Dynamic Semantics for Intensional Transitive Verbs – a Case Study

MSc Thesis *(Afstudeerscriptie)*

written by

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Chapter 1

Introduction

1.1 Introduction

The goal of this paper is to introduce a new formalism to capture some aspects of the semantics of intensional transitive verbs like *look for* or *want*. The literature abounds in lists of transitive verbs that should count as intensional, but the question of what principles actually govern or should govern such classifications seems still open. My approach is rather bottom-top in comparison. I develop a semantics for only one verb from this family.

There are two standard issues that a formal semantics of intensional transitive verbs should capture. The first one is the feature that they basically share with their nontransitive sisters (like *believe*), namely they do not seem to allow for substitution of coreferential terms in their object position. It is generally argued that if John is looking for Superman and John doesn't know that Superman and Clark Kent are the same person, then we can truthfully describe the situation with the sentence "John is looking for Superman", but not with "John is looking for Clark Kent".

The second problem is the general possibility of interpreting sentences with intensional verbs [1] in two ways: specifically and nonspecifically. The sentence:

(1) John is looking for a sweater.

can be taken to either say of John and some specific individual (which is a sweater) that the first is looking for the other (the relation of "looking for" holds between them); or it can be taken to say of John that – as Quine would put it – he is looking for *a mere relief from sweaterlessness* ([15]) - that he is in search of a sweater, but does not have any specific one in mind. In the second case of course the verb cannot denote a relation on individuals, since there will be no single individual related to John in that way. But again, this does not seem to be a phenomenon specific to ITVs. Rather the contrary; it is a general feature of indefinite noun phrases that they can be taken to refer or not to specific things. In what follows I will argue that the way we understand specificity of noun phrases will – in the context of the formalism I adopt – be enough to capture the corresponding behavior of intensional verbs.

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[1] From now on I will refer to intensional transitive verbs as ITVs or just intensional verbs - there will be no confusion with the nontransitive ones, since the latter won't be mentioned anymore.

My general idea is twofold. Firstly, I want to build a dynamic semantics for *look for*. Why go dynamic? The way that *look for* behaves in discourse is rather interesting and can go against the intuitions that governed earlier approaches to intensional verbs. Consider:

(2) *Bill*: Why are you running around like this today?
John: I am looking for Superman. Last night he saved my life and I want to thank him. And people say he is sometimes seen in our neighborhood.
Bill: Ah, I know who you're looking for then: Clark Kent. His office is on the third floor. He is Superman, you know.

(3) Anne is a journalist working on an article about the Research Center for Intensional Verbs (RCIV). She is just starting to research her topic, therefore she doesn't know yet that there is only one person there who works on the verb *prevent*. She is talking to Mary, one of the researchers:
Anne: I would like to mention in my article all possible lines of the research done in here. I am now looking for a member of RCIV working on *prevent* who would agree to be interviewed.
Mary: You're looking for Robert Smith then. No one else here works on that topic these days.

In case (2) we have a situation where John does not know that Superman and Clark Kent are the same person (he only learns that in the very end), and yet Bill can say honestly: "You are looking for Clark Kent". Why is that? Because Bill knows the relevant fact about Superman and seems to interpret the name *Superman* in John's utterance with respect to his own information state rather than John's. One could say: de re rather than de dicto. K. Taylor in his article *De Re and De Dicto: Against the Conventional Wisdom* [19] shows that a tendency to interpret reports of other people's beliefs in a *de re* rather than *de dicto* manner is more widespread that seems to be accounted for in the literature.

The situation described in (3) is even more interesting. When Anne says that she is looking for a such-and-such researcher, we are ready to say that in her utterance the verb *look for* was nonspecific – definitely there is no particular person she had in mind. Yet it is the case in the actual world that only one individual satisfies the condition given by Anne and Mary knows about it. This is why it is natural for her to use an indisputably specific sentence to describe Anne's search. We can say that for Mary the sentence uttered by Anne ("I am looking for a so-and-so") was specific – it was about Robert Smith.

What lesson do we learn from such examples?

One can see that even though the report of the first person in both dialogs might at the first glance refer to that person's belief state, it seems to be interpreted slightly differently by other participants of the dialog. This is what leads us to the dynamic semantics option – sentences with *look for* will be interpreted with respect to the hearer's belief state rather than the belief state of the agent of the sentence.

This is a good place to fix the terminology and give names to different actors on our current scene. The are three of them. Since I am interested in sentences of the form "A is looking for B", where A is a name of a single person, I will keep calling such A *the agent* (of the sentence). The person that utters the

said sentence will be *the speaker* – as the examples (2) and (3) show, sometimes the agent and the speaker are the same person. Then we have *the hearer* – Bill and Mary from above – who interprets the utterances of the speaker. It is the hearer's belief state that will be considered when interpreting the relevant sentences – in accordance with the dynamic semantics credo.

I will build a dynamic semantics for *look for* then, where sentences of the form "A is looking for B" will be interpreted with respect to some information state (the one of the hearer). Any sentence of the above type will say that a certain relation holds between A and the things that are B – it will not be a first-order relation on individuals then. But still it will not really take A's beliefs into account either. I end up with an interesting system that is neither truly intensional in the common understanding, neither traditionally extensional.

What about the issue of specific and nonspecific readings? First of all, since I chose dynamic semantics framework and will interpret sentences with respect to someone's information state, the focus on the notion of epistemic specificity rather than scopal specificity will come as a natural choice. Dialog (3) is a good case in point. There Mary interprets Anne's utterance as specific (being about a specific person) solely because, according to the information she has, there is only one possible referent for the NP *a member of RCIV working on "prevent"*. This is exactly the kind of situation Donka Farkas describes when she formalizes the notion of epistemic specificity in [5]. Her system actually has features that are very similar to what I present in Chapter 4. In the formalism I introduce below, the following will be the case. If the hearer, after hearing the sentence "A is looking for B", knows that there is only one such possible B, then I will say that she interprets that sentence as specific – because for her the NP "B" is specific in this context.

The language I use is based on Barwise and Cooper's logic with generalized quantifiers ([3]). The reason for that is that the language they introduce gives the same kind of denotation to all NPs and also makes it easy to capture formally the idea of "and when it happens to be the case that there is only one such B".

1.2   Semantics for ITVs

Before I move onto the specific arguments for adopting a dynamic view on intensional verbs, and *look for* in particular, some remarks of a more historical nature are in place. Montague's paper *On the Nature of Certain Philosophical Entities* ([14]) can be treated as a starting point of investigations into the semantics of intensional transitive verbs within formal semantics proper. Of course the basic problems associated with that topic – that ITVs seem ambiguous between specific and nonspecific readings, that they resist in their object position any substitution of coreferential terms – have been noted well before Montague's paper. The first modern text to mention that issue would be Quine's *Word and Object* ([16], p. 151–156), where he introduces the distinction between notional (de dicto, wide scope) and relational (de re, narrow scope) readings of ITVs. In the case of *look for* Quine proposes a paraphrase *endavour to find* which allows for reinterpreting the notional-relational dichotomy in terms of scope ambiguity.

This approach of can be called a lexical decomposition theory of intensional verbs. Once *seek* is decomposed as *try to find*, due to the fact that *try* is taken to denote a propositional attitude, the two readings of a sentence:

(4) John is looking for a coat.

can be roughly presented as:

(5) $\exists x(coat(x) \wedge try(j, find(j, x)))$

(6) $try(j, \exists x(find(j, x)))$

In this case the behavior of *seek* with respect to substitution is literally a special case of the same phenomenon regarding propositional attitudes in general.

Montague's starting point was exactly Quine's decompositional theory (cf. [14], p. 175). Once such an assumption is worked out in Montague's own intensional logic, *seek* turns out to denote relations between individuals and intensional quantifiers. But, as Montague notes himself already, some verbs seem to resist such decomposition, i.e. *worship* or *think of* (Zimmermann will later add *resemble* to that list), while at the same time they do pass standard tests for intensionality. On the other hand, the idea that objects of intensional verbs denote intensional quantifiers is not dependent on the decompositional approach. Montague then dropped the latter and ended up insisting that ITVs denote attitudes of individuals towards intensional quantifiers – attitudes that do not have to be decomposable into propositional attitudes.

What has been said in this section so far can roughly be summed up as follows. The question of what *seek* refers to can be reduced to the two following parts. First of them would be: what kinds of entities does *seek* relates individuals to? Secondly: how do we know, given that *seek* denotes a relation between individuals and entities of a type X, that that relation actually holds between a given individual and a given entity of a type X?

In the case of the Quinean, decompositional analysis, *seeks* denotes a relation between individuals and propositions. And the question of when such a relation actually holds could be answered by any standard theory of propositional attitudes, since those animals seem to be well studied. In the Montagovian analysis, on the other hand, *seek* denotes attitudes of individuals towards intensional quantifiers. As Zimmermann points out though (cf. [22], p. 159–160), it is not easy to see how we should know if a given individual has such an attitude. In other words, what Montague was unable to explain was how the NP in the object position contributes to our understanding of the intensional quantifier in question.

Those two approaches do not form the full landscape of the research concerning intensional transitive verbs. T. Zimmermann added another piece to that puzzle. He has been extensively studying issues connected with intensionality, specificity and objectual attitudes, but the most recognized part of his findings has been presented in the paper *Proper Treatment od Opacity in Certain Verbs* ([22]) and its later refinement can be found in *Monotonicity in Opaque Verbs* ([23]).

Zimmermann raises two objections to Montague's analysis. The first one has been already mentioned here: since there is no systematic way in which meanings of the object NPs contribute to the formation of the intensional quantifier, unless the verb in question is decomposable into a propositional attitude (and some of them are not), we cannot know when an individual holds the attitude in question (Zimmermann calls that the Compositionality Problem). The second

is that Montague's analysis seems to overgenerate in some cases, predicting nonspecific readings of sentences with intensional verbs in cases when they are not attested. I will turn to the topic of availability of only specific or only nonspecific readings in section 3.1.

Zimmermann argues subsequently that the source of problems for the Montagovian analysis is that it allows too many quantifiers to be the objects of intensional relations. If we were to find a way to restrict the ranges of those verbs in an adequate way, the problems would be avoided. He notices that intensional verbs accept only existential quantifiers as objects, and that there is a one-to-one correspondence between existential quantifiers and properties. If we assume that intensional verbs in their nonspecific readings denote relations between individuals and properties, then a straightforward analysis of the problem cases does follow.

