. *There was no one who didn't do a thing to help.

It seems as if an NPI must be in the scope of an odd number of NPI licensing operators (1,3,...), whereas a PPI must be in the scope of an even number of NPI licensing operators (0,2,...). Examples with more than two such operators are perhaps hard to come by, but this might well be a performance restriction, not a limit of our linguistic competence.

There are several ways to get a grip on the flip-flop behaviour of expressions containing polarity items. One is to identify the largest sentence and only check whether a polarity item is admissible there. For proper parts of that largest sentence, the admissibility of a polarity item cannot be at stake at all. This procedure, however, does not seem very attractive, as it does not relate the property of admissibility of a sentence to the admissibility of its immediate parts. A more compositional treatment would allow for a sentence to be unacceptable in isolation, but acceptable in the context of a larger expression.

One method to accomplish this is to identify the semantic representation of a polarity item **A'** in the semantic representation of a more complex expression Φ[**A'**], and ask whether **A'** is appropriate in Φ[**A'**]. If not, **A'** might still be appropriate in the semantic representation of a larger expression Ψ[Φ[**A'**]] containing Φ[**A'**], and we can develop rules which determine the acceptability of Ψ[Φ[**A'**]] on the basis of the acceptability of Φ[**A'**]. In such an approach, we must be able to recover the polarity item representation **A'** embedded in a complex expression Φ[**A'**]. This can be done with STRUCTURED SEMANTIC REPRESENTATIONS, as developed by Cresswell and von Stechow (1982) and Jacobs (1983). In this framework, Φ[**A'**] could be represented by a pair <**A'**, $\lambda X \Phi[X]$>, where the variable X marks the occurrence of the NPI representation **A'** in

Φ[**A'**]. We would have to make sure, of course, that this occurrence is recoverable in larger semantic representations as well.

Another method, which will be pursued in this paper (cf. also Krifka 1990), is to introduce a RECURSIVE notion of polarity items. To do so, we have to develop rules which, given **A'** is a polarity item representation, tell us when Φ[**A'**] is a polarity item representation as well and specify its lattice sort and ordering relation. We finally have a rule saying that we must not end up with an NPI, at least in an assertion (questions may behave differently). As polarity items are associated with lattice sorts of 'alternatives', this approach can be considered as an application of Rooth's ALTERNATIVE SEMANTICS for focusing operators (cf. Rooth 1985, and von Stechow 1988 for a comparison with the structured representation approach).

Let us assume that the composition of two semantic representations is handled by an operator C; for instance C(Φ,Ψ) is the semantic composition of the representations Φ and Ψ. C might be functional application, or functional composition, depending on the type of Φ and Ψ. As we reconstructed indefinite noun phrases and (intransitive) verbs both as properties, C must handle these cases as well; let us assume that C introduces an overlap relation in this case, e.g. C(**a.boy'**, **came'**) = λi[**a.boy'**(i) ∞ **came'**(i)] = λi$\exists$x[**a.boy'**(i)(x) $\wedge$ **came'**(i)(x)]. Obviously, C is syntactically driven, as it depends on the syntactic construction how it must be spelled out. We will consider only semantic compositions which result in types for which inclusion is defined, that is, for types based on **t**. Otherwise, I will remain fairly unspecific about C.

We can define three types of semantic compositions with an NPI or PPI representation: DOWNWARD ENTAILING (DE), UPWARD ENTAILING (UE), and NEUTRAL compositions.

(43) If $\langle$**A'**, L_A, $\leq_A\rangle$ is a polarity lattice and S[**A'**] = C(**A'**,Φ) or C(Φ,**A'**) a semantic composition, then S[**A'**] is

a. UE WITH RESPECT TO **A'** iff for any X,Y$\in L_A$: X $<_A$ Y $\rightarrow$ S[X] < S[Y].

b. DE WITH RESPECT TO **A'** iff for any X,Y$\in L_A$: X $<_A$ Y $\rightarrow$ S[Y] < S[X].

c. NEUTRAL WITH RESPECT TO **A'** if neither (a) nor (b).

Note that we do not define DEness and UEness generally, as in Ladusaw (1979), but always with respect to a polarity item representation **A'**.

