The Pragmatic Dimension of Indefinites

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ABSTRACT: This paper sets out to give a natural pragmatic explanation of several aspects of the interpretation of singular indefinite noun phrases. We develop a uniform account of characteristic features of their use which have been dealt with only partly in other semantic paradigms (in particular the dynamic, the E-type and the choice function one). We give an intuitive motivation for the familiar discourse dynamic features of the use of these expressions, and, taking due account of the structuring of information in more involved contexts, account for their behaviour in negated, conditional, quantified, and intensional constructions.

KEYWORDS: *semantics, pragmatics, anaphora, information structure, Skolem functions, scope islands*

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1 Introduction

It is generally agreed upon that pronouns and other definite terms may be coreferential with antecedent indefinite noun phrases. There is no general consensus, however, about how this is possible. If, as we have been taught by Frege, Russell and Montague, among many others, indefinite noun phrases behave like existentially quantified terms, then these phrases may be 'denoting' expressions, but they are not referential. So how can a pronoun then be coreferential? In the modern tradition this issue has first been discussed by Peter Geach in the early sixties.[2] Geach in a sense did away with the problem, assuming that, whereas an indefinite noun phrase indeed is like an existential quantifier, the associated quantifier is taken to bind the pronoun. According to [Geach 1968], in a sentence like:

(1) Socrates owned a dog, and it bit Socrates.

the conjunctive "and" is not the main operator, but the restrictive term "a dog" and the sentence, thus analyzed, states that there is some dog x such that Socrates owned x and x bit Socrates.

Geach's analysis has been criticized on two points, which are closely related but which have given rise to two different families of alternatives. Gareth Evans has forcefully argued against the idea that pronouns, like the one we find in example (1), are like bound variables. Rather, they are referential expressions and they should be assigned a reference of their own [Evans 1977]. Thus:

(2) John owns some sheep and Harry vaccinates them.

should not be taken to state that there are some sheep which John owns and Harry vaccinates, rather, it states that, first, Johns owns some sheep, and, second, that Harry vaccinates (all) the sheep that John owns. According to Evans, the pronouns in (2) and in quite a few other examples (which he called 'E-type pronouns') really are disguised definite descriptions, which must be interpreted by first reconstructing the description with the help of the context of use, and next interpreting the description in a more or less standard fashion. Evans's work, together with that of Cooper [Cooper 1979], has inspired a lot of work, notably in the early nineties, which tries to pin down what descriptions pronouns ought to be associated with, and how these in their turn ought to be interpreted.

Another research tradition has agreed with the E-type tradition that example (1) is a plain conjunction, but it rejects the idea that pronouns as in (1) are referential expressions. In various versions of discourse representation theory [Kamp and Reyle 1993], file change semantics [Heim 1982] and dynamic predicate logic [Groenendijk and Stokhof 1991], the pronoun in (1) is taken to be like a variable, as assumed by Geach, but it is not directly bound. Syntactically it is a free variable, which eventually is bound, semantically, using either an intermediary process of discourse representation construction or of dynamic interpretation. These dynamic and discourse representational systems build upon the observation by Lauri Karttunen that indefinite

[2] But see, e.g., [Egli 2000] for what has gone before.

noun phrases as in (1) in some sense introduce or set up discourse referents, which stand in for possible witnesses, and which can be subsequently picked up by pronouns [Karttunen 1968].

One family of approaches shares features with both the E-type and the dynamic analysis of sentences like (1), the choice function approaches. (Early references are [Ballmer 1978, p. 122ff and p. 307ff] and [Slater 1986]; see also papers from the Konstanz school [Egli and von Heusinger 1995, Peregrin and von Heusinger 2003] and [Meyer-Viol 1995].) The basic intuition of these approaches is that an indefinite term like "a dog" is associated with an ε-term, and that it denotes an individual chosen from the set of dogs. The pronoun "it" in (1) then can be taken to refer to the same dog. Example (1) is held true iff there is a choice function by means of which both conjuncts in (1) can be seen to be true, that is, a choice function Φ which selects an element from any non-empty set of individuals and such that $\Phi(\mathit{dog})$ is a dog d such that Socrates owns d and d bit Socrates.[3] Choice functions have also been used to deal with a local or in situ interpretation of indefinites, an issue which we will come back to in section 6.

In this paper I argue for a specific way of understanding the dynamic semantic notion of interpretation, which, like the E-type and choice function approaches, is more consistent with classical, referentially based theories of meaning. This understanding of a dynamic semantics is based on ideas exposed earlier in [Kamp 1990, van Rooy 1997, Stalnaker 1998, Zimmermann 1999], and worked out in [Dekker 2002a, more formally], [Dekker 2002b, more linguistically], [Dekker 2003, more philosophically]. With the E-type and choice function theorists, I agree that examples like (1) are ordinary conjunctions with a classical meaning. Like the choice function theorists, I assume that indefinite noun phrases and pronouns behave like terms, with an indefinite or variable interpretation which depends on the context of use. A pronoun's interpretation is functional on its occasions of use as it can be taken to refer to what is its referent on these occasions. It is assumed that also an indefinite noun phrase, like we find in the first conjunct of (1), is generally used with referential intentions. Thus, the pronoun which we find in the second conjunct can be taken to refer to whatever individual can be the intended referent associated with the indefinite noun phrase.

Without any need of shifting our notion of meaning, this can be accounted for by extending the semantic information expressed by the first conjunct of (1) with pragmatic information about what are the possibly intended referents associated with the uses of the indefinite. A dynamic semantics thus can be seen to be the result of a simple and systematic extension of a classical notion of meaning with quite general pragmatic features of the use of indefinites.[4]

I will proceed as follows. In the next section I will show in more detail how the

[3] See [von Heusinger 2003] for a dynamic implementation of the choice function strategy.

[4] It may be noticed that such a pragmatic understanding of the anaphoric relationship can also be cashed out in E-type terms. For the pronoun could also be interpreted as 'the individual which the previously used term was actually intended to refer to,' i.e., as the individual denoted by a referentially understood definite description. Notice that this definite description, besides being referential, is also highly indexical and intensional.

essential features of anaphoric relationships with indefinite noun phrases can be accounted for on the basis of this pragmatic understanding of the use of these terms. In section 3 I will sketch an equally pragmatic explanation of the 'fact' that indefinite noun phrases in certain configurations (for instance, in the scope of a negation) tend to lose their anaphoric potential, and I will briefly discuss the interpretation of donkey-conditionals. Then I will discuss two natural generalizations dealing, first, with the anaphoric potential of indefinites in 'derived' or dependent contexts (section 4) and, second, with wide and so-called 'intermediate' interpretations of indefinites on scope islands (section 5). Section 6 compares our approach to indefinites with the choice function approach and section 7 summarizes the results. The paper concludes with an appendix specifying some of the main technical machinery underlying the main claims made in this paper.

2 Surface Indefinites

This section gives a concise review of the understanding of indefinites and pronouns as it is worked out in [Dekker 2002a, Dekker 2003], and sketch the outlines of a formal pragmatic interpretation of them. (Technical details are provided in the appendix.) The main assumptions are the following:

- first, I want to stick to a classical (say, possible worlds) notion of meaning which can be specified as a satisfaction semantics
- second, conjunction amounts to intersection, basically, but when utterances are actually conjoined, we can incorporate the pragmatic fact that the first conjunct literally precedes the second
- third, I want to take to heart Stalnaker's observation that (surface) indefinite noun phrases can and generally are used with referential intentions
- fourth, I assume that anaphoric pronouns may pick up the individuals which are the intended referents of terms used earlier

I believe this to be a coherent set of ideas which can be used to motivate a formal toy system of interpretation *PLA* (Predicate Logic with Anaphora) which is a conservative extension of a classical system. The formal rendering of these assumptions may require some additional comments though.

The semantics of *PLA* is spelled out as a satisfaction relation $\models$ between, on the one hand, a model M, a variable assignment g, a world or possibility w and a sequence of individuals $\vec{e}$, and, on the other hand, a formula ϕ. The first three parameters are the usual ones, and the sequence of individuals parameter constitutes the extension over a classical system. These sequences provide the possible referents or witnesses of terms used in a formula, and they thus model what can be the targets of the referential intentions associated with these terms.

Satisfaction of conjoined utterances is defined, in the classical way, as the joint satisfaction of the conjoined conjuncts, but which accommodates the pragmatic fact

that terms in the first conjunct are used before those in the second, so that we can account for the fact that pronouns in the second may refer back to the witnesses of terms used in the first.[5]

That an indefinite can be used with referential intentions is formally modeled by specifying what is a possible witness of that term. Formally, an individual d is said to be a witness satisfying $\exists x\phi$ iff ϕ gets satisfied if we map x to d. This account of the use of indefinites may need some comments and qualifications. First, notice that I do not model what are *actually* intended referents on certain occasions of use, but what are possible intended referents on ideal occasions of use. However, second, when this extensional system gets lifted into a calculus defining the support speakers can be required to have for their utterances, indefinites have to be linked up with individuals or rather individual concepts they 'have in mind'. It would go too far here to fully explain what this 'having in mind' precisely means, but intuitively it means that the speaker must have some idea who it is about, even if it is as vague as for instance 'the individual whoever it is which somebody else must have intended to refer to when he told me this.' Thus, referential intentions do not need to allow the speaker to identify the referent in any contextually relevant sense, she is only required to have the idea that, eventually, it concerns some definite person, possibly via a causal intentional chain.

Third, the basic *PLA* system, which is basically a first order logic, does not actually model the referential intentions associated with full terms, but only that of the bare existential quantifier ("something"). However, later in the paper, and more specifically in the appendix, a more fine-grained interpretation is presented in which the contribution of indefinites is separated from what is said about their possible referents. Fourth, such a more fine-grained analysis will also allow us to clarify the pragmatic differences between the use of definite and indefinite noun phrases. Both types of terms are taken to be used with referential intentions. However, the first (and not the second) are of a presuppositional nature, and come with the assumption that the hearer should be able to identify the witness or referent; indefinites, on the other hand, typically do not allow the hearer to do so, and do not give him any further clue than that their reference should be the individual which the speaker should have been intended to refer to when he used the indefinite.

As for the fourth assumption, it proves very useful to formally distinguish anaphoric pronouns from bound variables, so they are introduced as a separate category in the language of *PLA*. Furthermore, in order to make them unambiguous they carry indices. So, apart from constants and variables, our language contains a set of pronouns $\mathtt{p}_1, \mathtt{p}_2, \ldots$ as terms, and basically such a pronoun $\mathtt{p}_i$ will be interpreted as the intended referent of a specific indefinite, viz., the i-th indefinite found when looking back in the discourse.[6]

[5] I assume that the phenomenon of kataphora is much more constrained than that of anaphora, and that it ought to be dealt with by separate means.