Zimmermann therefore answers the question of what kind of entities does *seek* relate individuals to with the answer: properties. What is left is to provide a semantic clause specifying when exactly an individual x seeks a property P, and that is done in the following way:

(7) For any property P, individual x, world w, and time t the following holds: $[seek'](P)(x)(w,t) = 1$ iff, for any worlds w' and times t', $(w,t)T_x(w',t')$ holds iff at (w',t'), the set of individuals found by x overlaps the extension of P. ([23], p. 735)

where $(w,t)T_x(w',t')$ if and only if (w',t') complies with the goals agent x pursues in world w at time t (here pairs of the form (w,t) denote indices taken to be world-time pairs). It is not hard to notice that in a way the "try to find" component of the meaning of *look for* is still present in this analysis.

The Quine-Montague-Zimmermann line of argumentation seems to form a hard core of the literature on our current topic. Many other approaches take one of those three analyses either as a starting point, or as their main adversary. F. Moltmann in *Intensional Verbs and Quantifiers* ([12]) argues for taking a middle road between Montague and Zimmermann. She adopts the property analysis with respect only to verbs of comparison (such as *resemble* – the one that resisted decomposition). For the rest of intensional verbs she argues for a slight modification of the quantifier analysis, where intensional quantifiers are defined as functions from situations (partial worlds) to extensional quantifiers, rather than functions from possible worlds to extensional quantifiers.

Another account worth noticing has been presented by V. Van Geenhoven and L. McNally in their paper *On the Property Analysis of Opaque Complements* ([20]). The authors have done the most comprehensive work when it comes to gathering the linguistic data concerning the behavior of different kinds of intensional verbs with respect to different kinds of objects they can take. They note also that not only intensional verbs can take properties as their arguments, so Zimmermann's analysis should be enriched by new content. The semantics they arrive at is therefore a mix of the Quinean analysis and the property approach. The authors note that taking property-type arguments is also a feature of some extensional verbs, and therefore it cannot be used as the only explanation for the different behavior of intensional verbs. Hence the semantics clauses for intensional verbs have to somehow richer. In the case of *look for* it is said that **lookfor**$_w(x, P)$ holds when in the actual world w the individual x is trying to

make it the case that in some other world w' there is an individual which is P and which x finds. This is clearly a case of typical Quinean decomposition. The property argument turns out to be modally embedded, which explains the lack of existential entailments. Furthermore, it is shown that the case of *resemble*, that Zimmermann though problematic for his own approach, can also be translated into this modal scheme.

It is hard not to notice a number of points that all the existing approaches seem to share (and not only because some of them are just variations on the others). On one hand this is not so surprising. We share a number of very strong intuitions about what is means to look for something, and all those intuitions were sought to be accommodated in the formal models. On the other hand, it does not mean that all the available literature focuses on the Montague-Zimmermann-like approaches. One can find some discussion of the decompositional approach in the form of more philosophical arguments against reducing objectual attitudes to propositional ones (cf. [13], [8]). Some researchers argue for such irreducibility only in some specific cases (cf. [17]).

Another approach worth mentioning is the one presented by G. Forbes in his book *Attitude Problems* ([9]). Forbes constructs a theory of some of the intensional verbs in terms of a formal theory of events. After arguing that action verbs require event semantics, he reaches the conclusion that, since search verbs are action verbs, some intensional verbs will need event semantics too. The main challenge at this point is of course dealing with nonspecific readings, which is done in terms of search events being characterized by certain properties. Lastly, an interesting feature of Forbes' approach is the idea that the lack of substitutivity and the lack of existential entailments do not necessarily require a common solution. On the opposite, these two features of intensional verbs can be explained by two different mechanisms.

The reason I put together this short overview of the literature on the semantics of intensional transitive verbs was to present the landscape out of which I will be traveling from now on. The semantics that I am about to develop differs significantly from the existing approaches. Hopefully such novelty will prove to be its strength rather than a vice.

Chapter 2

Intensionality and dynamic semantics

2.1 Belief ascriptions

The idea that ITVs do not allow for substitution of coreferential terms in the object position is widely accepted by philosophers. A sentence like

  (8) John is looking for Superman.

cannot imply

  (9) John is looking for Clark Kent.

because of the possibility that John does not know that Superman and Clark Kent are the same person. If one were to ask John: "Are you looking for Clark Kent?", he would respond negatively. The lesson learned from such examples is supposed to be the following: when evaluating sentences containing intensional verbs, it is the beliefs of the agent that need to be taken into account – analogously to the case of verbs like *believe*.

    It seems one of the dogmas of philosophy of language that when we ascribe beliefs to agents, the assumed point of view is the ascribee's, not the one of the ascriber:

 (10) John believes that grass is not green.

We would use the above sentence regardless of whether we share that belief with John or not. But how about a situation like the following one?

 (11) Anne really likes Bill. John says: "I think that idiot Bill is up for a promotion". Would Anne repeat the news to Mary in the following way: "John thinks that that idiot Bill is up for a promotion"?

    This last example relates to the point made by K. Taylor in his article *De Re and De Dicto: Against the Conventional Wisdom* ([19]), where he discusses whether fully de dicto belief ascriptions are as widespread as the majority of philosophers and semanticists seem to believe. As we have already noticed here, it is a widely held position that the notions that are at semantic issue when we

ascribe beliefs to agents are the ones of the ascribee. Taylor provides us with a number of examples of situations where we can talk about notional dysharmony between the ascriber and ascribee which results in the nonavailability or at least awkwardness of the de dicto readings of sentences used by the ascribers to actually ascribe the beliefs in question. He first discusses the use of expressive evaluatives in belief ascriptions, later moving onto referentially used definite descriptions. I will now present a couple of his own examples in hope that would be as persuasive here as in their original context.

Expressive evaluatives are expressions like *damn* or *bastard* – words that, even though they sometimes do have some descriptive content, are mainly used to express attitudes of derogation or approval. Imagine now the following situation.

(12) Smith overhears somebody's conversation about the fact that Jones, her long-time adversary whom she truly despises, is about to be granted tenure. She considers her source of that information reliable, and therefore proceeds to relate her newly formed belief to Black. Smith therefore says to Black:
Smith: That damned Jones is about to be granted tenure.
Black, on the other hand, holds Jones in the highest regard, so when he relates the news to Brown, he utters:
Black: Smith believes that Jones is about to be granted tenure.

Now, Black's utterance seems to be a true de dicto attribution of Smith's belief about Jones and his future. Being such an attibution, it should specify *either directly or indirectly both what Smith believes and how she believes it* ([19], p. 228). The latter means also correctly relating Smith's derogatory attitude towards Jones, since it is a component of Smith's belief, albeit an evaluative one. Black might try to stay entirely true to Smith's belief and use the following sentence when talking to Brown:

(13) Smith believes that that damned Jones is about to be granted tenure.

But (13) seems as if Black was expressing his own attitude towards Jones rather than attributing it to Smith. Notice that the same effect would be observed if Smith's and Black's roles in the story were switched and Smith was relating Black's entirely non-derogatory belief as:

(14) Black believes that that damned Jones is about to be granted tenure.

In this case Brown would not conclude that Black all of a sudden started to despise Jones, but rather accept (14) as conveying both Black's belief and Smith's attitude towards Jones. The least conclusion to draw here is that expressive evaluatives seem to resist embedding into intensional contexts and therefore force ascribers to choose a different strategy when they try to perform de dicto belief ascriptions.

To refute a possible objection that expressive evaluatives are just a special kind of expressions and their behavior has no significant bearing on our theories of de dicto beliefs, Taylor notes the following:

> Definite descriptions are the paradigm of expressions subject to embedding, but it turns out to be surprisingly difficult to use a description in a wholly notional manner. ([19], p. 238)

The following story helps him to make that point. Imagine Smith, Jones and Black working at a party as bartenders. They have been instructed to not serve alcohol to people who seem to have had too much to drink already. Jones notices such a person in the corner of the room. That person is a man drinking martinis, but Jones takes him to be a woman drinking gimlets. Jones wants to warn Smith that there is a person that they should keep an eye on and says, using a wrong definite description with an intention to refer to a particular individual:

(15) The woman in the corner drinking gimlets has had too much to drink.

Suppose further that Smith comes to realize Jones' mistake but still wants to convey Jones' belief to Black. Both Smith and Black know that the only person in the corner is a man drinking martinis. If Smith were to stay true to Jones' notions and make a de dicto ascription, she would have to say something like:

(16) Jones believes that the woman in the corner drinking gimlets has had too much to drink.

According to Taylor, in uttering (16) Smith would express not only Jones' commitment to the existence of such gimlet drinking woman, but also her own commitment to it. In the described situation then such an utterance would be inappropriate, since it is part of the common ground between Smith and Black that there is no such woman in the corner.

One can further modify the story. Imagine that this time in the corner both a woman drinking gimlets and a man drinking martinis can be found. Jones again took the man to be a gimlet drinking woman and uttered (15) with the intention to refer to the martini drinking man. Both Smith and Black know about both people in the corner. Again the sentence (16) would be inappropriate for Smith to use when reporting on Jones' belief, even though at face value (16) does not commit Smith to any false existence statements and it stays true to how Jones sees the situation, and therefore should be a felicitous de dicto belief ascription.

The main point that Taylor draws from the gimlet drinking woman story is that mere embedding in a belief ascription of a definite description previously used in a referential manner is not enough to put the ascribee's notions on display. On the contrary, there is a strong tendency to interpret such embedded descriptions as belonging to the way the ascriber takes the world to be. Therefore the ascriber is not free from the existential commitments of embedded descriptions.

The way Taylor uses the above stories and others of similar sorts is not entirely relevant for the topic of this paper. For Taylor argues for the need of adopting the notion of *fulsome de re* belief ascriptions which are roughly of the form: *S believes of x of which he thinks φ-ly that ψ is the case* rather than the standard *S believes that ψ of φ-like x*. Such a way of ascribing beliefs would be the way for the ascriber to escape being interpreted as sharing some of the ascribee's notions.

The conclusion to be drawn by us here is slightly different. What is important for me is the realization that the dogma that it is the ascribee's notions that belief ascriptions solely talk about is no longer as obvious as it seemed to be in the beginning of this section. Sentences of the form *S is looking for a P* are

also ascriptions of a certain kind – they are used to ascribe not a propositional attitude to an agent, but an objectual one – an attitude towards a certain (kind of) object. Therefore the same kind of argument can be cooked up against the idea that sentences involving the verb *look for* necessarily focus on their agents' notions. This is what I will turn to now.