With the definition of UE / DE semantic compositions, we can develop the notion of a polarity lattice which is DERIVED FROM ANOTHER POLARITY LATTICE by semantic composition. As we take into consideration only those derived lattices which are inclusion lattices, it is sufficient to know the lattice sort and the polarity item representation of the derived lattice; the ordering relation is always $\leq$ restricted to elements of the lattice sort.

(44) Let $\mathbf{L_A} = \langle \mathbf{A'}, L_A, \leq_A \rangle$ be a polarity lattice and $S[\mathbf{A'}]$ a semantic composition which is UE or DE with respect to $\mathbf{A'}$. Then the inclusion lattice generated by $\leq_A$ and $S[\mathbf{A'}]$ is $\mathbf{L_B} = \langle \mathbf{B'}, L_B \rangle$, where
a. $\mathbf{B'} = S[\mathbf{A'}]$;
b. $X \in L_B$ iff there is a Y, $Y \in L_A$, and $X = S[Y]$.

The polarity of the derived lattice depends on the polarity of $\mathbf{L_A}$ and whether $S[\mathbf{A'}]$ is UE or DE with respect to $\mathbf{A'}$. Proof: Let $\mathbf{L_A} = \langle \mathbf{A'}, L_A, \leq_A \rangle$ be an NP lattice and $S[\mathbf{A'}]$ a DE compositon with respect to $\mathbf{A'}$. The generated inclusion lattice is $\mathbf{L_B} = \langle S[\mathbf{A'}], \lambda X \exists Y[Y \in L_A \wedge X = S[Y]] \rangle$. As $\mathbf{L_A}$ is an NP lattice, we have for any $X \in L_A$ with $\neg X <_A \mathbf{A'}$: $\mathbf{A'} <_A X$; and as $S[\mathbf{A'}]$ is DE with respect to $\mathbf{A'}$, we have $S[X] < S[\mathbf{A'}]$, and hence $\mathbf{L_B}$ is a PP lattice. Similarly, if $\mathbf{L_A}$ is a PP lattice and $S[\mathbf{A'}]$ is an DE composition with respect to $\mathbf{A'}$, $\mathbf{L_B}$ will be an NP lattice. I will call this POLARITY REVERSAL. On the other hand, if $S[\mathbf{A'}]$ is an UE composition with respect to $\mathbf{A'}$ and $\mathbf{L_A}$ is an NP (PP) lattice, then $\mathbf{L_B}$ will also be an NP (PP) lattice. I will call this POLARITY PROJECTION.

If *A* is an NPI or PPI, with the polarity lattice $\mathbf{L_A}$, if ΦA has as its semantic representation $S[\mathbf{A'}] = C(\mathbf{A'},\Phi)$ or $C(\Phi,\mathbf{A'})$ which is DE or UE with respect to $\mathbf{A'}$, and if $\mathbf{L_{\Phi A}}$ is the inclusion lattice generated by $\mathbf{L_A}$ and $S[\mathbf{A'}]$, then we call ΦA a DERIVED NPI or DERIVED PPI, and $\mathbf{L_{\Phi A}}$.a derived NP or PP lattice.

It is time to look at some examples. The first is *any boy came*. Let us assume that *came* denotes the property of all individuals which came, **came'**. Combined with the semantic representation of *any boy*, which is **a.boy'**, this yields C(**came'**, **a.boy'**), which equals $\lambda i[\mathbf{came'}(i) \infty \mathbf{a.boy'}(i)]$, which is in turn the set of worlds in which at least one boy came. Now this composition is UE with respect to the NPI representation **a.boy'**, as it holds for every X, Y $\bullet$ $L_{\text{any.boy}}$ with X<Y: C(**came'**,X) < C(**came'**,Y), that is, $\lambda i[\mathbf{came'}(i) \infty X(i)] < \lambda i[\mathbf{came'}(i) \infty Y(i)]$. Proof: From X < Y, which is defined as $Y \subset X$, we can derive that for every i, $Y(i) \subseteq X(i)$, and for some i, $Y(i) \subset X(i)$. The first tells us that for every i, $\mathbf{came'}(i) \infty Y(i) \rightarrow \mathbf{came'}(i) \infty X(i)$. The second tells us that there might be some i such that $\mathbf{came'}(i) \infty X(i) \wedge \neg[\mathbf{came'}(i) \infty Y(i)]$. As we assume the set of worlds to be modally complete (that is, every possibility is realized in some possible world), we can assume that there are indeed such i. Hence $\lambda i[\mathbf{came'}(i) \infty X(i)] < \lambda i[\mathbf{came'}(i) \infty Y(i)]$.