[6] Thus, $\mathtt{p}_1$ is coreferential with the indefinite used last, the most prominent one, so to speak; $\mathtt{p}_2$ with the one but last, etc.

Building on the stated assumptions, it is now fairly easy to show how indefinites and pronouns are dealt with in the basic system of *PLA*. Apart from the satisfaction of atomic formulas, which is straightforward, the two main clauses deal with the existential quantifier, modeling indefinites in a rudimentary way, and conjunction:

- $M, g, w, d\vec{e} \models \exists x\phi$ iff $M, g[x/d], w, \vec{e} \models \phi$
  $M, g, w, \vec{c}\vec{e} \models \phi \wedge \psi$ iff $M, g, w, \vec{e} \models \phi$ and $M, g, w, \vec{c}\vec{e} \models \psi$

A sequence $d\vec{e}$, with d its first element, satisfies $\exists x\phi$ relative to g iff the sequence $\vec{e}$ satisfies ϕ relative to the assignment $g[x/d]$ which assigns the witness d to x. A sequence $\vec{c}\vec{e}$ satisfies a conjunction $\phi \wedge \psi$ iff $\vec{c}$ are witnesses for indefinites in ψ, and $\vec{e}$ witnesses for pronouns in ψ, which have been introduced earlier, in ϕ, or even earlier.

It is easily established that the following two formulas turn out equivalent:

(3) $\exists x(D(x) \wedge O(s, x)) \wedge B(\mathrm{p}_1, s)$

(4) $\exists x(D(x) \wedge O(s, x) \wedge B(x, s))$

Actually, we can take the first formula to be the natural first order rendering of our example (1) above, and from the equivalence with the second we can see it gets interpreted correctly. An individual satisfies formula (3) if it is a dog which Socrates owns, and if it, that same dog, bit Socrates. Example (4) has the same satisfaction conditions.

Example (2) can be dealt with in basically the same way, if we make sure that a witness for the plural noun phrase is not an individual sheep, but the set of sheep John owns. (Similar witness set constructions can and have to be made for structures with generalized quantifiers.) It should be pointed out, however, that plural indefinites can also be used with specific referential intentions, cf., e.g., [Kamp and Reyle 1993]. We will not go into the interpretation of plural noun phrases here though.

Before we inspect more fancy constructions in the subsequent sections it is useful to agree upon some further terminology. Conforming to quite general practice, I will refer to satisfying individuals as 'witnesses', to satisfying sequences of individuals as 'cases', and to sets of pairs consisting of a world and a case as 'information states'. Actually, such states can be taken to present the combined semantic and pragmatic 'content' of our formulas. Relative to a model and a variable assignment the content of a formula is simply the set of world-sequence pairs which satisfy that formula.[7]

The contents of two formulas can be merged in a sophisticated fashion whereby anaphoric pronouns may get resolved by a previous indefinite noun phrase. I will not go into the details of that here (but cf., e.g., [Dekker 2002a]), but a similar notion of merging can be used to define two other pragmatically crucial notions: the 'update' which a hearer may get from accepting an utterance, and the 'support' which a speaker can be required to have for it. We can think of the information states of a hearer and a speaker also as sets of world-sequence pairs. For a hearer such a state may serve

[7] For those interested, these contents can really be conceived of as the interpretations of Hans Kamp's discourse representation structures, or simply as Irene Heim's satisfaction sets. The difference is that these contents are taken to be independently specified here, and that they are not obtained by 'updating' a previously given information state.

to embody the information about 'discourse referents' which he has obtained from previous discourse. For a speaker such a state is required to embody the information about discourse referents which she herself introduces, and which she is supposed to associate with some defining characterization. A more detailed exposition of these notions can also be found in the appendix.

The ensuing notions of update and support have some nice formal features. As is shown in detail in [Dekker 2002a], satisfaction, content, update and support are interdefinable, so this gives us the pleasant theoretical freedom to take any one of these notions as basic. Moreover, properly resolved and supported updates never generate information which the involved agents together did not already have before the update. This is a highly desirable soundness result, which means, basically, that information does not get corrupted in an exchange. If speaker and hearer have true information, and they exchange some of it, their information is still true.[8]

There is one final point about the support relation which will become relevant later in the paper. For a speaker's state to support a formula it must be true in all the possible worlds in that state, in all possibilities which the speaker has not excluded as not being actual. But there is more. Like I said, discourse referents introduced by a speaker must themselves be associated with specific 'subjects' of her state, representatives of individuals which she believes to be uniquely specifiable. To model this I use a linking relation, which associates discourse referents with the speaker's subjects. In this way we can require a speaker to have support for an assertion in the sense that the things she attributes to discourse referents are really properties of the associated subjects of her information state.[9]

3 Background Indefinites

So far I only discussed what I called 'surface' indefinites, indefinite noun phrases which do not occur in the scope of other operators, like a negation, an implication, or, if we extend the language, quantifiers and mood indicators other than the indicative. It seems to belong to the received wisdom, however, that non-surface indefinites have a limited anaphoric potential, or even none. Consider:

(5) Onno doesn't run a sushibar.

(6) Is there a doctor in the audience?

(7) Give me a screwdriver, please.

In the first example (adapted from [Kamp and Reyle 1993]) the indefinite noun phrase "a sushibar" is in the scope of a negation, and somehow it does not seem to license any anaphoric pick up. That is, if one were to continue with "It's in Soho." our responder would most probably ask something like: "What? What's in Soho? What are you

[8] Notice that this type of soundness cannot be preserved when we start using a more expressive language. Asserting "You do not know it, but Carl will cook tonight." is self-corrupting in precisely this sense.

[9] So, again, a speaker is required to have *some* concept of the individual referred, even though this does not need to mean that she can identify it in any contextually relevant sense.

talking about?" From my point of view this means that in a regular utterance of (5), or upon a regular understanding of it, no referential intentions are associated with the indefinite noun phrase. Similarly, asking (6) does not seem to make much sense if one has a particular doctor in mind and if one wants to know whether he is in the audience. (Think how odd it would be if somebody stood up and responded: "Do you mean me? You want to know if I am in the audience?") Furthermore, as a request for a very particular screwdriver uttering (7) would be quite beside the point. One can not, indeed, comply with a request if it is not (fully) specified.

So it seems, quite generally, that certain non-surface indefinites come without referential intentions, and in the case of (6) and (7) indeed some partial pragmatic explanation can be given for this fact. For a question about or a request for a particular thing to make sense the thing itself must be specified. Still, the question remains, if indefinite noun phrases are generally associated with referential intentions then why should these at all vanish in certain constructions? And do they, really? Let us consider some more examples:

(8) If Merl throws a party tonight, I'll be there!

(9) Many boy scouts who keep a pet develop into animal liberators later.

(10) If a client comes in, I'll give her a folder.

There is clearly something odd about continuing (8) with "It starts at 21.00." What could be supposed to start at 21.00? Not Merl's party, since (8) at least implicates that maybe there is not going to be such a thing. But a speaker may have something special in mind with asserting such a sentence. For it is really natural to continue (8) with "It will be fun!" If we then ask what is going to be fun, the straightforward answer, of course, is "The party, if any, which Merl is going to give." It is a hypothetical entity, but it is very clearly circumscribed.

Example (9) pretty much resists an interpretation which relates to a particular pet. Singular pets are generally not kept by any great number of boy scouts. Intuitively, such a sentence may serve to assert something about boy scouts, about pet-owning boy scouts, or about the relation between boy scouts and pets owned. The last construal is interesting, since it licenses a continuation with for instance "They then feel sorry about the way they treated it." The pronoun "it" then refers, not necessarily to a particular pet, but, for each boy scout, to the pet he is related to, i.e., the one he kept.

Examples like (10) are of the notorious 'donkey sentence' kind. In such a conditional assertion the indefinite "a client" in the antecedent clause is picked up by a pronoun in the consequent clause. But is this, therefore, about a particular client? Obviously not, since it would be quite odd again to try and pick up the indefinite later with: "She is from Oklahoma." Nevertheless, the sentence can again be read as being about clients in general. "What do you do when a client comes in?" "I'll give her a folder."

The above observations, which are not at all new, suggest the following generalization. Whereas non-surface indefinites can (if needed) relate to specific individuals (some more examples which have popped up in the literature are discussed in section 4), also

when they do not relate to specific individuals, they can relate to classes of individuals, which the assertions can be conceived of as being about. That is to say, these assertions can be assigned a so-called information structure, part of which is a ground, which in a sense can be assumed to be given, and another part which can be called its focus. Indefinites in the ground are not associated with referential intentions then, because they are not part of the speaker's own contribution (which is laid down in the focus part) but part of the assumed given ground.

Consider again a statement made by means of (5). Typically, but not inflexibly, a negation "Not S" may serve to answer the issue—raised explicitly or implicitly—whether "S" is true or not. An utterance of (5) may serve to state—possibly in answer to the question whether Onno runs a sushibar—that he doesn't, that is, that there is no such bar which Onno runs.[10] A speaker need, in other words, not have a particular sushibar in mind when uttering (5), because the existence of such a sushibar is not part of what she claims to have evidence for. Rather, the existence of such a bar is part of the issue which the speaker addresses—negatively, with (5)—, or even part of what the hearer might have claimed just before. So actually, when somebody utters (5), she is normally not coming up with a sushibar herself, but she is claiming to have evidence against the existence of such a bar, were anybody else thinking of the possibility of there being one. And although the indefinite is clearly part of the string of words which the speaker utters, it is not part of what she asserts, or of what she can be required to (be able to) support.

But indeed an utterance of example (5) may have other interpretations than the mere negation of a proposition, much dependent on the way it is uttered, and the context in which it is used. Like I said, on a most regular interpretation such an assertion is about Onno (being presupposed) and it rejects the existence of a sushibar he runs. A truth-conditionally equivalent, but pragmatically different, construal takes the assertion to be about sushibars in general, and to reject that Onno owns one. Such an analysis seems to be appropriate if an utterance of (5) is followed by the subsequent assertion of "They are all run by non-residents." Truth-conditionally different is a construal which takes the assertion of (5) to be about a specific sushibar after all. An interpretation like this seems to be appropriate if the sushibar is picked up again, as in the following extension of (5):

(5) Onno doesn't run a sushibar.