2.2 *Look for* and ascriptions

For a start, notice that in the case of expressive evaluatives we observe similar problems when we consider intensional transitive verbs. Recall Jones who was about to be granted tenure, his good friend Black and not so good colleague Smith. Suppose Smith told Black:

(17) I am looking for that damned Jones. I will tell him what I think about his "success".

Later, Black met Brown, who asked him why Smith was walking frantically all over the institute in the morning. If Brown were to stay true to the intuitions quoted in the beginning of the previous section, the only truthful way of describing Smith's search available to him would be:

(18) Smith was looking for that damned Jones.

Here, just as in the case of belief ascriptions, Black could not escape being interpreted by Brown as someone who does not think highly of Jones, which was contrary to the actual situation. Here comes the first observation that not always a sentence of the form *S seeks a P* has to be used in a way that would be fully sensitive to *S*'s notions.

How about definite descriptions? Here also the situation highly resembles the one before. Consider again Jones, Smith, Black and their weekend party job. Suppose there was a man drinking martinis, whom Jones thought to be a gimlet drinking woman. As before, Smith and Black were not mistaken and Smith became aware of Jones' mistake. Suppose furthermore that the martini drinking man disappeared from the corner, and Jones said to Smith:

(19) I am looking for the gimlet drinking woman. She had too much to drink, I'm afraid she might have fallen into the pond.

If Smith were to report the above to Black in the following way:

(20) Jones is looking for the gimlet drinking woman (she disappeared from the corner and he is worried about her).

just as before, she would be committing herself to the existence of such a woman, which would not accord with her and Black's common ground. If there had been a gimlet drinking woman in the corner together with a martini drinking man (whom Jones mistook for a gimlet drinking woman) and she had disappeared together with that man, again Smith should not use (19) to relate (20) to Black.

As before, the phenomenon is more general and concerns not only expressive evaluatives and definite descriptions. Recall two dialogs already quoted in the introduction as (2) and (3), here repeated as (21) and (22).

(21) *Bill*: Why are you running around like this today?
John: I am looking for Superman. Last night he saved my life and I want to thank him. And people say he is sometimes seen in our neighborhood.
Bill: Ah, I know who you're looking for then: Clark Kent. His office is on the third floor. He is Superman, you know.

John can honestly and truthfully say that Bill is looking for Clark Kent even though Bill does not know that Clark Kent and Superman are the same person. If John were to stick to Bill's notions only, his reply would not have been allowed as a report on Bill's search.

(22) Anne is a journalist working on an article about the Research Center for Intensional Verbs (RCIV). She is just starting to research her topic, therefore she doesn't know yet that there is only one person there who works on the verb *prevent*. She is talking to Mary, one of the researchers:
Anne: I would like to mention in my article all possible lines of the research done in here. I am now looking for a member of RCIV working on *prevent* who would agree to be interviewed.
Mary: You're looking for Robert Smith then. No one else here works on that topic these days.

(22) is even more surprising and interesting. Anne uses the description *a member of RCIV working on* prevent in a nonreferring way – she does not have any clear idea yet of who that person might be and if there is more than one. Yet when Mary talks about Anne's search, she describes it as being a search for a particular person and she uses a proper name. The reason this is so is because according to Mary's information there is only one person satisfying the description used by Anne. So when Mary says her line, Anne interprets that sentence rather de re – as being about Robert Smith – than de dicto – as being about Anne's notion of such and such researchers.

Notice that we have slightly veered off from the initial picture where belief ascriptions had a tendency to be interpreted more de dicto rather than de re, but not the actual utterances that expressed those beliefs in the first place. Here, in the case of *look for*, we are beginning to see that also when the agent of the search professes her intentions, the hearer of such an utterance might tend to interpret it de re depending on the information he has.

Finally, consider the following situation. Black has a neighbor Jones. Jones works at the university and his boss there is Prof. Smith. One day John's son, Bill, gets beaten up at the playground by a girl called Mary. She happens to be Smith's daughter, though Jones does not know about it. After hearing about what happened, angry Jones says: "I'm going to find that awful girl's father and talk to him". At this point it can be said by Black that Jones is looking for Mary's father.

But now imagine that Black has a friend Brown, who knows Prof. Smith, but doesn't know who Mary is or about the incident. Brown is supposed to visit Black that afternoon. He comes in and says:

(23) I just saw your neighbor walking angrily with a baseball bat obviously looking for someone.

Would it be appropriate for Black to report to Brown on Jones' search in the following way:

(24) John is looking for Mary's father.

Since Black knows that Brown does not know who Mary's father is, keeping so close to Jones' notions in this situation would cost him his friend's understanding of his own utterance. It would be much better to start his explanation with the following sentence, even though it does not agree with what Jones professed:

(25) John is looking for Prof. Smith. (His daughter beat his son.)

A general lesson to be learned from the current section is that in cases of notional disharmony between the ascriber and the ascribee of "*seek* ascriptions" the ascriber does not have to stay true to ascribee's notions to perform a truthful ascription. In many cases what seems more important is for the ascriber to connect with whatever is known by the receiver of their utterance, or to connect with their own knowledge. Whoever hears someone professing that they are seeking something, interprets that sentence with respect to their own knowledge and their own notions. This is why in (21) Bill was ready to use the name *Clark Kent* instead of *Superman*.

The idea that the meaning and acceptability of a sentence depends on the information possessed by its receiver is of course not a novel one. It has led to the development of dynamic semantics in the early 1990s in Amsterdam. Two most important papers on the topic for our current purposes are *Coreference and Modality* of J. Groenendijk, M. Stokhof and F. Veltman ([10]) and F. Veltman's *Defaults in Update Semantics* ([21]). According to the dynamic credo, meaning of a sentence is the change it brings in the information state of its hearer.

Recall how Frege's puzzle would get interpreted in the dynamic setting. If an agent knows that Morning Star is Evening Star, then any sentence containing the first of those names will be equivalent for that person to that same sentence with *Evening Star* substituted for *Morning Star*. If the agent did not endorse the sentence *Morning Star is Evening Star*, then she will not conclude *Morning Star is a planet* from *Evening Star is a planet* – exactly because she will have no grounds to do so.

This is exactly what was happening in the Superman case and in the Mary's father case. In the Superman story, Bill endorses the sentence *Superman is Clark Kent*, so for him *John is looking for Superman* and *John is looking for Clark Kent* are interchangeable, because *Superman* and *Clark Kent* are interchangeable in every context. In the playground scenario, Brown does not endorse the sentence *Smith is Mary's father*, so for him *John is looking for Smith* and *John is looking for Mary's father* are not equivalent.

2.3   Update view of *seek* – a toy model

I will close this chapter with designing a toy dynamic model for simple *look for*-sentences to further elucidate what kind of a formalism I will be aiming at later. The general framework I am going to adopt is the one of update semantics (cf. [21]). Each sentence of a formal language will be assigned a procedure on information states which reflects the idea of updating the already possessed information with whatever the new sentence is saying.

Let us assume a language L containing individual constants $\mathbf{j}, \mathbf{f}, \mathbf{s}$; a two-place predicate $\mathbf{seek}$ and the identity sign $=$. $\mathbf{j}, \mathbf{f}, \mathbf{s}$ will stand for John, Mary's father and Smith respectively (technically speaking, Mary's father should be represented as a complex term including a function symbol standing for "father of x", but simplifying this matter won't affect the main point of this construction).

Moreover, let there be a domain $\mathcal{D}$ of individuals. An information state is a set of interpretation functions from L to $\mathcal{D}$. The interpretation functions work as expected: they assign members of D to constants of the language, a binary relation on $\mathcal{D} \times \mathcal{D}$ to $\mathbf{seek}$ and the identity relation on $\mathcal{D}$ to $=$.

Update of an information state σ with a formula φ means removing from σ those interpretation functions that render the formula false. Formally speaking: $\sigma[\mathbf{seek}(j, f)] = \{I \in \sigma | \langle I(j), I(f) \rangle \in I(\mathbf{seek})\}$. We say that state σ supports sentence φ iff $\sigma[\varphi] = \sigma$. Intuitively speaking it means that the information that φ already is in σ.

In such a system it is easy to distinguish between cases when the hearer of the sentence *John is looking for Mary's father* knows that Smith is Mary's father and the cases when she doesn't know that. First assume that $\sigma \Vdash \mathbf{f} = \mathbf{s}$, which means that the hearer already knows that Smith and Mary's father are the same person. Then $\sigma[\mathbf{seek}(\mathbf{j}, \mathbf{f})] \Vdash \mathbf{seek}(\mathbf{j}, \mathbf{s})$ and $\sigma[\mathbf{seek}(\mathbf{j}, \mathbf{s})] \Vdash \mathbf{seek}(\mathbf{j}, \mathbf{f})$. So, if the hearer already knows that Smith is Mary's father, then telling her that John is looking for Smith is the same as telling her that John is looking for Mary's father. Of course, when $\sigma \nVdash \mathbf{f} = \mathbf{s}$, such an equivalence does not hold. Note that it might as well be that in the actual world it is in fact the case that the Dean is Mary's father, but the hearer does not know about it. The actual state of the world does not influence these validities – only the information state of the hearer is considered relevant. This is exactly how dynamic semantics differs from the classical, truth-functional one.

Chapter 3

Specificity and nonspecificity

3.1 Specific and nonspecific readings

In the previous chapter I discussed the first of the two traditionally identified features of intensional transitive verbs, namely their supposed ability to block substitution of corefering terms in their object position. Now it is time to focus on the second characteristics, which is the fact that ITVs are taken to be ambiguous between specific and nonspecific interpretation.

The starting point of every existing article on ITVs – this one not being any exception – is the realization that sentences with intensional verbs allow for two kinds of readings, called specific and nonspecific, and that every formal account of their semantics should explain that feature. Most of the time the verb itself is taken to be ambiguous, with its nonspecific reading being derived from the specific one. At the same time a number of examples can be found when this general rule seems to be violated.

According to Van Geenhoven and McNally ([20]), the main problem with Zimmermann's approach is that in each case the existence of a nonspecific reading implies the existence of a specific one, since the first is directly derived from the second. This means that Zimmermann cannot account for cases where only nonspecific readings are available – and such cases are indeed attested.

Firstly, since Carlson's observation (cf. [2]), it is known that English bare plural receives a nonspecific interpretation regardless of whether it occurs in sentences containing intensional or extensional verbs:

(26) Mary is looking for red sweaters.

(27) Mary saw red sweaters in every store she visited yesterday.

In both of the above cases the red sweaters need not be specified, even though the sentence (27) does carry an existential entailment.

The same authors note also that there are verbs in West Greenlandic that allow only for nonspecific readings, even when their object is accompanied by modifiers that would normally force the specific interpretation. Clearly such verbs couldn't be handled by a theory where the nonspecific versions of ITVs are just the type-raised specific ones.