Let us look now at the NPI lattice generated by *any boy came*. Its NPI representation is $\lambda i[\mathbf{came'}(i) \infty \mathbf{a.boy'}(i)]$. Its lattice sort $L_{\text{any.boy.came}}$ is a set of sets of possible worlds such that $p \in L_{any.boy.came}$ iff there is an X, $X \in L_{any.boy}$, and $p = \lambda i[\mathbf{came'}(i) \infty X(i)]$. That is, its lattice sort can be given as $\lambda p[\exists X[X \subseteq \mathbf{a.boy'} \wedge p = \lambda i[\mathbf{came'}(i) \infty \mathbf{a.boy'}(i)]]]$

Our second example is *it is not the case that any boy came*. We assume that *it is not the case that* is interpreted as $\lambda p[-p]$, a function on sets of possible worlds which yields their complement with respect to the set of all possible worlds. Combined with the semantic representation of *any boy came*, this yields $-[\lambda i[\mathbf{came'}(i) \infty \mathbf{boy'}(i)]]$, which equals $\lambda i[\neg[\mathbf{came'}(i) \infty \mathbf{boy'}(i)]]$, the set of worlds in which no boy came. This composition is DE with respect to the NPI representation $\lambda i[\mathbf{came'}(i) \infty \mathbf{boy'}(i)]$, as it holds for any set of worlds p', $p'' \in L_{any.boy.came}$ with $p' < p''$: $\lambda p[-p](p'') < \lambda p[-p](p')$, that is, $-p'' < -p'$, as set inclusion is reversed under complementation. Thus, *it is not the case that any boy came* is a derived PPI with the PP inclusion lattice $\langle \lambda i[\neg[\mathbf{came'}(i) \infty \mathbf{boy'}(i)]], L_{it.is.not.the.case.that.any.boy.came} \rangle$, where $\lambda i[\neg[\mathbf{came'}(i) \infty \mathbf{boy'}(i)]]$ is the set of worlds in which no boy came, and $p \in L_{it.is.not.the.case.that.any.boy.came}$ iff there is a Y, $Y \subseteq \mathbf{boy'}$, and p is the set $\lambda i[\neg[\mathbf{came'}(i) \infty Y(i)]]$, that is, the set of worlds in which no Y came.

We can see with these examples that the UE and DE compositions capture the flip-flop behaviour mentioned above: An UE composition passes the polarity of the more basic polarity item to the complex expression; a DE composition passes the reverse polarity of the more basic polarity item to the complex expression. Furthermore, a composition which is neither UE nor DE can cancel any polarity.

Up to now, we have seen only examples of polarity projection or reversal with *inclusion* lattices. As non-inclusion lattices are based on more idiosyncratic orderings, it is harder to show that a particular semantic composition is DE or UE. However, these orderings are typically associated with the part relation on individuals (see section 3.2), and as there are some general rules for natural language predicates with respect to the part relation, we can show that particular compositions are UE or DE, and therefore generate a polarity lattice. As this derived polarity lattice is, in turn, an inclusion lattice, further derivations are captured by the rules already given.

Let us look at an example. To avoid distracting complications, we will choose one which is based on an intransitive verbal predicate, namely *a drop of wine was drunk.* The predicate *was drunk* can be represented as **was.drunk'**, the property of entities which were drunk. The NPI noun phrase *a drop of wine* is represented as a property **a.drop.of.wine'**. The semantic composition yields $C(\mathbf{was.drunk'}, \mathbf{a.drop.of.wine'}) = \lambda i[\mathbf{was.drunk'}(i) \infty \mathbf{a.drop.of.wine'}(i)]$. In order to prove that this is a derived NPI representation, we have to show that the composition is UE with respect to **a.drop.of.wine'**. This is the case because both the lattice sort