(11) He only does its financial administration.

Finally, an odd, but certainly not impossible construal has it that there is no Onno owning a sushibar, one that allows for the possibility that Onno does not even exist.

As is shown in some detail in the appendix, this variety of readings is elegantly accounted for in a multi-dimensional interpretation architecture. The nice thing about such a multi-dimensional set up is that the variety of interpretations is obtained without postulating a semantic ambiguity in the negative element. The different readings

[10] Alternative interpretations are easily made available, of course, by emphasizing, e.g., "Onno", or "run". I here assume the utterance to carry what may be called a neutral intonation.

emerge from the different pragmatic ways in which that element can be taken to act upon the information structure of the embedded clause. (See the appendix for more details.)

A flexible, multi-dimensional architecture is also very well equipped to deal with the previously mentioned donkey sentences in a principled way. Consider the following examples:

(12) If a farmer leases a donkey he beats it.

(13) A farmer beats a donkey only if he leases it.

(14) Only if a farmer leases a donkey does he beat it.

(15) A farmer beats a donkey if he leases it.

Example (12) is modeled after Geach's donkey sentences. It has constituted a major problem for standard theories of interpretation, because, in order for the indefinites in the antecedent of this conditional to 'bind' the pronouns, the indefinites need to gain wide scope. However, they will not, thus, gain the universal force which the indefinites in (12) arguably have. E-type pronoun theories, discourse representation theory and systems of dynamic semantics have given a neat and well-known account of this example, and most probably this account extends to example (13). However, these accounts terribly fail in the face of seemingly similar examples like (14) and (15). The reason is that the *only if*-clause in (14) is semantically (conditionally) dependent on the main clause, whereas the pronouns in the main clause are structurally (anaphorically) dependent on the *only if*-clause, and on the mentioned accounts this creates a paradox of interpretation. The same goes for example (15). (See, e.g., [von Fintel 1994, Dekker 2001b] for more discussion.)

Much of the mystery around (12–15) is cleared, however, if we acknowledge that indefinites may serve what can be labeled a 'topical' role. Their possible generic interpretation has first been discussed in, e.g., [Schubert and Pelletier 1989], and more recently a 'presuppositional' or 'non-novel' use of them has been discussed in [Gawron 1996, Aloni et al. 1999, Krifka 2001]. We can account for this if indefinites are assigned a special *use* (not: *meaning*) in such conditional (and quantified) contexts. For, intuitively, the examples (12–15) are about farmers and donkeys and each of them can be used to state a conditional dependency between a leasing and a beating relation between them. More precisely, the indefinites "a farmer" and "a donkey" may contribute to establish a domain of quantification consisting of pairs of farmers x and donkeys y, and on that domain of pairs example (12) can be used to state that if any such x leases any such y, then x beats y, example (13) that any such x beats any such y only if x leases y, example (14) that only if any such x leases any such y does x beat y, and example (15) that any such x beats any such y if x leases y.

I hope that this suffices to make clear how I think these sentences should be understood. Formally, such an interpretation can be obtained if we assume a partition of the contents of assertions into a ground and a focal part, a distinction familiar from many different types of theories of information structure, like that of, e.g.,

[Jackendoff 1972, van der Sandt 1989, von Stechow 1991, Vallduví 1992]. As can be seen in more detail in the appendix, the contents of all expression can be distributed over various dimensions of interpretation and indefinites can be taken to contribute to a dimension of their own. Possible witnesses then can be used to 'communicate' between the various dimensions. We thus can say that, for instance, a pair of individuals bd *satisfies the ground* of "a farmer leases a donkey" iff b is a farmer and d a donkey, and that such a pair *satisfies its focus* iff b leases d. The examples (12–15) then are adequately dealt with if they are taken to quantify (universally, or generically) over the (tuples of) individuals which satisfy the ground of the embedded clauses, and assert that all of them satisfy the asserted conditional dependency.

Let us take stock at this point. Typically—that is, if context or intonation do not imply otherwise—one can say that e.g., the contents of negated sentences, of questions and commands, but also the antecedents of conditional sentences, and the restrictions on quantifiers, all constitute or relate to a background or topic. Topics are assumed to be given in some sense and they do not belong or contribute to the conversational commitments which a participant takes upon herself when making a certain statement. A speaker then can be taken to have support for what the focal part of her utterance contributes to the ground, but not to the ground itself. Hence, she is not required to have any referential commitments associated with indefinites used in the ground, and indeed these indefinites may be topical (or 'non-novel') themselves.[11]

4 Dependent Indefinites

So far I have given an idea of how surface indefinites get associated with referential intentions and why some non-surface indefinite noun phrases do not. But of course this is still only part of the story. I already mentioned indefinites which figure in the focal part of an assertion. If a speaker can be held conversationally responsible for what the focal part of her utterance contributes to a ground, then we would indeed expect indefinites there to be associated with referential intentions again. Interestingly, this seems to be precisely what we find in a couple of examples familiar from the literature. And although these examples are arguably somewhat marginal, something which eventually has to be explained, I think they provide strong support for the pragmatic kind of analysis I am pursuing in this paper. Before I turn to the relevant examples it is useful to inspect the notion of implication which naturally suggests itself in the system of *PLA*.

If an implication $\phi \rightarrow \psi$ is defined, in a fairly usual way, as $\neg(\phi \wedge \neg\psi)$, it turns out that support for stating such an implication boils down to having support for ψ after one has updated one's information with ϕ. One could reformulate this as follows. I have epistemic support for *If A then B* if, and only if, if you were to tell me that *A*, or if I find out otherwise that *A*, then I have sufficient evidence for *B*. This sounds pretty fair, and close to the interpretation of conditional sentences in systems of game theoretical

[11] See also the contribution [Farkas 2003] to this volume, for the various uses of indefinites.

semantics. But notice that an utterance of *If A then B*, thus, does not commit a speaker to having support for *B*, but only for *B* in functional dependence upon (learning that) *A*. So if there are referential intentions to be associated with indefinites in *B*, we can assume them to be functionally dependent upon whatever is contributed by the ground in *A*.

Conditional statements thus can be interpreted as supported comments upon the types of situation provided by their antecedent clauses, which they are dependent upon. Likewise, many quantified constructions (in particular upward monotonic ones) can be interpreted as qualified comments on a domain set up (or presupposed) by the clauses restricting the main determiner. And then it can be expected, again, that a speaker has qualified (i.e., functional) support for terms used in the determiners' nuclear scope. Actually, such functional readings of noun phrases (*Wh*-phrases, definite and indefinite noun phrases) are familiar from the literature from the eighties and the nineties. (See [Jacobson 1999] for a recent overview, or [Alexopoulou and Heycock 2003].) Typical examples include:

(16) Whom does every Englishman admire? His mother.

(17) Every Englishman loves, but no man wants to marry his mother.

The question in (16) is about, and relative to, a domain consisting of Englishmen. Although it is most likely to be interpreted as asking for the individual x which is such that every Englishman likes x, the question also allows for a functional reading: what is a or the function f such that every Englishman e likes $f(e)$? As appears from the continuation in (16), a felicitous answer can be the mother-function, assigning to every Englishman e e's mother. Similarly, a functional interpretation of the definite noun phrase in (17) seems to be most appropriate.

Also indefinites and pronouns may license a functional interpretation in these configurations:

(18) Every Englishman loves some woman, but no one wants to marry her.

The indefinite in this example may relate to a particular woman which every Englishman loves, but which no one wants to marry. However, it can also be interpreted functionally, in case it yields a reading like that of (17). The difference is, of course, that an utterance of (18) does not specify which woman or woman-function it is about, and a speaker might continue the example with "But I forgot whether it is his mother, his grandmother, or his oldest sister."

The following examples display an essentially similar pattern:

(19) If a book is printed with Kluwer it has an index.
It can always be found at the end. (after Heim)

(20) Harvey courts a girl at every convention.
She always comes to the banquet with him. (Karttunen)

(21) Most men had a gun, but only a few used it. (Sandu)

(22) Mary believes there is a burglar in the house.
She thinks he came in through the chimney. (Landman)

In Heim's example we find an indefinite noun phrase "an index" in the consequent clause of a conditional sentence. If it is associated with referential intentions, the speaker can be assumed to have a specific index in mind (like 'the index of a book printed with Kluwer') which, however, is not one particular index, but functional upon Kluwer books. Assuming the speaker to have such a function in mind, we can also assume that it is that function which is picked up by the pronoun. That is, the second sentence of Heim's example can be taken to state that always (that is, in every Kluwer book) the index of that book can be found at the end of the book.

Karttunen's 'girl' can be thought of as a function associating every convention which Harvey visits with a girl he courts there. Sandu's 'gun' is appropriately associated with a function from gun owning men to their guns and Landman's burglar with a function from the alternatives which Mary believes to be possible to burglars which are there in the house.[12]

The above observations are precisely those expected on an analysis of indefinites like the one defended here. Focal indefinites are associated with referential intentions, and since they are functionally dependent on some ground, so are the entities which the speaker can be said or required to have in mind. That is to say, my notion of support and the way in which it is supposed to function, naturally suggests an analysis of these examples. Basically, they can be dealt with by generalizing our notion of a case, which are not only sequences of satisfying individuals, but also of witness functions from world and cases to individuals.[13] Satisfaction and support for the various operators (conditional, quantified, epistemic) then makes the witnesses for their embedded clauses parametric upon the indices they quantify over. (Basically, this is nothing but a suitable generalization of Geach's so-called rule of 'division'.) The net effect is that they generate Skolem equivalences of the following form, and they do this in an entirely compositional manner:

(23) $\exists x\phi(x) \rightarrow \exists y\psi(y) \Leftrightarrow \exists f(\exists x\phi(x) \rightarrow \psi(f(\mathrm{p}_1)))$

(24) $\forall x\exists y\phi(x,y) \Leftrightarrow \exists f\forall x\phi(x,f(x))$

(25) $B_x\exists y\phi(y) \Leftrightarrow \exists z B_x\phi(^\vee z)$

Satisfaction of an implication of the form $\exists x\phi(x) \rightarrow \exists y\psi(y)$ requires a witness function f, which applies to the type of entities which the antecedent requires to be ϕ, and which can be picked up by the pronoun p_1. By the set up of the system of interpretation the implication can be followed by another one in which an anaphoric pronoun picks up this function. Notice that for this to work, the second pronoun must be functionally dependent upon the same type of things which the original indefinite is functionally dependent upon. Thus, in order to effectively deal with Heim's example, it must be made sure that the adverbial quantifier "always" relates to books printed

[12] Notice that, while Sandu's first conjunct can be understood to be about 'the men', it contributes and focuses in on a set of men m who own a gun $f(m)$. It is this latter set which the second conjunct quantifies over.