Moreover, a number of cases have been identified where the nonspecific readings seem to be blocked. According to Zimmermann ([22]), the sentence:

(28) Tom needs many toy monsters.

can be understood only specifically if *many* is interpreted in a proportional way. Under the proportional reading 28 expresses that the number of monsters that Tom needs is large in comparison with the number of all monsters (that are there given the context). When *many* is understood under a cardinal interpretation, both specific and nonspecific reading is available. Under this second interpretation the NP *many toy monsters* denotes a property of being a sufficiently large (in the given context) collection of monsters.

Sentences involving *each* and *most* also seem to receive only specific interpretations ([22], [12]):

(29) I am looking for each typo in the manuscript.

(30) I am looking for most typos in the manuscript.

All the above examples point to the fact that the issue of specificity and nonspecificity of intensional verbs is not only complicated, but also that in order to get some answers, we should look into the semantics of NPs. After all, strictly speaking, specificity is a property of noun phrases and not of verbs. The issue of what it means exactly for a noun phrase to be specific has never been clear, therefore some introductory remarks are in place. This is what I turn to now.

3.2   Specific and nonspecific indefinites

Let us start with the considerations that can be found in D. Farkas' article *Specificity and Scope* ([5]). According to the author, there are at least three independent notions of specificity of indefinite NPs that should be kept apart: epistemic, scopal and partitive. These distinctions can be brought into light with the following set of examples (examples are as found in [5]).

(31) Epistemic specificity ([7]):

    a. A student in Syntax 1 cheated on the exam.
    b. His name is John.
    c. We are all trying to figure out who it was.

In (31) the continuation (31b) forces the specific reading, whereas (31c) suggests a nonspecific one. The difference between the two readings is supposed to lie in the difference between the information possessed by the speaker in each of the cases. In the case of epistemically specific sentences, the speaker is supposed to have just one individual in mind as a referent of the indefinite. In the nonspecific case the speaker does not intend to refer to any specific individual. Notice also that (31) provides also an example of a possible test for epistemic specificity of any given sentence. If the target sentence can be continued with an episodic sentence containing a personal pronoun referring to the indefinite, then the sentence is epistemically specific.

(32) Partitive-specificity ([4]):

    a. There are some ghosts in this house.

    b. Some ghosts live in the pantry; others live in the kitchen.

The first time partitives were discussed as connected with specificity issues was in M. Enç's article *The Semantics of Specificity* ([4]). A noun phrase is partitive if it denotes a subset of a set that has already been introduced in the discourse. In (32a) there were no ghosts previously acknowledged in the discourse. In (32b) such a set is required for the sentence to be correct. Notice that in (32a) the phrase *some ghosts* cannot be felicitously replaced with *some of the ghosts*, while it is admissible in (32b).

(33) Scopal specificity:

    a. John wants to marry a Norwegian.

    b. He met her last year.

    c. He'll move to Norway to try to achieve this goal.

The scopal one has been very often taken to be the default notion of specificity, sometimes even at a cost of confusing it with the other kinds. An indefinite is scopally specific if its interpretation depends on the interpretations of quantifiers and intensional operators in the same sentence. The continuation (33b) forces a reading where *a Norwegian* has wide scope with respect to *want*, which is assumed to be an intensional predicate. On the other hand, (33c) forces us to interpret the indefinite as taking narrow scope with respect to *want*.

Farkas concludes her overview of the types of specificity with the following remark. It turns out that what the three types have in common is that it is always the case that the range of possible referents is intuitively smaller in the specific case than in the nonspecific case. In the case of epistemic specificity the set of things that the indefinite might refer to is taken from the set of things that the speaker considers possible at all; and if that indefinite is specific, it will refer to just one of those objects. A non-partitive NP *three girls* does not presuppose any set of girls smaller than the set of all possible girls, whereas the partitive *three of the girls* does. Finally, scopally nonspecific noun phrases can take their referents from the domains of multiple possible worlds (access to which is given by intensional operators) or multiple variable assignments (in the case of qualificational phrases taking wide scope over the indefinite), while their scopally specific sisters do not. We will see soon that this observation can be fruitfully interpreted once we decided to interpret sentences with intensional verbs in a dynamic way.

3.3 Specificity and dynamics

With the new vocabulary at our disposal, it is time to redefine the task we have set out to complete. So far I have come to a conclusion that it might be a fruitful undertaking to devise a dynamic semantics for *look for*. Such a system would take care of hyperintensionaliy issues traditionally connected to semantics

of intensional verbs, but still the question of specific and nonspecific readings would have to be addressed. In the light of the previous section it becomes clear that once a dynamic perspective is adopted, the notion of specificity that will be primarily modeled is a hearer-oriented epistemic one.

Recall again the story (3) from section 1.1:

(34) Anne is a journalist working on an article about the Research Center for Intensional Verbs (RCIV). She is just starting to research her topic, therefore she doesn't know yet that there is only one person there who works on the verb *prevent*. She is talking to Mary, one of the researchers:
Anne: I would like to mention in my article all possible lines of the research done in here. I am now looking for a member of RCIV working on *prevent* who would agree to be interviewed.
Mary: You're looking for Robert Smith then. No one else here works on that topic these days.

Initially Mary has every reason to believe that Anne does not know how many people in the Center work on *prevent*. At the same time, she herself has full information about RCIV and its staff. So when Anne makes her utterance, Mary interprets it as being about Robert Smith; for Mary, Robert Smith is such that Anne is looking for him. An analogous situation can be observed in the following dialog:

(35) In a store:
John: I am looking for a size 40 blue coat with black lapels.
Bill: Then, Sir, you are looking for this coat. You were lucky – it is the last one left after our big sale last week.

Here, again, it is only Bill who knows what is in the store, and, specifically, how many blue coats with black lapels in size 40 are left. Therefore when John confesses that he is looking for a coat like that, a "specified" version of that utterance can be inferred by Bill as, indeed, being equivalent with what John said – regardless of what John's own beliefs and intentions were at that time.

What is happening in both cases is that it is the hearer who judges that the relevant sentence is about a specific individual. It is done because according to the hearer's information state there is only one individual fulfilling the description provided by the indefinite. If Bill had believed that there were two coats of the mentioned kind in the store, he would not have pointed at the one he did point at and he wouldn't have said what he said. If Smith had a collegue working on the same topic, and Mary knew about it, she also would not have said what she did say.

Therefore we can say that in both cases the relevant sentence was taken by the hearer to be specific exactly because according to their information there was only one object in the real world that the indefinite could refer to. A very similar notion was already described by Farkas:

> For epistemically specific indefinites, all updates relative to the variable introduced by the indefinite that are consistent with the speaker's point of view agree in the value they assign to this variable. In the case of epistemic non-specificity, there is variation with respect to

the value assigned to the variable in question not only given information provided by the context as a whole but also with respect to what the context present as information available to the speaker. ([6], p. 239)

Farkas preliminarily fleshes out this idea in [5]. She describes a simple model of conversation where each agent is assigned a set of worlds representing their information state. The common ground is represented as another set of possible worlds. An indefinite is taken to be epistemically specific for the agent i when in every world in i's information state the indefinite refers to the same object x - which means that the indefinite refers rigidly with respect to i's information state. The latter does not have to be the case for the common ground - it might be that i is the only participant in the conversation that takes the given indefinite to refer to a specific object. In the example (31), for instance, it might happen that the person uttering the sentence (31a) does have a specific person in mind, but none of the hearers have enough information to determine who the cheater is. In that case, even though *a student* will refer rigidly in i's information state, it will not be the case for the common ground.

When it comes to the semantics of *look for*, we can take this whole line of thought to another level. Recall Farkas' observation that the difference between specific and nonspecific indefinites is the size of sets of their possible referents. That observation can be generalized to the following statement: a specific indefinite is just a nonspecific one, whose set of possible referents happens to be a singleton set – and therefore the indefinite ends up referring to a single individual (cf. [18]). To implement such an idea one has to treat objects of intensional verbs as primarily denoting some set-like objects that will supply us with a range of possible referents. This is not too far fetched, if we compare this current formulation with i.e. Zimmermann's property semantics for intensional verbs.

The idea that epistemic specificity is just a special case of nonspecificity is also compatible with the following Zimmermann's observation that proper names have a strong tendency to force specific readings of sentences with intensional verbs:

As always with referentially opaque verbs, one may distinguish between specific (or 'objectual') and unspecific (or 'notional') readings, the latter being typical of indefinites whereas proper names tend to be restricted to the former. ([24], p.1)

Any hearer will interpret a proper name as a name of one object. Notice though that it does not have to be the case that the hearer will be able to identify the exact individual to which a proper name refers to. Suppose for instance that Bill hears John saying: *I am looking for Mary.* Bill knows that one of the women at a party they went to with John the other day was called Mary, but he is not sure, which one. Therefore even though Bill will know that John is looking for exactly one person (as opposed to i.e. an arbitrary member of a larger set of people), he won't be able to point to that person - and therefore the whole sentence will still be nonspecific to Bill. The less often such situations occur, the stronger the "specific tendency" of sentences involving proper names and intensional verbs will be.

What about interpreting scopal specificity in a dynamic setting? For the time being I leave that issue untouched – I will get back to it in section 5.6. It is indeed obvious that scopal specificity is an important phenomenon and, as Farkas shows, it's separate from epistemic specificity. Therefore eventually it will have to be dealt with in the present setting. First though I want to develop a formalism to capture the ideas I described so far and only later, with the formal machinery in hand, I will return to the question of scopal specificity.

Chapter 4

The system

4.1 Towards a formalization

Recall a simple dynamic system introduced in section 28. While it did get the idea of dynamic interpretation of *look for*-sentences right, it lacked the most important feature, namely a way to represent nonspecific objects of sentences containing an intensional verb. In this chapter I develop such a formalism. It will draw strongly on the logic for generalized quantifiers introduced by J. Barwise and R. Cooper in [3]. The main feature of this approach is that all NPs are given the same kind of denotation, namely sets of sets of individuals – quantifiers.

The first problem one encounters in this setting is of course the fact that the only verbs that Barwise and Cooper consider in their formalism are the extensional ones, represented by relation symbols taking individual constants and variables as their arguments. Treating intensional verbs in the same way would result in forcing the traditional specific readings on them, which is exactly what has to be avoided. An idea that immediately comes to mind in this situation is to take intensional verbs to denote relations not between individuals, but between quantifiers, which should grant us the desired amount of nonspecificity. What *a sweater* refers to is a set of all sets that contain at least one sweater - no existential quantifier shows up in the formula that would require a specific individual to be picked from the domain. We will therefore have to introduce a new kind of relation symbols to the language – I will call them higher order relation symbols. They will take quantifier expressions rather than individual variables or constants as their arguments.