$L_{a.drop.of.wine}$ and the predicate **was.drunk'** are associated with the part relation on individuals, $\leq_p$. On the one hand, we have as a plausible rule: For every x, y, and i, if **was.drunk'**(i)(x) and y $\leq_p$ x, then **was.drunk'**(i)(y). On the other hand, we can assume that for any X, Y, and i with X,Y$\in L_{a.drop.of.wine}$ and Y $<_{a.drop.of.wine}$ X, if X(i)(x) then there is a y, y $\leq_p$ x, for which Y(i)(y) holds. So every world i for which **was.drunk'**(i)(x) is a world for which **was.drunk'**(i)(y), but not necessarily vice versa. Therefore we have, assuming modal completeness: λi[**was.drunk'**(i) ∞ Y(i)] < λi[**was.drunk'**(i) ∞ X(i)]. But this means that C(**was.drunk'**, **a.drop.of.wine**) is UE with respect to **a.drop.of.wine'**. The inclusion lattice of *a drop of wine was drunk* is <λi[**was.drunk'**(i) ∞ **a.drop.of.wine'**(i)], $L_{a.drop.of.wine.was.drunk}$>, where the lattice sort is defined as follows: For any p, p$\in L_{a.drop.of.wine.was.drunk}$ iff there is an X, X$\in L_{a.drop.of.wine}$, such that p = λi[**was.drunk'**(i) ∞ X(i)] (that is, p is a set of worlds in which some quantitiy of wine was drunk). We have to show that λi[**was.drunk'**(i) ∞ **a.drop.of.wine'**(i)] is the most inclusive of these sets of worlds, and thus the least element on the ordering. This is indeed the case: For every i and every X, X$\in L_{a.drop.of.wine}$, if **was.drunk'**(i) ∞ X(i), then there is an x, x∈X, such that **was.drunk'**(i)(x). This x has, according to the rules mentioned above, a part y such that **a.drop.of.wine'**(i)(y) and **was.drunk'**(i)(y), and therefore **was.drunk'**(i) ∞ **a.drop.of.wine'**(i). This means that every set of worlds p for which there is a Y such that Y$\in L_{a.drop.of.wine}$ and p = λi[**was.drunk'**(i) ∞ Y(i)] is a subset of λi[**was.drunk'**(i) ∞ **a.drop.of.wine'**(i)]. Thus, *a drop of wine was drunk* is a derived NPI.

At this point, I would have to show that we can extend our treatment to cases with verbal predicates of more than one argument, and to verbal predicates like *lift a finger* where the part relation which generates the inclusion lattice is the part relation for events. For reasons of space, this will not be done here.[7]

We have seen that the polarity property is preserved under DE and UE semantic compositions (where the orientation of the polarity changes in the DE case). It is easy to see that the pair property is preserved also: If **A'** is an NPI representation with a lattice sort {X,**A'**}, then a composition S[**A'**] which is DE or UE with respect to **A'** will yield a derived lattice sort {S[X], S[**A'**]}, as the DE or UE property prevents S[X] and S[**A'**] from being identical.

3.5. Assertions, Directives, Questions

In this section, we will formulate rules for the occurrence of polarity items in sentences of different moods and try to give motivations for these rules. Let us assume that the sentences as developed above are SENTENCE RADICALS which get their illocutionary force by some sentence mood operator, such as an assertion operator, a directive operator or a question operator. These ILLOCUTIONARY OPERATORS perform two tasks: First, they relate the sentence radical to a specific world (typically, the actual world), in the case of the assertion operator by claiming that this world is in the set of worlds denoted by the sentence radical. Second, they relate a speaker and a hearer to that sentence. If we treat these operators similar to Zaefferer (1984), we can represent them as follows; ASSERT, DIR and ERO stand for assertive, directive and erotetic, respectively.

(45) If **p'** is a proposition (the representation of the sentence radical), i is a world (typically, the real world), s is the speaker, h is the hearer, then
a. ASSERT(s,h,i,**p'**) says that s asserts **p'**(i) to h,
b. DIR(s,h,i,**p'**) says that s requires h to make **p'**(i) true, and
c. ERO(s,h,i,**p'**) says that s asks h whether **p'**(i) is true.

Let us first look at ASSERTIONS. The basic rule seems to be: Assertions cannot be based on NP sentence radicals. That is:

(46) If **A'** is an NPI, ASSERT(s,h,i,**A'**) will not be a good assertion.

A consequence of this requirement is that, if an NPI occurs in an assertion, its semantic representation must be part of a semantic composition which is DE with respect to the NPI representation, or which is at least neutral. For example, *any boy came* is a bad assertion (because it is an NPI), whereas *it is not the case that any boy came* is a good assertion (because the semantic representation of *any boy came* occurs in a semantic composition which is DE with respect to it, namely negation, and thus the whole expression isn't an NPI anymore; in fact, it is a PPI).