[13] Actually, this requires a recursive definition of (i) a class of type t of sets of satisfying cases of type c, (ii) a class of type c of sequences of witnesses of type w, and (iii) a class of type w of individuals of type e, individual concepts of type $\langle s, w\rangle$, and Skolem functions of type $\langle c, w\rangle$.

with Kluwer.

Something similar holds of the seemingly regular Skolem equivalence (24). The difference with an ordinary Skolem equivalence is that the use of f is associated with referential intentions, so that it is available for anaphoric take up. This gives us a handle on Karttunen's example, if, again, the quantifier "always" is made to range over the right types of things. In the equivalence (25) I have suggestively used Montague's extension operator $^\vee$ (which is not actually part of my own formal language).

On the basis of the above equivalences we can account for the examples (19–22). For instance, an appropriate interpretation of (22) satisfies the following sequence of equations:

(26) $B_x\exists y\phi(y) \wedge B_x\psi(\mathtt{p}_1) \Leftrightarrow \exists z B_x\phi(^\vee z) \wedge B_x\psi(\mathtt{p}_1) \Leftrightarrow$
$\exists z(B_x\phi(^\vee z) \wedge B_x\psi(^\vee z)) \Leftrightarrow \exists z B_x(\phi(^\vee z) \wedge \psi(^\vee z)) \Leftrightarrow B_x\exists y(\phi(y) \wedge \psi(y))$

The first and the last equivalence in this sequence corresponds to the Skolem one in (25). The second serves to display the effect of anaphoric take up. The third is part of the logic of belief. The other examples can be dealt with analogously. (See the appendix for some more details.)

The preceding discussion may also serve to answer the question which I raised earlier in this section. Although the general idea behind the support of indefinites indeed serves to predict the type of functional dependencies discussed here, such dependencies are hardly felt to be there in the great majority of conditionals and quantified statements. Why should that be? Part of the answer is this. For a functional indefinite to be picked up by a subsequent pronoun, it is absolutely necessary that the pronoun is evaluated relative to precisely the same ground as the indefinite is. For, in short, functions require arguments, and these must be of the right type. In a lot of discourse and dialogue, however, contexts seem to change so quickly and subtly that in many cases anaphoric pick up of dependent indefinites is impossible, and functional readings are therefore invisible. Besides, of course, individual concepts and Skolem functions do not really belong to the most familiar things which linguistics agents deal with, so this will certainly be a further reason why the functional interpretation of indefinite noun phrases and pronouns does not belong to our most basic linguistic skills.

5 'Intermediate' Indefinites

We have seen, on the one hand, that surface indefinites are generally used with referential intentions, which can be functional if they figure in the scope of quantified constructions, and that they may acquire a topical nature when they figure in a ground. However, indefinites can also be used with referential intentions when they are not in, say, focal position. In this section we discuss two types of examples which have puzzled logicians and linguists alike, which have given rise to non-standard systems of interpretation, but which naturally fit in the pragmatic outlook on indefinites argued for in this paper.

The first type of example is due to Charles Sanders Peirce [Peirce 1906], and is

discussed in detail in [Dekker 2001a]:

(27) There is some married woman who will commit suicide in case her husband fails in business.

Peirce notes that on what we understand as a relatively straightforward predicate logical analysis the sentence would be equivalent with:

(28) Some married woman will commit suicide if all married men fail in business.[14]

Most people judge that an utterance of (27) conveys something stronger and more specific than an utterance of (28), however. Peirce puts the blame for this "absurd result" on "admitting no reality but existence," and his diagnosis consists in taking *possible* courses of event into account. What is really meant by an assertion of (27), Peirce claims, is that "[t]here is some *one* married woman who under all possible conditions would commit suicide or else her husband would not have failed."

Interestingly, our pragmatic outlook upon the use of indefinite noun phrases gives us precisely this. For someone's information state to support an utterance of (27), and not for an utterance of (28), the speaker must have an individual in mind which, in all possibilities which the speaker conceives possible, commits suicide if her husband fails. Various pragmatic principles contribute to making such an utterance non-trivial only if the speaker indeed has a conception of a person about which she believes such a dependency to be true.

The point about Peirce's example in the present context is this. If the indefinite gives only existentially quantified information then indeed, as Peirce observes, example (27) is in danger of conveying nothing more than example (28). However, since it is assumed that such indefinites should be supported by subjects in the speaker's information state, and because what is predicated of them must be non-trivial in a fully Gricean sense, an utterance of (27) gets its special bite. About the person which the speaker has in mind the speaker may, normally, not have pertinent information that that person's husband actually is, or is not, going to fail in business, or that that person will, or will not, commit suicide anyway.

As implicated by Peirce himself, and as Read has made explicit, a basically similar analysis of (27) and (28) can be obtained by reading $\leftarrow$ as a strict (not material) implication. Upon such an analysis the overtones of (27) would be properly semantic, in stead of systematically pragmatic, as they are on our account. It is hard to decide between the two analyses, because the results are the same and each of them comes with its own independent motivation. Notice, however, that, first, our pragmatic analysis is consistent with a strict reading of conditional sentences, so it is not in conflict with any motivation for that. Second, our analysis directly carries over to non-conditional

[14] A more minimal pair of examples is (28–29), due to [Read 1992] (also discussed in [Gillon 1996]):

(28) Someone wins \$1,000 if he takes part. ($\exists x(Wx \leftarrow Px)$)

(29) Someone wins \$1,000 if everyone takes part. ($\exists x Wx \leftarrow \forall x Px$)

Reading $\leftarrow$ as a material implication the two are equivalent. For instance, if (29) is true, and everyone takes part, then (28) is made true by taking the entailed winner as a witness for the existential quantifier; if (29) is true and not everyone takes part, then (28) is made by true by taking any person who does not take part as a witness. Reasoning from the truth of (28) to that of (29) proceeds analogously.

variants of Peirce's examples, which a strict conditional analysis does not. As Gillon observed, the examples (28–29) can be given a disjunctive formulation, as in:

(30) Someone wins $1,000 or he does not take part.

(31) Someone wins $1,000 or someone does not take part.

Indeed, one could explain the overtones of (30) by assuming an intensional analysis of the disjunction; however, no such move need be made if they are attributed to the very same pragmatic principles I have argued for above.[15]

Another intriguing type of examples are those with indefinites on so-called 'scope islands'. 'Scope islands' are, for instance, phrases restricting the scope of quantifiers, antecedents of conditional sentences and other subordinate clauses. It is one of the rather persistent observations from the formal linguistic canon that quantified noun phrases do not 'escape' from there, that is, that they are unable to outscope quantified, conditional, or superordinate constructions. Indefinite noun phrases, however, seem to do what the canon forbids quantified noun phrases to do. Constructions in which an indefinite noun phrases figures on a scope island can often be paraphrased, appropriately, with a formulation in which the indefinite does have wide scope. I will not go through all the motivating data, which go back to the seventies of the last century, but simply refer to the more recent literature on the subject found in, e.g., [Abusch 1994, Reinhart 1997, Winter 1997, Kratzer 1998], see also some other contributions to this volume.

The 'aberrant' behaviour of indefinite noun phrases on scope islands has been first explained in [Fodor and Sag 1982], where it is argued that indefinites can have a quantified and a referential interpretation, and under the last they can obtain 'wide scope' without being outscoping. Indeed, such an interpretation neatly fits in with the one argued for here, but for the fact that I do not want to deem indefinites ambiguous, but simply attribute the referential interpretation to the pragmatic fact that the indefinite is used with referential intentions. This pragmatic account is advantageous, as it also undercuts one of the main arguments against the Fodor and Sag analysis: the existence of so-called 'intermediate' readings.

Indefinites on scope islands have an intermediate interpretation when their contri-

[15] A quite related example is known as the 'Beers Puzzle', as has been pointed out to me by Paul Egré, and the solution is the same as that of 'Peirce's Puzzle'. Also the following formulas are equivalent in first order logic:

- $(\forall x \phi(x) \rightarrow \forall x \psi(x))$
  $\exists x(\phi(x) \rightarrow \forall x \psi(x))$
  $(\neg \forall x \phi(x) \vee \forall x \psi(x))$
  $\exists x(\neg \phi(x) \vee \forall x \psi(x))$

Now consider:

(32) If everybody has a beer, then everybody has a beer.

(33) There is someone such that if he has a beer, everybody has.

(34) Either not everybody has a beer, or everybody has a beer.

(35) There is someone such that either he doesn't have a beer, or everybody has.

The examples (32) and (34) are clearly tautologous, and so are (33) and (35), truth-conditionally speaking. However, asserting the latter two implicates something non-trivial, viz., that there is someone such that his or her decision to take a beer will influence that of all others. A proper support for such utterances indeed requires the speaker to know of some such person, hence the examples are not equivalent, pragmatically speaking.

bution is not global (i.e., directly referential), but also not purely local (restricted to the scope island itself). A very clear example is from [Abusch 1994], which seems to favour what is classified as such an intermediate reading:

(36) Every one of them moved to Stuttgart because a woman lived there.

The most natural interpretation of this example is that for every person referred to, there was a woman who lived in Stuttgart, and who made up the reason for that person to move to Stuttgart. Notice that the motivating women thus escape from the *because*-scope island, without thereby entailing it was one particular person who motivated the move of all of them. Each of them may have had his own woman motivating his move to Stuttgart. The indefinite, thus, is not purely referential, it is argued, but if the only other options is that it is, therefore, quantificational, and at the same time takes scope over the *because*-clause, it would violate the scope island constraint.