In the previous two chapters two ideas have been introduced. First I argued for the feasibility and the need of developing a dynamic semantics for intensional verbs. Secondly I noticed that specific readings of sentences with intensional verbs can be seen as special cases of nonspecific readings. This chapter aims at making both of these ideas formal, taking the simple uses of the verb *seek* as a starting point.

4.2 Language and semantics

In developing the first approximation of an accurate formalism, I will focus on the simplest possible language that can serve that purpose – i.e. the one having only symbols representing intensional transitive verbs and not the extensional ones. One place predicates are used in order to form translations of English noun phrases. The simplest kind of language to be inspected is presented in definition 4.2.1.

Definition 4.2.1 (The language). *The language L_1 consists of the following:*

- **Logical symbols:**
  propositional connectives $\wedge$, $\vee$, $\neg$
  individual variables $x, y, \ldots$
  a distinguished set term thing
  parentheses (,)
  an equality symbol $=$
  a cap symbol $\hat{\ }$
  *a set of logical determiners such as **some**, **every**, **no**, **both** etc.*

- **Nonlogical symbols:**
  *a set of individual constants **j**, **m**, $\ldots$*
  predicate symbols: P, S, $\ldots$
  higher-order relation symbols $\mathbf{R}, \mathbf{S}, \mathbf{seek}$
  *a set of non-logical determiners, i.e. **most**, **many** etc.*

Therefore L_1 is a variation on a class of languages defined by Barwise and Cooper. The main difference is that out of classical relation symbols only unary predicates are retained. Also, a new kind of binary relation symbols replaced the standard ones. All this was made possible by deciding to not include extensional verbs in the picture, at least for the time being. The following definition makes it clear how the new relation symbols will act.

Definition 4.2.2 (Expressions of L_1). *The following rules apply to forming expressions of L_1:*

- **Set terms:** *Every predicate symbol is a set term. The term* thing *is a set term. For every individual constant or variable t, $\hat{x}(x = t)$ is a set term*

- **Quantifiers:** *If D is a determiner and η a set term, then $D(\eta)$ is a quantifier.*

- **Formulas:**
  Every individual constant and variable is a formula.
  If η is a set term and t is an individual variable or a constant then $\eta(t)$ is a formula.
  If Q_1 and Q_2 are quantifiers and $\mathbf{R}$ is a higher-order relation symbol, then $\mathbf{R}(Q_1, Q_2)$ is a formula.
  If Q is a quantifier and η is a set term, then $Q(\eta)$ is a formula.
  Formulas are closed under standard sentence formation rules for propositional connectives.

Set terms can be understood to be names of sets - P is a name of a set of things that are P, *thing* is the name of the set of all things in the domain. The term *thing* is needed to form quantifiers like **every**(*thing*) or **some**(*thing*), corresponding to the English *everything* and *something*, as discussed in [3]. Set terms are then combined with determiners to form quantifiers, i.e. **some(dog)**, **2!(woman)** (*some dog, (exactly) two women*).

Formulas of L_1 are expressions that correspond to English sentences. The first clause in the definition of formulas allows for forming sentences like **run(r)**, which can be a translation of a simple English sentence *Rex runs*. Combining a quantifier and a set term gives us sentences like **every(dog)(run)**, which can be a translation of *Every dog runs* into L_1. The novel part in the definition 4.2.2 is formation of sentences with the use of higher-order relation symbols. These symbols represent relations on quantifiers, which are taken to be what intensional transitive verbs refer to.

The semantics for L_1 will differ from the semantics of Barwise and Cooper in two respects. First, the use of relations on sets of sets has to be made, and second, notions of information state and update of it with a formula need to be defined. For a given domain of individuals $\mathcal{D}$ I define an interpretation function I that assigns denotations to all expressions of L_1.

Definition 4.2.3 (Semantics of L_1 - static)**.** *An interpretation function I of L_1 into a domain $\mathcal{D}$ of individuals is defined as follows:*

- *If t is an individual constant or a variable, then $I(t)$ is an element of $\mathcal{D}$.*

- *If η is a set term, then $I(\eta)$ is a subset of $\mathcal{D}$. For every I, $I(thing) = \mathcal{D}$. For every t, $I(\hat{x}(x = t)) = \{I(t)\}$.*

- *$I(=) = Id$, the identity relation on $\mathcal{D}$.*

- *If D is a determiner, then $I(D)$ is a function from $\mathcal{P}(\mathcal{D})$ to $\mathcal{P}(\mathcal{P}(\mathcal{D}))$.*

- *If $\mathbf{Q}$ is a higher-order relation symbol, then $I(\mathbf{Q})$ is a binary relation on $\mathcal{P}(\mathcal{P}(D)) \times \mathcal{P}(\mathcal{P}(D))$.*

- *If D is a determiner and η a set term, then $I(D(\eta))$ is the result of applying $I(D)$ to $I(\eta)$.*

- *If Q is a quantifier and η is a set term, then $I(Q(\eta)) = 1$ if $I(\eta) \in I(Q)$ and $I(Q(\eta)) = 0$ if $I(\eta) \notin I(Q)$.*

- *If $\mathbf{Q}$ is a higher-order relation symbol and Q_1 and Q_2 quantifiers, then $I(\mathbf{Q}(Q_1, Q_2)) = 1$ if $(I(Q_1), I(Q_2)) \in I(\mathbf{Q})$ and $I(\mathbf{Q}(Q_1, Q_2)) = 0$ otherwise.*

- *Compound sentences like $\varphi \wedge \psi$ receive truth values in the classical way.*

The above definition gives the same interpretation to expressions of L_1-type languages as in [3]. Predicates and individual constants/variables receive a standard, first-order interpretation. The expression $\hat{x}(x = t)$ allows us to refer to a singleton set rather than to an individual in it. Determiners denote functions from sets of individuals to sets of sets of individuals. Therefore when a determiner is combined with a set term, the result is a set quantifier

– a set of sets of individuals.[1] A sentence consisting of a quantifier Q and a set term η is true if the set denoted by η is in the denotation of Q, i.e. $\mathbf{2!}(woman)(\mathbf{run})$ is true if the set of individuals that run is one of the sets that contain exactly two women in them (and possibly other things). A sentence like $\mathbf{seek}(\mathbf{most}(man), \mathbf{some}(woman))$ (*Most men seek a woman.*) is true if the relation denoted by $\mathbf{seek}$ holds between set quantifers denoted by $\mathbf{most}(man)$ and $\mathbf{some}(woman)$.

Definition 4.2.3 provides denotations of expressions of L_1 in a given domain, but only for one interpretation function. In order to interpret sentences of L_1 dynamically an appropriate notion of an information state needs to be defined. In the most straightforward way an information state for a language like L_1 can be defined as a set of interpretation functions defined as in 4.2.3. The different interpretation functions can be seen as the different ways the world could be like according to the hearer.

Note that it is only meaningful to define an update of an information state with a sentence, not with just any expression available in the language. That is of course the way things should be, since hearing only the expression *Most men* does not allow the hearer to update her information state with any information [2]. Since in the current setting I am not concerned with sentences containing anaphoric references, I can define update operation on information states to take only sentences of L_1 that do not contain free variables.

Definition 4.2.4 (Semantics of L_1 - dynamic).   • *An information state is a set of interpretation functions as defined in 4.2.3.*

- *Update of a state σ with a formula φ is defined only for formulas with no free variables.*

- *For an information state σ and a formula φ with no free variables we define the update of σ with φ as: $\sigma[\varphi] = \{I \in \sigma | I(\varphi) = 1\}$.*

- *A state σ supports a formula φ, $\sigma \Vdash \varphi$, iff $\sigma[\varphi] = \sigma$.*

According to this definition, updating an information state σ with a formula φ removes all those interpretation functions from σ that made φ false - the hearer accepts the information conveyed by φ.

4.3   Translating English into L_1

The main point of developing L_1 and its semantics was to be able to formalize simple English sentences containing the verb *look for* and to model their behavior in dialog settings with the use of an update semantics. The rules of translating such English sentences are therefore simple and rather intuitive.

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[1]Some clarification of terminology is due at this point. The term *quantifier* can be used to denote both certain expressions of the formal language L_1 and the sets of sets that those expressions denote in the model. In contexts where confusion might arise I will refer to the latter as *set quantifiers.*

[2]Unless *Most men.* is an ellipsis and stands for a whole proposition, like in a dialogue: A: Who wore suits last night? B: Most men (wore suits).

First of all, proper names like *John* when used as noun phrases get a translation $\mathbf{the}\hat{x}[x = \mathbf{j}]$ rather than just $\mathbf{j}$. This allows us to treat all noun phrases uniformly as denoting quantifiers (cf. [[3],p. 174]). The verb *look for* is translated as $\mathbf{seek}$, a higer-order relation symbol (similarly for other intensional verbs). Sentences of the form "NP_1 *is looking for* NP_2" are translated as $\mathbf{seek}(Q_1, Q_2)$, where Q_1 and Q_2 are respective translations of NP_1 and NP_2.

Nouns like *dog, sweater* are translated into predicate symbols in a standard way. English determiners are straightforwardly translated into determiners of L_1.

Examples:

(36) John is looking for Mary: $\mathbf{seek}(\mathbf{the}\hat{x}[x = \mathbf{j}], \mathbf{the}\hat{x}[x = \mathbf{m}])$

(37) John is looking for a sweater: $\mathbf{seek}(\mathbf{the}\hat{x}[x = \mathbf{j}], some(sweater))$

(38) Three men are looking for two women: $\mathbf{seek}(3(man), 2(women))$

4.4 Defining specific readings

It is time to give some formal shape to our earlier considerations about specific readings and how they could be seen as a special case of the nonspecific ones. Consider the following two sentences:

(39) John is looking for Mary.

(40) John is looking for a sweater.

We want both of these sentences to be able to receive a specific reading, in fact we want the first one to (almost) always receive one. Let's look at what meaning will these sentences be assigned according to the definitions introduced in this chapter.