Of course, rule (46) can be a good generalization at best but is not really an explanation. Therefore our next question must be: Why are assertions based on sentential NPIs bad? I think that the answer can be found in pragmatics. Before I go into a formal explanation, let us look at the following example:

(47) *John lifted a finger to help me.

Why is this a bad assertion? The general line of explanation I want to propose runs as follows: The idiom *lift a finger* denotes a very small action. Consequently, (47) says that John did a very small action to help me. As this does not exclude that John did more than just that to help me, (47) is very uninformative. Now we can assume that in communication a sentence should be informative at least to a certain extent. (47) fails to be informative to that extent, and therefore it is out. This hypothesis can be generalized by saying that (sentential) NPIs in general have a very wide range of meaning, and therefore, as assertions, make very weak claims. The claim they make can be considered as not informative enough, so they cannot be used felicitously as assertions.

An obvious counterargument against this is that there are many sentences which are not informative, but which nevertheless are grammatical. Examples are *The capital of Yemen is the capital of Yemen*, or *John comes or he doesn't come*, which are surely even less informative than *John lifted a finger* or *any boy came*. Therefore, lack of informativity cannot be the only reason why assertions cannot be based on NPIs.

The difference between ordinary uninformative assertions and assertions based on an NPI is that assertions of the first type are uninformative per se, whereas assertions of the second type are uninformative with respect to the other elements in their polarity lattice sort. This difference is crucial. We can assume that the fact that NPI and PPI sentence radicals (in contrast with ordinary sentence radicals) come with a lattice sort, should influence their use. The elements in the polarity lattice can be considered as the basis of possible ALTERNATIVE ASSERTIONS. A plausible rule for assertions on the basis of polarity sentence radicals, then, is the following: If a speaker makes an assertion on the basis of a sentential polarity item, then he DELIBERATELY DOES NOT MAKE AN ASSERTION ON THE BASIS OF ANOTHER ELEMENT IN THE LATTICE SORT OF THIS POLARITY ITEM. That his, he can be assumed to have reasons not to make such an assertion. Formally:

(48) if ASSERT(s,h,i,**A'**) and **A'** is an NPI or PPI representation with lattice sort L_A, then for any $X \in L_A$ with $X \neq$ **A'**, s has reasons for $\neg$ASSERT(s,h,i,X).

Let us first take the PPI case. The obvious reason why the speaker does not make an assertion on the basis of X is that such an assertion would be less informative, and thus make a weaker claim. The hearer can infer from that that the speaker wants to make a claim as strong as possible. This explains why PPIs often have the flavor of 'exaggerations'.

Now take the NPI case. In this case, it is hard to find a good reason why the speaker does not make an assertion based on another proposition X in L_A. Note that this would be more informative than **A'**, and typically some of the elements in L_A could be truthfully asserted as well.

But there are cases in which a speaker could have good reasons not to base his assertion on another X in L_A. One such case is the following: It might be that no other element in L_A except **A'** itself is true -- for example, if John indeed performed only a minimal action in i, only *John lifted a finger*, but no alternative in $L_{John.lifted.a.finger}$, would be true in i. By uttering *A*, then, the speaker can implicate that no other element in L_A could be asserted. That is, he says that only **A'** minus all other elements of L_A, which can be given as $\mathbf{A'} \setminus \lambda X[X \in [L_A \setminus \{\mathbf{A'}\}]]$, can be asserted. This is a set of worlds in which only very 'small' things happened with respect to the basic polarity lattice, for example, the set of worlds in which John indeed performed only a minimal action. So, the speaker could implicate with *A* that all he can truthfully say is something minimal. Along these lines, we can develop an explanation for the ironical use of certain NPIs.

Note that this explanation does not work with sentential NPIs based on *any*: If $<\mathbf{A'}, L_A>$ is an NPI inclusion lattice based on *any*, there is always some X, $X \in L_A$, such that X is true (if **A'** is true). As an example, take *any boy came*, whose lattice is $<\lambda i[\mathbf{a.boy'}(i) \infty \mathbf{came'}(i), \lambda p \exists X[X \subseteq \mathbf{a.boy'} \wedge p = \lambda i[\mathbf{came'}(i) \infty \mathbf{a.boy'}(i)]]>$. Whenever the NPI representation is true for a world i, then also some other element in the lattice sort is true of it. Consequently, the explanation of the ironical use of NPIs does not work in this case. And indeed, we do not find it with NPIs based on *any*.