Like I said, the facts about the interpretation of indefinites on scope islands perfectly fit the picture sketched in this paper. Basically, example (36) can be interpreted in three ways, depending on how we understand the *use* (not *meaning*) of the indefinite, and these three interpretations are naturally predicted. First, of course, the indefinite can be used without any referential intentions, and then we obtain the reading that every one moved to Stuttgart because Stuttgart was not 100% male.[16] But it may as well be a pragmatic fact that the indefinite *is* used with referential intentions. The speaker may have had, for instance, Dorit Abusch herself in mind, and can be taken to claim that the reason for everybody to move was the fact that Dorit lived there.[17] Finally, as we have seen in the previous section, referential intentions associated with indefinites in quantified constructions can be functional as well, so that the speaker can be taken to claim that the reason for each of them to move was the fact that his or her fiancé(e) lived there.[18]

In our multi-dimensional framework the three interpretations of example (36) are naturally obtained, arguably without violating scope island constraints. The semantic denotation of the indefinite is its possible witness (or, better, the function from possible witnesses to the propositions expressed about them) and upon each of the three readings this witness or witness-function plays its properly semantic or assertoric role on the scope island. It generates an individual which is a woman. This woman, however, can be either arbitrary, or specific, or functionally related to the group referred to by "them," depending on the way in which the (non-assertoric) contribution of the indefinite is pragmatically understood. The uniform semantics of the *because*-operator, and the meaning of "every one of them", can flexibly interact with this pragmatic contribution, and neglect or absorb it. But this process of composition is arguably pragmatic as well, and the *pragmatic* fact that the indefinite is used with referential (possibly func-

[16] Quite an unlikely reading: many more cities are not 100% male.

[17] Not a good reason, by the way, because Dorit has moved herself.

[18] Let me emphasize again that these referential or functional uses of the indefinite do not require the speaker to be able to specify or identify the intended individuals or functions in a contextually relevant sense. She may simply have heard that there is such a specific individual or function, and not be able to say anything more about it than that "it is the individual or function which So and So must have intended when he told me this."

tional) intentions does not conflict with the scope island constraint, which is structural (*syntactic and/or semantic*). (See, again, the appendix, for some of the formal details.)

6 The Use of Choice Functions

In the introduction I have mentioned a family of approaches to indefinites which employ choice functions and which are close in spirit to the one advocated here. In this section I will discuss some of the data which have given rise to such choice function interpretations and I will argue that a pragmatic approach like the one presented in this paper is actually more economical, although my findings are, I believe, quite consistent with the pragmatic choice function approach advocated in [Kratzer 1998]. Most of my observations are not really new, though, and they are close to those of [Schlenker 1998, Kamp and Bende-Farkas 2001]. See also [Winter 2003].

The interpretation of scope island indefinites has provided strong support for a choice function analysis (cf., e.g., [Abusch 1994,Reinhard 1997, Winter 1997, Kratzer 1998, Matthewson 1999]). The general idea is that indefinite noun phrases on scope islands deliver their semantic contribution locally, and, thus, do not violate island constraints. The semantic contribution of an indefinite "Some A" is an individual, which is the value of a choice function f which is applied to the set denoted by "A". Upon most approaches this choice function is existentially quantified, but the locus of quantification is generally assumed to be free.[19] Thus, for instance, example (36) can be associated with three interpretations:

- ($\exists f$) Every one of them ($\exists f$) moved to Stuttgart because ($\exists f$) f(woman) lived there.

where the first, second, and third locus of quantification generate the global, intermediate and local reading of the example, respectively. Choice functions thus generate the required number of readings arguably without violating island constraints.

This basic analysis, however, is or has to be amended in three ways, each one of which makes it more into an analysis of the kind advocated here. In the first place choice functions may have to be skolemized themselves [Winter 2003]. I will not discuss this point in detail here, as it has been extensively discussed elsewhere (cf., e.g., [Schlenker 1998, Kamp and Bende-Farkas 2001]). The point is that once one adopts the possibility of skolemization, the effects of intermediate existential closure can be captured by means of global closure, as we have seen in the previous section.[20]

[19] With the exception of Kratzer's approach. For [Kratzer 1998] the choice function is the denotation of a free variable, the interpretation of which is pragmatically determined.

[20] However, as has been pointed out by [Schwarz 2001], this does not hold for all configurations. An example is the negation (37) of the intermediate reading of (38):

(37) Not every student read every book some teacher had praised.

(38) Every student read every book some teacher had praised.

Indeed, global existential quantification over the choice function variable in example (37) will not negate the reading obtained by global existential quantification over the choice function variable in example (38). However, as Schwarz himself observes, these readings are, of course, highly context dependent. As a matter of fact the pair of examples provides a good case for a pragmatic analysis like that of Kratzer,

Two other amendations can be advanced by means of an example which has originally been used to motivate a choice function approach in the first place.

The following example from Irene Heim has been seen to raise what Tanya Reinhart labeled the 'Donald Duck' problem:

(39) If we invite some philosopher, Max will be offended.

An utterance of this example may be used to convey that the speaker does not really know (in a contextually relevant sense) which specific philosopher it is whose possible invitation would offend Max. By uttering (39) the speaker may wish to convey that she wants to know who this possibly disputable philosopher is. By the same token, the utterance does not need to convey that if we invite any philosopher, Max will be offended. Max may go along well with a lot of philosophers. Upon a first analysis one might think that the informational contribution of the indefinite is indeed local, but that it is somehow 'existentially quantified from the outside': that there is some individual x, and that if x is some philosopher which we invite, then Max will be offended. This is where Donald Duck hits in. For, to make such a statement true, it suffices to choose Donald Duck as a witness for x. Since Donald Duck is supposed not to be a philosopher, a disputable assumption by the way, the statement would be trivially true. As a matter of fact, upon this analysis (39) would become equivalent with:

(40) If we invite everybody, Max will be offended.

(Assuming there to be at least one philosopher.) Clearly, (40) is not an appropriate paraphrase of (39).

The use of choice functions partly solves this problem. The idea is that (39) conveys that there is some choice function, and that if we invite the philosopher whom that choice function assigns to the set of philosophers, then Max will be offended. Indeed, Donald Duck would not be a proper witness any longer, since a choice function cannot pick him out of the set of philosophers.[21] Even so, an essentially similar problem remains. For let us now take Jacques Derrida: Derrida is a philosopher, but we are simply not going to invite him. Derrida thus is a good choice from the set of philosophers which will make an assertion of (39) trivially true. The triviality problem is only partly dealt with for if we analyze (39) this way it is rendered equivalent with:

(41) If we invite all philosophers, Max will be offended.

(Again assuming there to be at least one philosopher.) Obviously, this is still not an appropriate paraphrase, and the discussion of Peirce's example above may indicate what fails.

In order for an utterance of (39) to be felicitous, the speaker must have a philosopher in mind for which the conditional sentence is significant and not trivial. True, someone who sincerely asserts it may not know in some quite relevant sense which philosopher

and the one advocated here. If the pragmatically determined interpretation of the free choice function variable in both examples is the same, or if (in our terms) the indefinite in both examples is used with the same (functionally dependent) referential intention, then the specific uses of (37) and (38) contradict each other, of course, and we obtain the readings argued for.

[21] Upon the previously mentioned, questionable, assumption.

it is about but it seems it has to be about some definite philosopher. Someone the speaker has heard about from somebody else, or somebody whose name she forgot. In either case, it ought to be a philosopher, which the speaker heard or learned about, whose possible invitation would offend Max. For her utterance to be non-trivial, in all Gricean respects, she should not know of that philosopher whether or not (s)he is going to be invited, or whether or not Max will be offended anyway. The example shows, again, that there are pragmatic constraints on what are appropriate witnesses for the indefinite. But if these witnesses, or the choice functions which generate them, are existentially quantified, we don't have a handle on the entities (individuals, choice functions) onto which to apply these constraints. Indeed, for this reason the example really supplies motivation for the pragmatic (free variable) choice function approach like that of [Kratzer 1998], or more simply, for the one argued for here.

It could be objected that the problem with example (39) lies not so much in the interpretation of the indefinite, but in the material interpretation of the conditional. Thus, one might say, the actual (global) interpretation of the indefinite should be that there is some philosopher such that on all 'relevant' possibilities, the invitation of that philosopher would offend Max. Notice, first, that this paraphrase comes close to the interpretation we actually get by pragmatic means. Notice, second, that, as in the case of Peirce's example, a strict reading of conditionals is consistent with our analysis. But, third, this would again be of no help when we consider a variant of (39) in disjunctive form:

(42) Either we invite some philosopher, or Max will be offended.

I think this sentence has a sensible reading as to which Max has his favourite philosopher (not Derrida) such that if we don't invite him, Max will be offended. Upon this reading not any arbitrary philosopher which we *do* invite suffices to make the assertion true or felicitous. It should be the philosopher whose non-invitation would upset Max. Fourth, and most importantly, a choice function analysis of the indefinite in (39) would definitely have to be amended in case we use a strict analysis of the conditional. For if we start looking at different possibilities, there are possibly different sets of philosophers, and the choice function might yield a different philosopher in each of these possibilities, one that is not even actually a philosopher.[22]

The latter problem can be solved by resorting to an intensional choice function analysis like one suggested by Reinhart and Winter. Essentially the idea then is that choice functions apply to properties (not sets), and such that on the locus of existential closure choice functions assign to any property an individual which *actually* has that property. But here the intuitive appeal of the choice function analysis starts to break down almost completely. If this is the ultimate analysis, the local semantic contribution of an indefinite "Some A" is whatever a function f assigns to the property A.

[22] One could maintain that 'relevant' possibilities are those in which the set of philosophers is the same as in the actual world. Obviously this will not help when we turn to global interpretations of counterfactuals like the following:

(43) If some philosopher had not gone into philosophy, his tutors would have been disappointed.

(44) If a certain war criminal had not committed his crimes, this region would have been a much safer place.

Only on the superordinate level of existential closure it is required that f is some function assigning to any property in any possibility an individual which *at that level of interpretation* actually has that property. I find it hard to see why this analysis should still comply with the scope island constraint. The most important ingredients of the interpretation of indefinites are lifted out of their islands. Indeed, upon our approach, and upon all the paraphrases of the non-local interpretation of scope island indefinites, the very same thing happens. But on our account this happens on the pragmatic level, different from the structural level of syntax/semantics where the scope island constraint applies. On an intensional choice function alternative, this substantial type of lifting takes place at the level of logical form.

Let me summarize the findings of this section. Special interpretations of scope island indefinites can be accounted for by assuming they structurally obey scope island constraints. They have access to a pragmatic dimension of use, which can be used to explain their apparent escapist behaviour, and independently motivated functional interpretations can be used to explain so-called intermediate readings. Alternative analyses adopting choice function readings will arguably have to be adapted in three ways. They must allow skolemization, context dependence, and intensionalization in order to work out proper in general. This use of choice functions simply complicates matters, instead of being explanatory.