Assume that both sentences are heard by a hearer with an information state σ, which results in updates of σ into $\sigma[\varphi_1]$ and $\sigma[\varphi_2]$ (assuming that φ_1, φ_2 are translations of (39) and (40) into L_1, respectively). In both cases we can safely assume that according to every interpretation in σ the NP *John* receives the same denotation – that means that the hearer has no doubts as to who John is. Of course it does not have to be the case, but it would be an example of a completely different, here irrelevant, idea of unspecificity. So, for every $I \in \sigma$, $I(\mathbf{the}\hat{x}[x = \mathbf{j}]) = \{X \subseteq D | j \in X\}$, where j is John (according to the hearer).

Traditionally, a sentence containing an intensional verb is understood specifically if there is an object in the domain such that the object NP refers to it and only it. In the present setup though, NPs cannot receive denotations that are individuals. We need to rethink what "referring to a specific individual" can mean here. The inspiration comes from the way proper names are interpreted – they can be taken as a paradigmatic case of specific NPs. The NP *John* is interpreted as a set of all sets in D that contain j - that set is a filter on $\langle D, \subseteq \rangle$ generated by $\{j\}$. Given such a structure, it is possible to identify the individual that would be the denotation of that NP in a standard first-order setting. We will therefore say that a quantifier is specific in the domain $\mathcal{D}$ according to an

interpretation I if its denotation according to I is a filter generated by a single subset of $\mathcal{D}$.

It becomes clear at this point that the dynamic perspective introduces not one, but two possible ways of understanding what it means for a sentence containing an intensional verb to be interpreted as specific by the hearer. Let us go back to the sentence (39). Our agent might not have a clear idea of who exactly Mary is - it might therefore be the case that there are two interpretation functions in σ that differ with respect to the denotation of $\mathbf{the}\hat{x}[x = \mathbf{m}]$. Still, in each of these cases, *Mary* will be specific in D - it will always be interpreted as a filter generated by some singleton set, just not necessarily the same one in every case. If such a situation occurs we can say that the sentence was interpreted in a weakly specific way - the hearer did interpret the sentence as saying something about an individual, but cannot point to the exact one (this notion will come back to us in section 5.6). On the other hand, if every interpretation function in $\sigma[\varphi_1]$ assigns the same filter to $\mathbf{the}\hat{x}[x = \mathbf{m}]$, we can talk about a strongly specific interpretation which is equivalent to the traditional notion of epistemic specificity.

So far it seems that things go smoothly and we are ready for formal definitions, but a quick look at (40) reveals that there are still some serious problems to be solved. Remember that we want to allow for the case when the hearer interprets (40) as saying something about a particular sweater. But with the current definitions the only way for that to happen is if the hearer also believes that there is only one sweater in the world - otherwise the translation of the NP *a sweater* into L_1 will by no means receive a denotation that is a filter. This is not right. We want it to be possible for the hearer to believe both that there are many sweaters in the world and that John seeks just one of them.

It seems that the best way to have that is to modify the semantics of the **seek** relation in such a way that it will sometimes give us a filter in a model regardless of whether the original object quantifier had a specific denotation or not. One way to do it is to allow for **seek** sentences to be true also in cases when the relation holds between the denotation of the first argument and only a subset of the denotation of the second. The only problem with this definition is that arbitrary subsets of quantifiers have no intuitive counterpart on the side of natural language.

Definition 4.4.1 (Right semantics of **seek** - static). *Given an interpretation function I of L_1 into a domain $\mathcal{D}$ of individiuals, define:*
if $\mathbf{Q}$ is a higher-order relation symbol and Q_1 and Q_2 quantifiers, then
$I(\mathbf{Q}(Q_1, Q_2)) = 1$ if there is a nonempty set $X \subseteq I(Q_2)$ such that $(I(Q_1), X) \in I(\mathbf{Q})$ and $I(\mathbf{Q}(Q_1, Q_2)) = 0$ otherwise.

With this definition at hand we can go back to the sentence (40). Its translation into L_1 is $\mathbf{seek}(\mathbf{the}\hat{x}[x = \mathbf{j}], some(sweater))$. It will be true in those interpretations, where the set quantifier denoted by the name *John* is in the **seek** relation with some nonempty subset of $\{X \subseteq \mathcal{D} | X \cap S\}$ (where S is the set of sweaters). If that subset happens to be $\{X \subseteq \mathcal{D} | s_1 \in X\}$, we can say that there is a one particular sweater that John seeks - namely, s_1.

Also sentences like

(41) John is looking for two sweaters.

can be interpreted specifically in the current setting. The NP *two sweaters* denotes a set X of all sets that contain at least two sweaters. It is enough for getting the specific reading that def. 4.4.1 will provide a subset of X which will be a fliter on $\mathcal{D}$ generated by $\{s_1, s_2\}$ with $sweater(s_1)$, $sweater(s_2)$.

Chapter 5

Solutions

5.1 Validity

To be able to talk about what kinds of inferences are valid in the system introduced in the previous chapter, an appropriate concept of validity has to be defined. In [21] F. Veltman considers three distinct notions of validity of arguments that can be defined in a dynamic setting. The three notions coincide in case the system in question is an additive one.

An update system (a system consisting of a formal language, a set of information states and an update relation on the latter) is additive if it contains a minimal information state and there is a binary operation on the set of states that has all the properties of a join operation. Moreover it has to be the case that updating any state with a sentence φ is equivalent to joining that state with the minimal state updated with φ (cf. [21], p. 222-223). It is easy to show, using the Proposition 1.2 from [21], that the update system defined in the previous chapter is in fact additive. I can therefore use the most straightforward definition of validity:

Definition 5.1.1 (Validity of arguments). *An argument from premises $\varphi_1, \ldots, \varphi_n$ to a conclusion ψ is valid iff for every information state σ: if $\sigma \Vdash \varphi_i$ for all $i \leq n$, then $\sigma \Vdash \psi$.*

5.2 Modeling dialogs

Recall the following stories that were used to motivate the formal setup of this paper:

(42) *Bill*: Why are you running around like this today?
John: I am looking for Superman. Last night he saved my life and I want to thank him. And people say he is sometimes seen in our neighborhood.
Bill: Ah, I know who you're looking for then: Clark Kent. His office is on the third floor. He is Superman, you know.

(43) Anne is a journalist working on an article about the Research Center for Intensional Verbs (RCIV). She is just starting to research her topic,

therefore she doesn't know yet that there is only one person there who works on the verb *prevent*. She is talking to Mary, one of the researchers:

Anne: I would like to mention in my article all possible lines of the research done in here. I am now looking for a member of RCIV working on *prevent* who would agree to be interviewed.

Mary: You're looking for Robert Smith then. No one else here works on that topic these days.

It is time to see if such scenarios can be fruitfully translated into my system.

In (42) Bill knows that Superman and Clark Kent are the same person. This means that his information state after hearing John's utterance supports both *Superman is Clark Kent* and *John is looking for Superman*. Since under every interpretation in Bill's belief state *Superman* and *Clark Kent* receive exactly the same interpretation, every subset of the denotation of *Superman* will be also a subset of a denotation of *Clark Kent*. This means that Bill's state supports the sentence *John is looking for Clark Kent*, which he shows by uttering it honestly.

In (43) Mary knows that there is only one researcher working on *prevent*. This means that in every interpretation in her belief state *a researcher working on* preventand *Robert Smith* are mapped into the same set quantifier, namely a filter R generated by $\{r\}$ (a singleton set containing the actual Robert Smith). Therefore after she updates with *Anna is looking for a researcher working on* prevent, in every remaining interpretation there is a subset of R that is in the **seek**-relation with Anna. Which means that Mary's state supports the sentence *Anna is looking for Robert Smith*.

5.3 Inference patterns

After checking if my semantics conforms to the intuitions that motivated it in the first place, I proceed to check if it also correctly predicts some intuitively valid inference patterns. First of all, let us check if the new definition 4.4.1 gives the right predictions about substitution of coreferential terms:

(44) Mary's father is the Dean.
    John is looking for Mary's father.
    John is looking for the Dean.

The way to think about (44) in a dynamic way is the following. Imagine a person that already knows that Mary's father is the Dean. That person, moreover, was told that John is looking for Mary's father. Her information state therefore supports both these sentences. The question now is whether her information state also supports the conclusion of the argument.

(44) translates into L_1 in the following way:

(45) $\mathbf{f} = \mathbf{d}$
    $\mathbf{seek}(\mathbf{the}\hat{x}[x = \mathbf{j}], \mathbf{the}\hat{x}[x = \mathbf{f}])$
    $\mathbf{seek}(\mathbf{the}\hat{x}[x = \mathbf{j}], \mathbf{the}\hat{x}[x = \mathbf{d}])$

Assume $\sigma \Vdash \mathbf{f} = \mathbf{d}$. This means that for every $I \in \sigma$ we have $I(f) = I(d)$. Assume also $\sigma \Vdash \mathbf{seek}(\mathbf{the}\hat{x}[x = \mathbf{j}], \mathbf{the}\hat{x}[x = \mathbf{f}])$. Therefore in every model in σ the filter generated by $\{j\}$ is in the **seek**-relation with some subset of the filter

generated by $\{f\}$. But since $I(f) = I(d)$, every such subset is also a subset of the filter generated by $\{d\}$ and therefore we get $\sigma \Vdash \textbf{seek}(\textbf{the}\hat{x}[x = \textbf{j}], \textbf{the}\hat{x}[x = \textbf{d}])$.

Note that so far in the formal analysis of (44) no beliefs of John were considered. Such a perspective comes naturally in the dynamic setting, but by no means are we disallowed to consider John as an agent with an information state. John might as well support the sentence *I am looking for Mary's father*. But as long as he does not also support *The Dean is Mary's father*, he will not support *I am looking for the Dean*. Therefore the classic analysis of the intensionality problem for intensional verbs can actually be modelled in our present setting.

To analyze the behavior of the **seek**-relation with respect to logical connectives conjunctions and disjunctions of NPs have to be defined first.

Definition 5.3.1 (Conjunctions and disjunctions of NPs). *For every interpretation function I on a domain $\mathcal{D}$ and quantifiers Q_1, Q_2:*

- $I(Q_1\, and\, Q_2) = I(Q_1) \cap I(Q_2)$

- $I(Q_1\, or\, Q_2) = I(Q_1) \cup I(Q_2)$

With these definitions the following inferences become valid:

(46) John is looking for a sweater and John is looking for a coat.
John is looking for a sweater and a coat.

(47) John is looking for a sweater and a coat.
John is looking for a sweater and John is looking for a coat.

(48) John is looking for a sweater or John is looking for a coat.
John is looking for a sweater or a coat.

(49) John is looking for a sweater or a coat.
John is looking for a sweater or John is looking for a coat.

Notice that in all the above cases specificity of the premise gets inherited by the conclusion – a nonspecific premise can grant only a nonspecific conclusion, and a specific premise insures a specific conclusion.