But we do find sentential NPIs based on *any* which are assertions. Some examples:

(49) a. Mary likes anyone.
b. Anything could be in that box.
c. Any man can move this stone.
d. Any cat will chase a mouse.

Traditionally, these cases are treated as another reading of *any*, the so-called FREE-CHOICE *any*. It is so-called because it allows one to pick out an arbitrary object to which the noun applies (or an arbitrary person or object in the case of *anyone* or *anything*). Therefore, noun phrases with the determiner *any* act as universal quantifiers. Consequently, there are analyses which tried to give a unary interpretation of *any* as a universal quantifier (cf. e.g. Hintikka 1983). I take the argumentation in Horn (1972), Fauconnier (1975a,b), Ladusaw (1980), Linebarger (1981) and Carlson (1981) to be convincing that a unary interpretation of noun phrases based on *any* as universal quantifier is not tenable. But I think that a uniform interpretation of these noun phrases as negative polarity items is feasible. However, I can only give an outline of this hypothesis here.

Take example (49.a). If we analyze *anyone* as *any person*, and *Mary likes anyone* as a sentential NPI on which an assertion is based, then our rule (48) tells us that the speaker asserts that Mary likes a person, and that he has reasons not to assert that Mary likes an X, where X is a subproperty of **person'**. That is, he has reasons not to assert for any more specified person (or set of persons) that Mary likes that person or these persons. One obvious reason is that the speaker would make too weak a claim with one of these alternative assertions. Therefore, the hearer can implicate that the speaker wants to express that Mary likes every person.

Of course, we have to explain why there are contexts in which *anyone* cannot mean *everyone*, as in the following examples:

(50) a. *John met anyone.
b. *Anyone came to the party.

One generalization is that assertions based on sentential NPIs generated by *any* which are episodic (non-stative) sentences are out. The reason for this is that an episodic sentence reports a specific event in the real world, and as the alternative assertions are based on all possible subproperties of **person'**, many of these alternative assertions are bound to be false, as specific events have specific participants to which not every subproperty of **person'** will apply. In contrast, the quantifier *everyone* can be restricted to a contextually salient set of persons, and therefore can be used in episodic sentences.

Rule (48) could allow the speaker to make an assertion with an NPI based on *any* because he wants to indicate that he lacks more specific information. As a matter of fact, NPIs based on *any* are not used to indicate uncertainty. For example, *any boy came* cannot be used to say that some boy whom the speaker cannot identify more closely came. The reason of this is as follows: If the speaker would assert the sentence *any boy came*, then he has reasons not to assert any alternative, according to (46). That is, he has reasons, for every element in $L_{\text{any.boy}}$, i.e., every subproperty X of **a.boy'**, not to assert $\lambda i[X(i) \infty \textbf{came'}]$. But as the X's exhaust the property **a.boy'**, this is tantamount to saying that for any boy whatsoever, the speaker has reasons not to assert that he came. So the sentence *any boy came* cannot be used to say that some unspecified boy came.

The closest German equivalent to *any*, the determiners based on *irgend-*, do allow that use; for example, in *irgendein Junge kam* the speaker asserts that a boy came, and indicates that he cannot, or does not want to, identify him more closely. This difference in use should fall out from the fact that the polarity lattices of *any boy* and *irgendein Junge* differ. In our reconstruction, $L_{\text{any.boy.came}}$ is the set $\lambda p \exists Y[Y \subseteq \textbf{boy'} \wedge p = \lambda i[Y(i) \infty \textbf{came'}(i)]]$, whereas $L_{\text{irgendein.Junge.kam}}$ is the set $\{\lambda i[\textbf{boy'}(i) \infty \textbf{came'}(i)],$

$\lambda i[SP(i)(\mathbf{boy'}) \in \mathbf{came'}(i)]\}$ (cf. section 3.3). In the last case, we have to assume that a speaker who utters the sentence *irgendein Junge kam*, whose semantic representation corresponds to the first element, has reasons not to base his assertion on the second element, which would correspond to a sentence like *ein bestimmter Junge kam* 'a certain boy came'. Given that, the hearer can infer that the speaker lacks or does not want to provide the information to identify the boy he is speaking about. This renders the use of assertions like *irgendein Junge kam* quite well.