7 Conclusions

In this paper I have presented a view upon the use and interpretation of indefinite noun phrase formally inspired by the dynamic paradigms of discourse representation theory, file change semantics, and dynamic predicate logic. Conceptually it has been inspired by [Stalnaker 1998] and other philosophers who have given their thoughts to the use and interpretation of definite and indefinite noun phrases. Both types of phrases are used with referential intentions, the difference being that the intended referents of definites are required to be determinable in principle, whereas the use of an indefinite indicates that the identity or determination of the intended referent is not relevant. Truly Gricean notions of support have been called upon to explain a couple of basic facts about the use of these expressions, such as the anaphoric potential, and, e.g., their behaviour in Peirce's example.

Not much more has been needed to analyze the use of indefinites in constructions dealt with in alternative approaches to indefinites. We need to adopt some appropriate notion of ground and focus in order to deal with information structure, but this is nothing new. We also need to allow terms to have functional readings, but this, too, is old wisdom. All of the data discussed in this paper can thus be dealt in a rather conservative manner.

I have started from a classical satisfaction semantics and the tools which I have used are basically, those of Tarski (satisfying sequences), Jackendoff (information structure), Geach (division) and Grice (pragmatics). The main challenge, and result,

of this paper has been that of finding a proper formulation of the interaction of semantic and pragmatic information. First, in order to account for the referential intentions associated with the use of indefinites, by adding possible witnesses as an additional parameter of interpretation; second, in order to account for the structure of information, by the distribution of meaning over various dimensions of interpretation. Interestingly, by considering the contribution which indefinites make as part of what their use may pragmatically convey, we get a neat account of their behaviour on scope islands, which seems to be different from that of other noun phrases, but which actually is the same.

Empirically, I believe the present account does just as well as *DRT*, E-type pronoun approaches, or a choice function treatment, and possibly also the other way around. For instance, an intensionalized version of Kratzer's pragmatic choice function treatment can empirically be virtually indistinguishable from ours. If such indeed is the case, I favour the account presented in this paper, for the reason that it is more principled and less involved.

8 Appendix

In this appendix I present and illustrate the basics of the formal architecture underlying the main claims of this paper. I first present the system of *PLA*, *Predicate Logic with Anaphora*, in which quite systematic facts about the use of indefinite noun phrases and pronouns are appended to a classical satisfaction semantics. I then lift this semantics to an update and support calculus, which incorporates basics aspects of information exchange and it is shown that this set up natural asks for a form of quantified and modal parametrization by means of which functional dependencies get accounted for in a straightforward manner. I finally show how information structure is handled flexibly, assuming a distribution of meaning over several dimensions which get correlated by being evaluated relative to the same parameters of witnesses.

Predicate Logic with Anaphora

The language of *PLA* is that of ordinary predicate logic, except for the fact that it also contains a category of pronouns $\mathrm{p}_1, \mathrm{p}_2, \ldots$, which can be used as terms in atomic formulas. For ease of exposition I focus on a fragment built up from atomic formulas by means of negation $\neg$, existential quantification $\exists$ and conjunction $\wedge$.[23] A model for *PLA* can be an ordinary first order predicate logical model, but with a view upon later intensional (and epistemic) applications, I adopt Kripke models $M = \langle W, (R_i), D, I\rangle$ consisting of a set of possibilities W, a (possibly empty) family of accessibility relations R_i over W (modeling the beliefs of agents i), a domain of individuals D, and a possibility dependent interpretation of the (individual and relational) constants I. For

[23] Universal quantification, disjunction and (material) implication can of course be defined using the classical equivalences: $\forall x\phi \equiv \neg\exists x\neg\phi$, $(\phi \rightarrow \psi) \equiv \neg(\phi \wedge \neg\psi)$, $(\phi \vee \psi) \equiv (\neg\phi \rightarrow \psi)$.

the sake of simplicity I assume D to be the same in all worlds, but nothing hinges upon this assumption.

Before I can turn to the semantics of *PLA*, I have to define the 'length' and the 'reach' of a formula. The length $n(\phi)$ of ϕ is the number of individuals it introduces: the number of existentials (indefinites) not outscoped by a negation. The reach $r(\phi)$ of ϕ is the number of individuals it presupposes: the number of existentials (indefinites) which pronouns require there to be present in discourse preceding ϕ. The scope $s(\phi)$ equals the sum of the two.

- $n(Rt_1 \ldots t_m) = 0 \qquad n(\neg\phi) \quad = 0$
  $n(\exists x\phi) \qquad = n(\phi) + 1 \quad n(\phi \wedge \psi) = n(\phi) + n(\psi)$
- $r(Rt_1 \ldots t_m) = \mathit{MAX}\{j \mid \mathtt{p}_j \textit{ is among } t_1, \ldots, t_n\} \quad r(\neg\phi) \;= r(\phi)$
  $r(\phi \wedge \psi) \quad = \mathit{MAX}\{r(\phi), (r(\psi) - n(\phi))\} \qquad r(\exists x\phi) = r(\phi)$

If $n(\phi) = 0$, ϕ is called closed, and if $r(\phi) = 0$, it is called resolved.

The semantics of *PLA* is formulated as a satisfaction relation among, on the one hand, a formula ϕ, and, on the other, a model M, a variable assignment g, a world w, and a sequence of individuals $\vec{e}$. The sequences $\vec{e}$ consist of the possibly intended referents of terms in ϕ. I will always, silently, assume that the sequences are 'long enough', that is, in any clause in which $\vec{e}$ is related to ϕ, it is assumed that the length of $\vec{e}$ is $s(\phi) = r(\phi) + n(\phi)$ at least. Moreover, if $\vec{e} = e_1 \ldots e_n$, then $\vec{e}_i = e_i$.

Definition 8.1 (PLA Semantics)

- $[x]_{M,g,w,\vec{e}} = g(x) \qquad [c]_{M,g,w,\vec{e}} = I_w(c) \qquad [\mathtt{p}_i]_{M,g,w,\vec{e}} = \vec{e}_i$
- $M, g, w, \;\; \vec{e} \models Rt_1 \ldots t_m$ iff $\langle [t_1]_{M,g,w,\vec{e}}, \ldots, [t_m]_{M,g,w,\vec{e}} \rangle \in I_w(R)$
  $M, g, w, \;\; \vec{e} \models \neg\phi \qquad$ iff $\neg\exists \vec{c} \in D^{n(\phi)}$: $M, g, w, \vec{ce} \models \phi$
  $M, g, w, d\vec{e} \models \exists x\phi \qquad$ iff $M, g[x/d], w, \vec{e} \models \phi$
  $M, g, w, \vec{ce} \models \phi \wedge \psi \qquad$ iff $M, g, w, \vec{e} \models \phi$ and $M, g, w, \vec{ce} \models \psi$ $(\vec{c} \in D^{n(\psi)})$

Apart from the possibility of there being pronouns, atomic formulas are evaluated in a totally classical way. A pronoun $\mathtt{p}_i$ simply picks up the i-th element of a satisfying sequence, thus establishing coreference with the i-th term before the pronoun. A negated formula $\neg\phi$ is satisfied if there is no way to find witnesses to satisfy ϕ. An existentially quantified formula $\exists x\phi$ is evaluated in the classical way, but for the fact that witnesses d for x by means of which ϕ can be satisfied are put on the stack of witnesses $\vec{e}$. Satisfaction of a conjunction $\phi \wedge \psi$ is also standard, except that it incorporates the 'pragmatic' fact that in actual use ϕ comes before ψ: ϕ is evaluated *before* ψ has contributed its $n(\psi)$ witnesses. Thus $\vec{ce}$ can be taken to satisfy ϕ in its conjunction with ψ because it satisfies ϕ plus the fact that $n(\psi)$ more terms have been used afterwards.

PLA models the interpretation of intersentential anaphoric relationships in a compositional way, without resorting to a representational format (which *DRT* does) and

without changing the standard notions of scope and binding (which *DPL* does).[24] Technically, indefinites and pronouns (and upon a proper extension: definites) behave pretty similar. The different types of terms are assumed to be basically referential, and only differ in matters of use. Indefinites are assumed to be new, and they may leave the intended referent undetermined; pronouns (and definites) are assumed to be given and determinable.[25] Some of these facts show from the following observation (in which $\exists$ is short for $\exists x(x = x)$):

Observation 8.2 (Indefinites and Pronouns)

(45) A diver found a pearl. She lost it again.

(46) A diver lost a pearl she found.

(47) There is something. It is a pearl. There is someone. She is a diver. She found it. She lost it again.

- $\exists x(Dx \wedge \exists y(Py \wedge Fxy)) \wedge L\mathtt{p}_1\mathtt{p}_2 \Leftrightarrow$
  $\exists x(Dx \wedge \exists y((Py \wedge Fxy) \wedge Lxy)) \Leftrightarrow$
  $\exists \wedge P\mathtt{p}_1 \wedge \exists \wedge D\mathtt{p}_1 \wedge F\mathtt{p}_1\mathtt{p}_2 \wedge L\mathtt{p}_1\mathtt{p}_2))$

As these equivalences already suggest, we can do away with all variables and we can also eliminate all resolved pronouns. Resolved pronouns can be eliminated by means of a normalization procedure which draws from the following equations:

Definition 8.3 (Normal Binding Forms)

- $(Rt_1 \ldots t_m)^\bullet = Rt_1 \ldots t_m$
  $(\neg\phi)^\bullet = \neg\phi$ if ϕ is in normal form
  $(\exists x\phi)^\bullet = \exists x\phi$ if ϕ is in normal form
  $(\exists\vec{x}\phi \wedge \exists\vec{y}\psi)^\bullet = \exists\vec{y}\vec{x}(\phi \wedge [\vec{x}]\psi)$ if
  – ϕ and ψ are in normal form *and* closed
  – $\vec{y}$ do not occur free in ϕ and $\vec{x}$ do not occur free in ψ
  – $[x_1 \ldots x_n]\psi$ is obtained from ψ by replacing any pronoun $\mathtt{p}_i$ in ϕ by x_i if $i \leq n$ and by $\mathtt{p}_{i-n}$ otherwise (of course, the x_i should be free for the $\mathtt{p}_i$ in ψ)[26]

If embedded formulas are not in normal form, these equations have to be applied to them first (where ϕ is in normal form iff $(\phi)^\bullet \equiv \phi$). Notice that if ϕ is in normal form, then it is of the form $\exists\vec{x}\psi$, where ψ is both in normal form and closed. Computing normal binding forms is insightful for the following reasons:

[24] It is a proper extension of a classical semantics and does not suffer from the technical complications which hamper *DPL* precisely because discourse information is 'hung' on variables there, which automatically introduces the possibility of unwanted information loss.