In principle it would also be possible to define conjunctions and disjunctions of NPs as mereological sums of their denotations - *Bill and Mary* would in that case denote a compound individual that is exactly Bill and Mary taken together. In such a setting inferences like (46) and (47) would not be valid, and rightly so. We might imagine a situation when the hearer knows that John is suspecting that his girlfriend Mary and his friend Bill are having an affair and goes on a hunt for them. It is therefore natural to conclude that John is only interested in finding Bill and Mary together and finding Mary in her office and Bill in the gym is not an option.

Montague notes ([14], p. 175) that it was already noted by Buridan that from the fact that Jones owes Smith a horse it does not follow for any specific horse that Jones owes Smith that very horse. In fact, the following inference is not correct according to the present semantics:

(50) John is looking for a sweater. $\nRightarrow$ John is looking for sweater 1 or John is looking for sweater 2 or . . .

This is of course the way things should be – intuitions behind examples like (50) were the exact reason for considering verbs like *look for* to be of a different kind than standard extensional verbs. On the other hand, when the premise is specific, the conclusion does follow, which is again desired.

5.4   Monotonicity

Zimmermann in [23] points to an interesting issue in formal semantics of ITVs which he calls the Monotonicity Problem. He argues that any such semantics should validate the following inference pattern:

(51) John is looking for a dog. $\Rightarrow$ John is looking for an animal.

Or, more generally:

(52) John is looking for an A. (Every A is a B) $\Rightarrow$ John is looking for a B.

But such a principle, combined with the seemingly equally plausible:

(53) John is looking for a dog. Mary is looking for a dog. $\Rightarrow$ John and Mary are looking for the same thing.

gives us an obviously wrong:

(54) John is looking for a dog. Mary is looking for a coat. $\Rightarrow$ John and Mary are looking for the same thing.

This last inference is made possible because (52) allows us to infer *John is looking for something* and *Mary is looking for something* from the initial premises.

It is easy to check that (51) holds in the system developed in this paper: every set containing at least one dog is also a set containing at least one animal. One can also infer "John is looking for something" from "John is looking for a dog", since *something* is interpreted as **some**(*thing*) in L_1.

To check the rest of the predictions in question we have to find a way of interpreting the sentence "John and Mary are looking for the same thing" in L_1 and its semantics. Remember that if the sentence "John is looking for a dog" is true in a given interpretation I, then there is a subset of the denotation of *a dog* related to John with the **seek** relation.[1] The sentence 'Mary is looking for a dog" will introduce another subset of $I(\mathbf{some}(dog))$, which does not have to be identical with the previous one.

We can say that Mary and John are looking for the same thing only in case there is a thing that both Mary and John are looking for – in case of our semantics, there would have to be a set quantifier that is **seek**-related to both Mary and John. But the truth of the premises of (54) can supply us with two

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[1] I do speak somewhat loosely here, not distinguishing between English and its translations into L_1. In this case though it does not seem to cause confusion.

different sets – one **seek**-related to Mary, the other to John, and they do not have to be the same. Therefore both (53) and (54) fail in my system.

All the above results should not come as a surprise for a reader familiar with Zimmermann's paper on the Monotonicity Problem. The solution he adopts is very similar to the present one. Zimmermann defines the semantics of *look for* in such a way that it guarantees the existence of subsets of properties rather than those properties alone (remember that for Zimmermann intensional verbs denote relations between individuals and properties). It seems though that my semantics has an advantage here. While for Zimmermann introducing such subsets solves only the problems arising around the monotonicity issue, my main motivation was to be able to have a uniform treatment of specific and nonspecific readings. The latter lets me avoid having to have two separate translations of the verb *look for* in the lexicon. What this fact nevertheless suggest, is that in principle the ideas presented here could be translated into Zimmermann's framework.

5.5 Existential entailments and fictional objects

Another important topic that our system needs to deal with are the issues related to existential entailments of sentences with and without ITVs. First of all, a crucial observation that has driven all attempts to devise a semantics for intensional verbs was that the fact that John is looking for a unicorn does not entail that any unicorns exist in the actual world. This fact goes hand in hand with the idea that if John were to find a unicorn, the actual existence of the latter would be indisputable.

The second idea that has predominated the research concerning ITVs is that existentially entailing readings of intensional verbs are the same as the specific ones. In other words, whenever John is looking for some specific individual, that individual has to exist in the actual world.

This last assumption does not fare well when it is epistemic specificity that we are after, like in the present case. After all, it is perfectly possible for any agent to believe that Sherlock Holmes is an individual with certain characteristics, and also an individual different than Dr. Watson. Moreover, sentences like:

(55) Sherlock Holmes does not exist.

(56) Sherlock Holmes lived in London.

are perfectly acceptable for many people and indeed believed to be true. This suggests that issues of existence, fictionality etc. should not be confused with specificity. There are many ways to make a formal language express sentences like (55) and (56). One of them is to introduce the existence predicate into the object language. Once it is done, we can make sense of conversations of the following types:

(57) *John*: I am looking for a unicorn. I'm sure it will heal my wounds.
    Bill: You're looking for something that does not exist. Stop being such a fool.

(58) *John*: I'm looking for Sherlock Holmes. I lost my cell phone and I want him to find it for me.
Bill: Would you please come to your senses? You're looking for a guy that doesn't exist.

In the traditional way of interpreting *look for* it was impossible to treat the sentence *John is looking for something that does not exist* as meaningful. Moreover, such a sentence was supposed to report John's beliefs, and he could not be seeking something he knew did not exist. In a dynamic setting those sentences are not only meaningful, but also can be straightforwardly modeled.

In (58) Bill, even though he does not think Sherlock Holmes is a real person, still recognizes the name and recognizes it as a name of a particular man as described by Arthur Conan Doyle. Sherlock Holmes is still a specific individual for him, albeit merely a fictional one. For John, on the other hand, Sherlock is a very real person - but the hearer is not interested in that, since he evaluates John's utterances in (57) and (58) against his own information state. Since Bill is a man of common sense, he knows that unicorns do not exist and that there are many fictional ones – which is why for him John's utterance in (57) is nonspecific. On the other hand, every interpretation in Bill's belief state assigns the same object to the name *Sherlock Holmes*, and under all those interpretations the predicate *fictional* (which by a meaning postulate implies nonexistence) applies to that object.

Once the existence predicate is introduced to our formal language, it turns out that extensional verbs will no longer straightforwardly carry hearer-oriented existential entailments. Nothing prevents an information state from only consisting of interpretation functions according to which John found a unicorn, but all unicorns in all such models are nonexistent. Such a situation wouldn't be problematic once the verb in question here was of the *look for* sort. Such a tendency of extensional verbs to talk only of real things can be represented by introducing meaning postulates for them that will imply that every object of any extensional verb has the existence property.

5.6   Reinterpreting scopal specificity

I already mentioned in chapter 3 that I should return to the question of scopal specificity and how it could be represented in the formal system I have set up initially to deal with epistemic specificity. What is scopal specificity? At a first approximation, we can say that an indefinite is scopally specific when it takes wide scope over other operators in the sentence, and scopally nonspecific if it takes the narrow scope. There are many problems associated with this idea, an obvious one being the classification of indefinites taking intermediate scope (i.e. narrow with respect to some operators in the sentence and wide with respect to other), or indefinites in sentences without any operators. More discussion of these problems can be found in [7], [4] and [18].

In the current setting the issue of scopal specificity of indefinites is not crystal clear either, because *look for* is analyzed primarily in an extensional way (when we consider a single interpretation function), which means it does not contribute any operators to the sentence, unlike in the classic Montagovian decompositional analysis (cf. [14]). It still doesn't change the fact that one can find examples like this:

(59) I am looking for a certain book. John recommended it to me, but I don't know whether he meant the first or the second part of *Harry Potter.* [2]

Here the indefinite is definitely epistemically nonspecific, yet the NP *a certain* points to some sort of specific reading – namely, scopally specific. Cases like this fall into a category known as *specific unknown* (cf. [11], [1]) - they are scopally specific, but epistemically they are not. They are one more reason for which dealing with scopal specificity seems not only interesting, but also inevitable, even given the way the current setting has been set up.

Assuming, after Farkas [5], the independence of the two distinctions (between scopal and epistemic specificity and nospecificity), we are to expect that uses of indefinite NPs will fall into one of the following four categories:

(e+s+) Both epistemically and scopally specific.

(e+s−) Epistemically specific and scopally nonspecific.

(e−s+) Epistemically nonspecific and scopally specific.

(e−s−) Both epistemically and scopally nonspecific.

Farkas in [5] does not want to discuss the issue of whether readings of the type (e+s−) can exist at all. She mentions only that this issue is related to the way we interpret sentences like:

(60) John believes that a unicorn has destroyed his flowerbeds. ([5])

(61) Cob believes that a witch has blighted his mare and Nob believes that she has destroyed his crops. ([5])

where the indefinite is supposed to take narrow scope with respect to the intensional operator *believe* even though it is epistemically specific for the agent of the sentence. Such cases are not directly relevant in the current setting – mostly because the problem of the lack of existential import of specific sentences has been treated in a nonstandard way (cf. section 5.5).

The remaining three cases find their natural representation in the semantics I introduced, in spite of there being no operators in *look for*-sentences. Consider the following sentences:

(62)   a. John is looking for Mary's father.

        b. Namely, Mr. Smith.

        c. But I don't know who that might be.

Further consider an agent i that updates her information state with (a) above. It might happen that after the update in every interpretation that i considers possible John is in the *seek*-relation with the same individual, Mr. Smith[3]. This is the case described by Definition 4.4.1 as specific – there is one

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specific individual that John is looking for according to i. Now we can note that this is a case of both scopal and epistemic specificity – (e+s+).

On the other hand, the current semantics allows for a situation when, after the update, according to every interpretation in i's information state there is an individual that John seeks, but it happens to be the case that those individuals vary from interpretation to interpretation. Such a model is compatible with the storyline (a)–(c) above, which means we that there is a natural interpretation of the cases of the type (e–s+) in our current semantics.