Let us now turn to DIRECTIVES. We find some marginal uses of idiomatic NPIs in them, e.g. in the ironical *Please, lift a finger!* More important is that we again find NPIs based on *any*:

(51) a. You can take any apple.
b. Confiscate any alcohol you can find.

These sentences exemplify two different types of directives. Example (51.a) is an OFFER; in this case, the fulfillment of the proposition is in the interest of the hearer. Example (51.b) is a REQUEST; the fulfillment of the proposition is in the interest of the speaker. The interpretation of a noun phrase based on *any* differs in these examples: In (51.a) it can be paraphrased as referring to an arbitrary object (*You can take an apple, it does not matter which one*). In (51.b), it must be interpreted as universal quantifier (*For every (quantity of) alcohol x you can find, confiscate x!*).

How can we explain these interpretations? First, I think we can safely assume that it is clear by contextual clues whether a directive is meant as an offer or as a request. Second, we assume for directives a rule similar to the rule for assertions:

(52) if $DIR(s,h,i,\mathbf{A'})$ and $\mathbf{A'}$ is an NPI or PPI representation with lattice sort L_A, then for any $X \in L_A$ with $X \neq \mathbf{A'}$, s has reasons for $\neg DIR(s,h,i,X)$.

In the case of an offer, the obvious reason for the speaker not to use an alternative is that it would put too strong a restriction on the hearer. So the hearer can implicate that the speaker wants to restrict the choice of the hearer as little as possible. In the case of a request, the obvious reason for the speaker not to use an alternative is that it would put too weak a restriction on the hearer. In this case, the hearer has to interpret the sentence as universally quantified, because this yields the strongest possible interpretation.

Now let us look at QUESTIONS, which is a classical NPI context. Why do NPIs occur in questions, and why especially in rhetorical or biased questions, and in inquisitive questions? This can be explained if we look more closely at the pragmatic setting of asking questions.

Imagine a speaker who asks a yes/no-question, and a hearer who answers with *yes* or *no* -- probably the prototypical question situation. The speaker wants to get out as much information as possible from the hearer by his questions. He has at least two strategies: (i) To ask a rather specific question. If the answer is *yes*, then he will be highly informed. However, if the answer is *no* -- and this will be frequently the case with a specific question -- he will remain relatively uninformed. (ii) To ask a rather general question. If the answer is *yes* -- which will be freqently the case -- then he remains relatively uninformed. If the answer is *no*, he will gain much information. As an example, consider a case where the hearer draws a card from a deck of cards, and the speaker has to find out which one it is. According to strategy (i), he would ask: *Is it the seven of diamonds?*, *Is it the eight of diamonds?*, etc. According to strategy (ii), he would ask: *Is it a diamonds?*, *Is it a seven?*, etc. Both strategies can be efficient, but in different circumstances. Strategy (ii), in particular, will be used if the speaker has relatively little background information or if he does not want to give the hearer the possibility of an evasive answer. Furthermore, we can assume that with rhetorical questions and biased questions, the speaker wants to show that he is sure to get a negative answer, and therefore boldly chooses strategy (ii) as well.

Interestingly, we find questions based on NPIs exactly in those situations where strategy (ii) is appropriate. This is a consequence of the following rule:

(53) if ERO(s,h,i,**A'**) and **A'** is an NPI or PPI representation with lattice sort L_A, then for any $X \in L_A$ with $X \neq$ **A'**, s has reasons for $\neg$ERO(s,h,i,X).

The reason why a speaker does not base his question on a more specific X could be either to indicate that he is sure to get a negative answer even with the most general proposition (in the case of rhetorical questions), or that any more specific question would not meet his information needs.