[25] To which it should be added that this type of 'determinability' may be dependent on what actually is the intended referent of other terms.

[26] If the conditions on free variable occurrences are not met, we can use α-conversion to produce alphabetical variants.

Observation 8.4 (PLA, PL and DRT)

- $M, g, w, \vec{e} \models (\phi)^\bullet$ iff $M, g, w, \vec{e} \models \phi$
- let $\vec{x} = x_1 \ldots x_{r(\phi)}$ be not free in ϕ and free for $\mathtt{p}_1 \ldots \mathtt{p}_{r(\phi)}$ in $(\phi)^\bullet$, then
  - $M, g, w \models_{CL} [\vec{x}](\phi)^\bullet$ iff $\exists \vec{e} \in D^{n(\phi)}$: $M, g, w, \vec{e} \models [\vec{x}](\phi)^\bullet$
  - $[\vec{x}](\phi)^\bullet$ has the structure of a *DRS*, and is of the form $\exists \vec{z} \psi$ where $\vec{z}$ is a sequence of variables and ψ a a series of conjunctions of conditions (atomic formulas and negated formulas with the structure of *DRS*)

The first observation here shows the normalization procedure to be fully meaning preserving. The second shows that it produces a formula whose classical satisfaction conditions are the same in classical logic. (The additional substitution with $[\vec{x}]$ is needed to remove unresolved pronouns.) The third observation shows that these truth-conditions are adequately captured by the discourse representation structures of *DRT*. Thus it shows that *PLA*, like *DPL* and unlike *DRT*, can stick to a natural translation of natural language expressions which globally respects their syntactic structure. Even so the semantics of these expressions is equivalent with the (classical) interpretations of the corresponding representations produced in *DRT*.

Update and Support

I assume that information states of interlocutors contain information about the world and about the possible values of terms used in a discourse. They can be modeled by sets of sequences $w\vec{e}$ where the $\vec{e}$ are witnesses in worlds w conceived possible. Then we can define what it means to update an information state τ with the contribution made by an utterance of ϕ, the result written as $(\tau)[\![\phi]\!]_{M,g,\vec{\epsilon}}$, and what a speaker's state σ can be required to be like to support such an utterance, in case we will write $\sigma \models_{M,g,\vec{\epsilon}} \phi$. Since terms get an epistemic interpretation here, they are associated with (sequences of) witnesses $\vec{\epsilon}$ which are individual concepts now, functions from the possibilities in an information state to individuals. They can be modeled as (sequences of) numbers, so that if $\vec{\epsilon}_i$ is j, it is associated with the projection function that assigns $\vec{e}_j$ to each relevant possibility $w\vec{e}$. Under an update with ϕ these sequences determine the interpretation of unresolved pronouns in ϕ only, whereas for ϕ to be supported, they must also specify the concepts supporting indefinites.[27] If $\vec{\epsilon}$ is a sequence of concepts modeled by the numbers $i_1 \ldots i_n$, and if $w\vec{e}$ is a possibility, $\vec{\epsilon}(w\vec{e})$ is the sequence of n individuals $\vec{\epsilon}_1(w\vec{e}) \ldots \vec{\epsilon}_n(w\vec{e})$ which, really, is the sequence $\vec{e}_{i_1} \ldots \vec{e}_{i_n}$. The definitions run as follows:

Definition 8.5 (Update and Support)

[27] The interpretation of variables thus has to be adjusted so that $[x]_{M,g,w,\vec{e}} = g(x)(e)$; after an update with ϕ an assignment g has to be updated to $h = g[+n(\phi)]$ defined by $h(x)(\vec{e}) = g(x)(\vec{e} - n(\phi))$, where $\vec{e} - m$ is $\vec{e}$ with the first m elements stripped off.

- $(\tau)[\![\phi]\!]_{M,g,\vec{\epsilon}} = \{w\vec{c}\vec{e} \mid w\vec{e} \in \tau \;\&\; \vec{c} \in D^{n(\phi)} \;\&\; M, g, w, \vec{c}\vec{\epsilon}(w\vec{e}) \models \phi\}$
  $\sigma \models_{M,g,\vec{\epsilon}} \phi$ iff $\forall w\vec{e} \in \sigma$: $M, g, w, \vec{\epsilon}(w\vec{e}) \models \phi$

If one accepts an utterance of ϕ, the information conveyed by ϕ is taken to be correct: one excludes possibilities inconsistent with its contents, and possibly intended witnesses are 'remembered'. In any remaining possibility $w\vec{c}\vec{e}$, $\vec{c}$ is conceived of as the sequence of individuals the speaker might have intended if his or her information is correct. Support can be understood in two ways. On a Gricean view it characterizes what a speaker's state must be like if she is cooperative and if she complies with the quality maxim. However, one may as well conceive of it as a qualitative characterization of the commitments the speaker makes, in the sense of Hamblin. These definitions are pragmatically well-behaved in the following sense:

Observation 8.6 (Supported Updates)

- $(\tau)[\![\phi]\!]$ and $\sigma \models \phi$ can be independently defined in a compositional way
- if $\sigma \models_{M,g,\vec{\epsilon}} \phi$ and ϕ is resolved, then $(\downarrow\sigma \cap \downarrow\tau) \subseteq \downarrow((\tau)[\![\phi]\!]_{M,g})$
  (where $\downarrow\sigma = \{w \mid \exists\vec{e}\text{: } w\vec{e} \in \sigma\}$)

The benefit of the first of these two observations is obvious, and it is substantiated in [Dekker 2002a].[28] The second observation should be more appealing. It says that if an utterance of ϕ is resolved and supported, then the information which a hearer may get from it is supported by the distributed information he and the speaker had before the update. It means that supported updates are safe: they are reliable if the initial information was. (The requirement that ϕ be resolved arises from the fact that unresolved pronouns allow for the possibility of miss-resolution.)

Conditional sentences (as well as negated ones) also mediate nicely between update and support:

Observation 8.7 (Negations and Conditionals)

- $\sigma \models_{M,g,\vec{\epsilon}} \neg\phi$ iff $(\sigma)[\![\phi]\!]_{M,g,\vec{\epsilon}} = \emptyset$
  $\sigma \models_{M,g,\vec{\epsilon}} (\phi \rightarrow \psi)$ iff $\exists\vec{\alpha}$: $(\sigma)[\![\phi]\!]_{M,g,\vec{\epsilon}} \models_{M,g[+n(\phi)],\vec{\alpha}n(\vec{\phi})\vec{\epsilon}} \psi$

The first observation here is the most transparent one. Support for asserting $\neg\phi$ boils down to a veto on updating with ϕ, on the pain of inconsistency. Thus we see indeed

[28] Except for the fact that we have a more given a more homogeneous definition here. By way of illustration:

- $(\tau)[\![\exists x\phi]\!]_{M,g,\vec{\epsilon}} = \{wd\vec{e} \mid w\vec{e} \in (\tau)[\![\phi]\!]_{M,g[x/d]}\}$
  $(\tau)[\![\phi \wedge \psi]\!]_{M,g,\vec{\epsilon}} = ((\sigma)[\![\phi]\!]_{M,g,\vec{\epsilon}})[\![\psi]\!]_{M,g[+n(\phi)],n(\vec{\phi})\vec{\epsilon}}$

where $n(\vec{\phi})$ is the sequence of numbers (projection functions) $1 \ldots n(\phi)$ and $g[x/d]$ does not really assign d to x, but the constant function from possibilities to d. Likewise:

- $\sigma \models_{M,g,\vec{\epsilon}} \exists x\phi$ iff $\sigma \models_{M,g[x/\vec{\epsilon}_1],\vec{\epsilon}-1} \phi$
  $\sigma \models_{M,g,\vec{\alpha}\vec{\epsilon}} \phi \wedge \psi$ iff $\sigma \models_{M,g,\vec{\epsilon}} \phi$ and $\sigma \models_{M,g,\vec{\alpha}\vec{\epsilon}} \psi$

something like a role switch at the formal level. Less transparent, but even more suggestive is the second observation. Support for asserting a conditional consists in having support for the consequent clause if one has updated with the antecedent clause. Thus a speaker's state supports $\phi \rightarrow \psi$ iff, if she updates with ϕ, her state supports ψ. Here we witness a double role-switch: if you support ϕ, I support ψ.[29]

As already indicated in the main text of the paper, our treatment of conditional sentences naturally invites two possible amendations, which are not restricted to conditional sentences though. As appears from observation (8.7), support for the assertion of a conditional consists in *possible* support for the consequent clause upon a hypothetical update with the antecedent clause. This type of support can be made specific, provided that it is functional upon the contents of the antecedent clause:

Definition 8.8 (Conditional Satisfaction and Support)

- $M, g, w, \vec{a}\vec{e} \models \phi \rightarrow \psi$ iff $\forall \vec{c} \in D^{n(\phi)}$ & $M, g, w, \vec{c}\vec{e}_{\vec{c}} \models \phi$: $M, g, w, \vec{a}_{\vec{c}}\vec{c}\vec{e}_{\vec{c}} \models \psi$
  $\sigma \models_{M,g,\vec{\alpha\epsilon}} \phi \rightarrow \psi$ iff $(\sigma)[\![\phi]\!]_{M,g,\vec{e}} \models_{M,g[+n(\phi)],\vec{\alpha}_{n(\vec{\phi})}n(\vec{\phi})\vec{\epsilon}_{n(\vec{\phi})}} \psi$

In this definition, $\vec{a}\vec{e}$ and $\vec{\alpha}\vec{\epsilon}$ indicate (sequences of) witnesses and concepts which are possibly functionally dependent on the (sequences of) witnesses $\vec{c}$ and concepts $n(\vec{\phi})$ respectively.[30] The definition generates equivalences like the following:

Observation 8.9 (Functional Support)

(19) If a book is printed with Kluwer it has an index. It can always be found at the end.

- $(\exists x\phi(x) \rightarrow \exists y\psi(y)) \wedge (\exists x\phi(x) \rightarrow \chi(\mathtt{p}_2)) \Leftrightarrow$
  $\exists f(\exists x\phi(x) \rightarrow \psi(f(\mathtt{p}_1))) \wedge (\exists x\phi(x) \rightarrow \chi(\mathtt{p}_2)) \Leftrightarrow$
  $\exists f((\exists x\phi(x) \rightarrow \psi(f(\mathtt{p}_1))) \wedge (\exists x\phi(x) \rightarrow \chi(f(\mathtt{p}_1))))$

Example (19) can be reformulated as follows: if something is a book, say d, then $f(d)$ is its index; and if something is a book, say d', then $f(d')$ can be found at its end. These are by and large the truth-conditions of the example.[31]

Information Structure

The earlier definitions will also have to be amended in order to account for the flexible way in which quantifiers and other operators act upon the information structure of em-

[29] Negation can be phrased analogously, if $\neg\phi$ is interpreted as the equivalent $\phi \rightarrow \bot$. If my state supports this conditional it amounts to saying: if you support ϕ we are over and done.