Remember that in traditional settings sentences of the form *John is looking for a N* interpreted in a (scopally) specific way are formalized roughly as $\exists x(N(x) \wedge seek(j,x))$. In principle nothing prevents us from defining a binary relation on individuals, denoted by *seek* (as opposed to **seek** that already is in L_1), in the following way:

Definition 5.6.1 (*seek*). *Let I be an interpretation function as defined in Chapter 4.*
For all $x, y \in \mathcal{D}$: $seek(x,y)$ iff there are Q_1, Q_2 such that:

1. *$I(\mathbf{seek}(Q_1, Q_2)) = 1$;*

2. *Q_1 is a filter on $\mathcal{P}(\mathcal{D})$ generated by $\{x\}$;*

3. *the witness $X \subseteq Q_1$ whose existence is provided by Definition 4.4.1 is a filter on $\mathcal{P}(\mathcal{D})$ generated by $\{y\}$.*

Definition 5.6.1 is just a formalization of the idea introduced above, where the object sought by John was an individual in every interpretation, but those individuals could vary between interpretations. Definition 5.6.2 shows furthermore that in principle the intuition behind the readings of the form $\exists x(N(x) \wedge seek(j,x))$ can be emulated in the language and semantics of L_1 (note that the interpretation of $\exists x$ would have to be nonstandard due to the previous introduction of the existence predicate):

Definition 5.6.2 (Scopal specificity). *Assume that both "seek" and the first-order existential quantifier (with its usual interpretation) are added to L_1. We say that a sentence of the form $\mathbf{seek}(Q_1, Q_2)$ is scopally specific in an information state σ iff $\sigma[\mathbf{seek}(Q_1, Q_2)] \Vdash \exists y(seek(x,y))$ where x and y are as in Definition 5.6.1.*

Extending the above definitions to cover other cases of scopal specificity (i.e. as in *John is looking for three sweaters* as opposed to *John is looking for a sweater*) is perfectly possible, albeit tedious, and therefore I will not dwell into that territory any further.

Covering the issue of scopal specificity allows us also to explain examples like the following:

(63) John is looking for Mary's killer. It might be Jones or it might be Smith.

The intuitive reading of this example is that there is only one person that killed Mary (s+), but the speaker doesn't know who that was (e–). Assuming that *might*-sentences are tests of what holds in an information state rather than constitute information updates themselves (cf. [21]), the second sentence of (63) tells us to check if after updating σ with the first sentence, in the remaining

interpretation functions there is one where Mary's killer and Jones are the same person, and the same for Smith. This is fully consistent with a type (e–s+) scenario in our current semantics.

Finally, recall the premise in the example (50) above, and it's scopally specific reading:

(64) John is looking for a sweater. (But I don't know which one exactly.)

For (64) to be scopally specific it has to be the case that after the update in each remaining interpretation there is a specific sweater that John seeks, but those sweaters can differ between the interpretations. Notice that under such a reading the following, previously unacceptable, specifically read sentence follows – which indeed conforms with the intuitions:

(65) John is looking for $sweater_1$ or John is looking for $sweater_2$ or ...

The above sentence is a disjunction where the object positions range over all sweaters that the hearer considers possible. For it to be scopally specific there needs to be some specific sweater sought by John in every interpretation – and that is insured by the scopally specific premise.

5.7 Intensional or extensional?

A question that might and should be asked at this point is the following: how do all intensional phenomena in the behavior of *look for* come about in the right way in the current formal setup if the actual semantic clause for the **seek** relation does not strike us as particularly intensional? After all, the definition 4.2.3 looks like any other almost-first-order, extensional definition – the truth of a formula of the form $\textbf{seek}(Q_1, Q_2)$ is evaluated with respect to just one index. The source of all the interesting action here is the interplay between that definition and the further introduction of dynamic notions of an update and an information state, as well as the switch from an agent-oriented to a speaker-oriented perspective.

What are the supposedly intensional phenomena in the behavior of *look for* that our semantics should account for? First, the problems with substitution of coreferents in the object position. Second, the lack of existential entailments. Third, the availability of nonspecific readings (not an intensional phenomenon per se, but definitely characteristic of intensional verbs).

Regarding substitution, the current system follows the example of dynamic semantics in allowing substitution of coreferential terms as long as they are such for the hearer. The lack of existential entailments of sentences with *look for* is accounted for by separate means, presented in section 5.5. There is also one more way to look at this problem, though it might not be particularly enlightening. The way this issue is usually presented is the following: truth of the sentence *John is looking for a unicorn* should not imply existence of any unicorns *in the actual world*. In the current framework, the notion of the truth of a sentence has been replaced (roughly speaking) by the notion of support. Therefore the "existence problem" translated into the dynamic lingo states that the fact that an agent a supports the sentence *John is looking for a unicorn* does not entail existence of unicorns *in the actual world*. Such a requirement is almost trivially

satisfied by the very essence of dynamic semantics – the fact that an agent supports a given sentence has nothing to do with what is actually the case, but only with what that agent considers to be the case. Moreover, it is easy to give reasons for why a person that utters *I am looking for a unicorn* should believe that unicorns actually exist, or at least are possible. Recall the example (57). There the hearer refused to accept the sentence *John is looking for a unicorn* on the basis of his belief that there are no unicorns. The same would happen if John himself had that belief and would try to utter *I am looking for a unicorn.*

Finally, the problems associated with specificity were possible to deal with by adopting a hearer-oriented perspective in the semantics, together with the fact that we model the hearer's information with a set of indices rather than a single index.

5.8   Shortcomings

It is my strong belief that every reasonably simple formal theory of some linguistic phenomenon will run into problems and will turn out to not explain every detail of the available data. The current semantics is in no way different. While the dynamic perspective on the semantics of *look for* offers some new insights and new explanations, some aspects of the behavior of this verb remain unaccounted for. In this section I will hint at some of such problems.

The first problem concerns the current general definition of specificity and the way the semantics of the **seek** was defined. Recall John who was looking for sweaters in section 5.6. The following inference is valid in the system:

(66) John is looking for $sweater_1$ or John is looking for $sweater_2$ or ... $\Rightarrow$ John is looking for a sweater.

It will not be the case, on the other hand, that the premise of this argument will turn out to be specific in every context. This is at first counterintuitive, if the names $sweater_1$, $sweater_2$ etc. are supposed to range over all possible sweaters, therefore exhausting the possibilities. Our first intuition is that such a sentence should be always be at least scopally specific, provided that the expressions of the form $sweater_n$ are treated like proper names/individual constants, and therefore meant to denote individuals. But note that it might still happen that for the hearer of the sentence (66) names $sweater_1$, $sweater_2$, etc. fail to be proper names (because of her own information state). If the speaker uses proper names that are, so to speak, not part of the speaker's and hearer's common ground, then utterances like the premise of (66) might end up unspecific.

However, example (66) points to a more general problem. It turns out that our semantics as it stands now does not insure scopal specificity of sentences with proper names in the object position. All was good when it was the epistemically specific interpretation of *John is looking for Mary* that was being ruled out. But the intuition that the name *Mary* will always refer to a single individual should also be accounted for. It seems however that these kinds of problematic cases could be prevented by supplying the semantic clause for the formulas of the form $\mathbf{seek}(Q_1, Q_2)$ with a note that if Q_2 already denotes a singleton-generated subset of the domain, then the subset that acts as a witness for the truth of $\mathbf{seek}(Q_1, Q_2)$ will be the denotation of Q_2 itself. This idea points to a more

general approach – maybe the general definition should be formulated in a way that would allow for only specific kinds of subsets of the original quantifier.

Another problem concerns the odd behavior of *look for*-sentences with complements of the form *every N*, *each N*, *most N*. Van Geenhoven and McNally ([20], p. 909) conclude that it is a general feature of such NPs that they force nonspecific readings on sentences with intensional verbs, with an exception of *every N*. The latter does allow for specific readings, but the authors conclude that it happens so because of the special semantic characteristics of *every*. The problem is that so far our semantics does not prevent any specific readings in any case, which leaves the current examples unaccounted for. Going back to the previous paragraph: maybe if we were to arrive at a list of such permissible subsets, it would turn out that *most*-quantifiers and their lot won't have permissible subsets.

The probably most expected criticism of the current approach would concern the way intensionality problems are dealt with – or, as some might put it, avoided – by moving the semantics to a dynamic setting. In fact, any critic of dynamic semantics would try to raise such a point. It might be said that by focusing on the information state of the hearer of a *look for* sentence the content of the intentions of its agent is lost on the way. This point is tightly connected to what I talked about in the previous section. In principle it should be possible to plug in the intentions of the sentence's agent into the semantic clause for **seek**, possibly in a way Zimmermann did it (recall definition 7 from section 1.2). I have also showed earlier that talking about the agent's beliefs is not disallowed by the dynamic setting and can be successfully done. Finally, in general it is an essential – and rather felicitous – feature of dynamic semantics that some problems of truth-functional semantics simply disappear.

I do believe that the reasons I have given for moving to a dynamic setting were strong enough for anyone to consider such an option. Adopting the dynamic perspective allowed us to tackle phenomena that have been ignored up to this point. These developments should shed some light on our understanding of the use of *look for* and intensional transitive verbs in general. An ideal theory would probably have to combine both the dynamic intuitions with the considerations about the belief states of the agents of *seek*-sentences. My current enterprise hopefully can be seen as a first step towards such a theory.

Chapter 6

Conclusion

I started by introducing the problems traditionally associated with the semantics of intensional transitive verbs like *seek* or *want*. I briefly presented the most popular ways of dealing with those problems that can be found in the literature that is available on this topic. Later on I argued for a possible usefulness of adopting a dynamic perspective in developing the semantics of *look for*. A number of examples of how sentences with *look for* are used in dialogs suggested that the way *look for* is actually used by participants of discourses does not always conform with the widely shared intuitions about substitutivity.

Moreover, the way *look for* is sometimes used in dialogs made me consider a nonstandard way of understanding the issue of specificity and nonspecificity of sentences with intensional verbs. I surveyed the possible understandings of the notion of specificity and came to a conclusion that the notion initially most suited for a dynamic setting was epistemic specificity. Later on it turned out that scopal specificity was also interpretable in my semantics. The resulting formalism was roughly an update version of the logic of generalized quantifiers of Barwise and Cooper with intensional verbs replacing the extensional ones. Two most important and possibly most valuable features of the research presented here are the idea of introducing intensional verbs into an update framework and the way specificity can be interpreted in such a setting.

Finally, the system presented here is not free from faults. The shortcomings of the current semantics that I presented in the very end seem like a good departure point for future work on the topic. Firstly, the fact that in certain cases specific readings are not available for *look for* sentences needs to be accounted for. Since the formal setup of my framework is based on a very versatile language of the logic with generalized quantifiers, another theme worth looking into would be the interactions of the theory of generalized quantifiers with my current system. Some work in this direction, although in a different formal setting, has already been done by F. Moltmann ([12]). Finally, probably the most natural extension of the current system would consist of supplying the language L_1 with extensional verbs.

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