To sum up, we have seen that polarity items generate alternative propositions for illocutionary operators. Now, we can assume that illocutionary operators in general are focusing operators (cf. Jacobs 1984) and therefore sensitive to alternatives. Typically, the alternatives are determined by focus, which is marked by stress. To cite an example by Rooth (1985):

(54) John introduced BILL to Mary.
Proposition Φ: $\lambda i[\mathbf{introduce'}(i)(\mathbf{John'},\mathbf{Bill'},\mathbf{Mary'})]$
Alternatives ALT(Φ):
$$\lambda p \exists x[x \in \mathrm{ALT}(\mathbf{Bill'}) \wedge p = \lambda i[\mathbf{introduce'}(i)(\mathbf{John'},x,\mathbf{Mary'})]]$$

If Φ is asserted, ASSERT(s,h,i,Φ), then the alternatives are explicitly not asserted, $\forall p[p \in \mathrm{ALT}(\Phi) \wedge p \neq \Phi \rightarrow \neg\mathrm{ASSERT}(s,h,i,\Phi)]$. From this, the hearer can implicate that the alternatives (except Φ) are not true. This is the case with contrastive focus. The alternatives are determined by linguistic means, such as stress, and by the context of use; in the case at hand, ALT(**Bill'**) is the contextually determined set of alternatives of Bill. Polarity items can be seen as another linguistic means to construct alternatives. In this case, the alternative set is specified by the linguistic knowledge, and not by the contextual setting of the utterance.

4. Further Research

This concludes my remarks on polarity items. They are still quite preliminary, as I have covered only a few of the NPI contexts mentioned in section (1.2) -- negation, directives and questions. However, I hope that I have shown that there is a general explanation as to why these contexts support NPIs. Furthermore, work reported in Krifka 1990 shows that the theory developed here can be applied to explain the distribution of NPIs and PPIs in the protasis of conditionals.

Notes

I want to thank Christa Hauenschild, Zuzana Dobes and Dietmar Zaefferer for valuable informations and comments on this article.

1. For example, NPIs are not covered by the questionnaire (Comrie and Smith 1977) on which the *Lingua descriptive series*, now *Croom Helm descriptive grammars*, is based.

2. A more recent syntactic theory of polarity items is Progovac (1988)..

3. Throughout the paper, I identify characteristic functions with sets. That is, a function $\lambda x[\Phi[x]]$, where Φ is a proposition, is identified with $\{x \mid \Phi[x]\}$.

4. Heim's rule is formulated as follows: Suppose you have a conditional "if X then Y", where X contains the NPI-occurrence A. Let $X[^A/_B]$ be just like X, except with A replaced by B. Let c be the set of presupposed background assumptions. Then A is licensed in "if X then Y" if for any B of the appropriate type: $c \wedge [X[^A/_B] \rightarrow X] \wedge [\text{if } X \text{ then } Y] \rightarrow \text{if } X[^A/_B] \text{ then } Y$.

5. That is, L_A is a set of entities of the type of **A'**.

6. Note that $<L_A, \leq_A>$ is not necessarily a lattice in the usual sense, as we do not claim that $\leq_A$ is a partial order relation -- it may lack the property of antisymmetry.

7. In the text, we assumed only such semantic compositions in which we could identify at most one polarity item representation. However, we often find cases with more than one polarity item, for example in *Mary doesn't believe that anyone ever enjoyed a trip to Yemen.* I will not treat cases like that in detail here, but want to make clear that a general solution is possible in the framework of Rooth (1985). I have mentioned that polarity lattices can be considered as a special kind of Rooth's alternative sets. Now assume that every semantic representation has two parts, a plain semantic representation and a set of alternatives; in the case of semantic representations without alternative, the alternative set is a singleton containing only the plain semantic representation. Let us write $ALT(\alpha')$ for a set of alternatives of the plain semantic representation α' (of a type based on **t**), and let us call $<\alpha', ALT(\alpha')>$ a complex semantic representation. The complex semantic representation of an NPI **A'** with lattice $<\mathbf{A'}, L_A, \leq_A>$ then can be given as $<\mathbf{A'}, L_A>$. Now we can assume a semantic composition C* applying to complex semantic representations. C* can be defined on the basis of the semantic composition C as follows: $C^*(<\alpha', ALT(\alpha')>, <\beta', ALT(\beta')>) = <C(\alpha', \beta'), \lambda X \exists Y,Z[Y \in ALT(\alpha') \wedge Z \in ALT(\beta') \wedge X=C(Y,Z)]>$. The rule for the generation of derived polarity lattices is a consequence of this general rule, which allows for the composition of two polarity items in a natural way. The two polarity lattices must have the same polarity in order that the composition is a polarity lattice as well.

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