[30] Similar definitions can be given for, e.g., the satisfaction of universally quantified assertions and belief reports:

- $M, g, w, \vec{e} \models \forall x\phi$ iff $\forall d$: $M, g[x/d], \vec{e}_d \models \phi$
  $M, g, w, \vec{e} \models B_x\phi$ iff $\forall w'$ $wR_{g(x)}w'$: $M, g, w', \vec{e}_{w'} \models \phi$

[31] Similar equivalences are raised by a functional interpretation of universally quantified assertions and belief attributions.

bedded clauses. Material from *if*- and *only if*-clauses, from negated expressions, and from the restrictions of quantifiers, sometimes float free from their local environment, especially terms (definite and indefinite) and presuppositions. We can account for this behaviour by distributing the contents of all expressions (sentential and other) over various dimensions of interpretation (basically as in [Karttunen and Peters 1979]), and let the main operators act upon these dimensions in flexible ways. I end this appendix with a concise sketch of how this works. I assume a fully compositional three-dimensional satisfaction semantics for a fragment dealing with nominal terms, quantifiers and presupposition. (It is available in manuscript, but has not yet been published.)

The basic idea is to split up meaning in a background and a focus component, where the background again is split up in an old and a new part. I will use 'presupposition,' 'contribution' and 'assertion' as mere technical labels for the old, new, and focal dimension respectively, and let these labels apply to all the relevant categories and types of our language. Thus, for instance, formulas will have a presuppositional, contributional, and assertional dimension which is stated as a satisfaction relation, $\models_p$, $\models_c$ and $\models_a$, respectively; nouns and verbs will have sets of individuals as their presuppositional, contributional or assertional denotation, and terms and quantifiers sets of sets of individuals, etc. The ground of any clause can be identified by the conjunction or intersection of its presupposition and contribution (so that $\models_b = (\models_p \cap \models_c)$) and the full interpretation is the conjunction or intersection of $\models_p$, $\models_c$ and $\models_a$. I present some examples by way of illustration.

(48) A student qualifies if she satisfies the prerequisites.
$\mathit{IF}(P(\mathtt{p}_1))(\mathit{SOME}(S)(Q))$

(49) A student qualifies only if she satisfies the prerequisites.
$\mathit{ONLY\_IF}(P(\mathtt{p}_1))(\mathit{SOME}(S)(Q))$

The main clause of these examples gets satisfied as follows:

- $M, g, w, d\vec{e} \models_b \mathit{SOME}(S)(Q)$ iff $d \in I_w(S)$
  $M, g, w, d\vec{e} \models_a \mathit{SOME}(S)(Q)$ iff $d \in I_w(Q)$

Operators like *IF* and *ONLY_IF* have their usual interpretation, but they can quantify (universally or generically) over the ground of embedded clauses. Such a (one- or more-place) operator O can then be topically restricted, roughly as follows:

- $M, g, w, R\vec{e} \models_b O^t(\phi)$ iff $R = \{\vec{c} \mid M, g, w, \vec{ce} \models_b \phi\}$
  $M, g, w, R\vec{e} \models_a O^t(\phi)$ iff $\forall \vec{c} \in R$: $M, g, w, \vec{ce} \models_a O(\phi)$

For examples (48) and (49) this would give:

- $M, g, w, \vec{e} \models (48)$ iff $\forall d \in I_w(S)$: $d \in I_w(Q)$ if $d \in I_w(P)$
- $M, g, w, \vec{e} \models (49)$ iff $\forall d \in I_w(S)$: $d \in I_w(Q)$ only if $d \in I_w(P)$

The donkey examples (12–15) can be analyzed in an entirely similar fashion.

The following example illustrates how we can deal with three dimensions:

(50) The boy bought a DVD-drive.
THE(*BOY*)(λx *SOME*(λy *DVD*y)(λy *BUY*xy))

- $M, g, w, bd\vec{e} \models_p (50)$ iff $\{b\} = I_w(BOY)$
  $M, g, w, bd\vec{e} \models_c (50)$ iff $d \in I_w(\textit{DVD})$
  $M, g, w, bd\vec{e} \models_a (50)$ iff $\langle b, d\rangle \in I_w(\textit{BUY})$

(51) He likes it very much. $\textit{HE}_1(\lambda x\ \textit{IT}_2(\lambda y\ \textit{LIKE}xy))$

- $M, g, w, b'd'bd\vec{e} \models_p (51)$ iff $b' = b$ and $d' = d$
  $M, g, w, b'd'bd\vec{e} \models_c (51)$ iff $\top$
  $M, g, w, b'd'bd\vec{e} \models_a (51)$ iff $\langle b', d'\rangle \in I_w(\textit{LIKE})$

As the reader can verify, the joint satisfaction of the presuppositions, contribution and assertion of the examples (50) and (51) is like we had it before.[32] However, by distributing the contents of such sentences over separate dimensions we can access and handle the various parts flexibly and in different ways in the process of further composition. Consider again example (5), assuming for the sake of simplicity it involves the sentential negation of (53):

(53) Onno runs a sushibar.
ONNO(λx *SOME*(SB)(λy *RUN*xy))

(5) Onno doesn't run a sushibar.
NOT(*ONNO*(λx *SOME*(SB)(λy *RUN*xy)))

As we have argued above, depending on the arguably pragmatic effects of context, intonation and focus, asserting (5) can convey various things, which can be explained in terms of the different ways in which the negation acts on the information structure of the embedded clause. The four readings mentioned there ('standard', topical / generic, specific and presupposition denying) can be obtained in the following ways. The assertion of the embedded sentences (53) presupposes a witness o for *onno*, contributes a witness b for a sushibar, and asserts that o runs b. Thus we can have the following construals (specifying relevant clauses only):

1. $M, g, w, o\vec{e} \models_b (5)$ iff $\exists b$: $M, g, w, ob\vec{e} \models_p (53)$
   iff $o = I_w(\textit{onno})$
   $M, g, w, o\vec{e} \models_a (5)$ iff $\neg\exists b$: $M, g, w, ob\vec{e} \models_{c\&a} (53)$
   iff $\neg\exists b$: $b \in I_w(\textit{SB})$ & $\langle o, b\rangle \in I_w(\textit{RUN})$

[32] As an example of a genuinely quantified structure, consider:

(52) Most men who sent a present to Curt sent a different$_2$ present to Amelia.
MOST(λx *MAN*$x \wedge$ *CURT*(λy *SOME*(λz *PRES*z)(λz *SEND*xyz)))
(λx *AMEL*(λy *SOME*($\lambda z\ z \neq$ p$_2 \wedge$ *PRES*z)(λz *SEND*xyz)))

- presupposes witnesses c for Curt, a for Amelia, M for the non-empty set of men who sent a present to c, and a witness-function p which associates any man $m \in M$ with the present $p(m)$ which m sent to c
- contributes a witness-function p' which associates any man $m \in M$ with a present $p'(m)$ different from $p(m)$
- asserts that most $m \in M$ sent $p'(m)$ to a

2. $M, g, w, oB\vec{e} \models_b (5)$ iff $o = I_w(\textit{onno}) \;\&\; B = I_w(\textit{SB})$
   $M, g, w, oB\vec{e} \models_a (5)$ iff $\forall b \in B$: $\langle o, b\rangle \notin I_w(\textit{SB})$
3. $M, g, w, ob\vec{e} \models_p (5)$ iff $o = I_w(\textit{onno})$
   $M, g, w, ob\vec{e} \models_c (5)$ iff $b \in I_w(\textit{SB})$
   $M, g, w, ob\vec{e} \models_a (5)$ iff $\langle o, b\rangle \notin I_w(\textit{RUN})$
4. $M, g, w, \vec{e} \models_p (5)$ iff $\top$
   $M, g, w, \vec{e} \models_c (5)$ iff $\top$
   $M, g, w, \vec{e} \models_a (5)$ iff $\neg\exists ob$: $M, g, w, ob\vec{e} \models_{p\&c\&a} (53)$

What is nice about the multi-dimensional set up is that all these interpretations can be obtained, without postulating a semantic ambiguity in the negative element. The different readings emerge from the different pragmatic ways in which that element can be taken to act upon the information structure of the embedded clause.

Very much the same goes for the examples in which indefinites seem to violate island constraints. I end this appendix with a concise sketch of the three ways in which example (36) can be construed, using a slightly simplified version of the example, and again displaying only the relevant lines and parameters:

(36′) They came because a man came.
THEY$_1(\lambda x$ *BECAUSE*$($*SOME*$($*MAN*$)($*CAME*$))($*CAME*$x))$

- $g, w, D \models_b (36')$ iff $\top$
  $g, w, D \models_a (36')$ iff $\forall d \in D$: $d \in I_w(\textit{CAME})$ because
  $\exists m$: $g[x/d], w, m \models \textit{SOME}(\textit{MAN})(\textit{CAME})$ i.e. because
  $(I_w(\textit{MAN}) \cap I_w(\textit{CAME})) \neq \emptyset$
- $g, w, mD \models_b (36')$ iff $\forall d \in D$: $g[x/d], w, m \models_b \textit{SOME}(\textit{MAN})(\textit{CAME})$
  iff $m \in I_w(\textit{MAN})$
  $g, w, mD \models_a (36')$ iff $\forall d \in D$: $d \in I_w(\textit{CAME})$ because
  $g[x/d], w, m \models_a \textit{SOME}(\textit{MAN})(\textit{CAME})$ i.e. because
  $m \in I_w(\textit{CAME})$
- $g, w, fD \models_b (36')$ iff $\forall d \in D$: $g[x/d], w, f(d) \models_b \textit{SOME}(\textit{MAN})(\textit{CAME})$
  iff $\forall d \in D$: $f(d) \in I_w(\textit{MAN})$
  $g, w, fD \models_a (36')$ iff $\forall d \in D$: $d \in I_w(\textit{CAME})$ because
  $g[x/d], w, f(d) \models_a \textit{SOME}(\textit{MAN})(\textit{CAME})$ i.e. because
  $f(d) \in I_w(\textit{CAME})$

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