RESOLVING QUESTIONS, I*

ABSTRACT. The paper is in two parts. In Part I, a semantics for embedded and query uses of interrogatives is put forward, couched within a situation semantics framework. Unlike many previous analyses, questions are not reductively analysed in terms of their answers. This enables us to provide a notion of an answer that resolves a question which varies across contexts relative to parameters such as goals and inferential capabilities. In Part II of the paper, extensive motivation is provided for an ontology that distinguishes propositions, questions, and facts, while at the same time the semantics provided captures an important commonality between questions and propositions: facts prove propositions and resolve questions. This commonality is exploited to provide an explanation for why predicates such as ‘know’ carry presuppositions such as factivity and for a novel account of the behaviour of adverbially modified predicates with interrogative, declarative and fact-nominal arguments.

1. Introduction

Answers have, by and large, had the upper hand in contemporary semantic treatments of embedded interrogatives: interrogative sentences have been analysed either without appealing to an independent notion of a question, or alternatively, the notion of question adopted is a reductive one, a higher order construct of propositions intended to capture the conditions under which a proposition constitutes an exhaustive answer. (See e.g. Hintikka 1975, Karttunen 1977, Boër 1978, Groenendijk and Stokhof 1982, 1984a,b, 1989).

In this paper I argue for what might seem an opposite perspective, characterising answers in terms of certain properties of or relations involv-
ing questions. Neither questions nor propositions are reductively analysed in terms of the other, rather they both receive a situation theoretic analysis whose underlying ontology includes situations, properties and states-of-affairs.

The initial motivation for such an approach will be data provided in Section 2 that demonstrates that the meaning of embedded interrogatives cannot be reduced to their exhaustive-answerhood conditions. Exhaustiveness is neither sufficient nor necessary. On the one hand, I show that whether information can be described as resolving a given question is conditioned in part by the mental states of the participants in a dialogue, in particular the goals of the agent and her inferential capabilities (cf. Boër and Lycan 1985). I will argue that predicates such as ‘know’ and ‘tell’ impose a resolvedness condition on their interrogative complements analogously to the factivity condition imposed on certain declarative complements.

The need for increased sensitivity to factors such as inferential capabilities and goals might not seem a surprising conclusion when such issues are considered part of pragmatics rather than semantics. What is more surprising is that these same factors play a role in the truth conditions of embedded interrogatives. The account I develop in Section 3 – where I also provide compositional semantic rules for interrogatives couched within situation semantics (Barwise and Perry 1983, Gawron and Peters 1990) and HPSG (Pollard and Sag 1994) – shows that such apparent tension between semantic and pragmatic factors can be accommodated naturally within a family of theories dubbed ‘triadic theories of belief’ (see e.g. Barwise and Perry 1983, Richard 1990, Kamp 1990, Crimmins 1993a) which individuate attitudes with reference to parameters additional to propositional content. I will suggest that in the cases discussed such additional parameters often get fixed in such a way as to mask their presence: if the goal is assumed to be transparently expressed by the denoted question \( q_0 \) and the limited nature of informational resources is ignored, it will emerge that resolvedness reduces to exhaustiveness.

Equally, I argue that exhaustiveness is not a necessary condition for information to be resolving. In Section 4, I provide a characterisation of the class of informational items that potentially resolve a given question by associating each such class with a condition that they subsume certain minimal bounds determined by the question: such conditions will be formally expressed in terms of information containment within a SOA algebra (Barwise and Etchemendy 1990).

I turn attention to query uses in Section 5; the account of resolvedness extends with certain modifications to provide a characterisation of the
class of responses that a querier would consider optimal. While it will be possible to offer an explanation for why responses are often implicated to be exhaustive, it will also be possible to account for the fact that on many occasions no such implicature arises. Conversely, weakening the notion of potential resolvedness will allow a characterisation of when information is about a given question. This relation serves to characterize the range of responses a responder knows to be associated with a question regardless of the contextual factors that relativize resolvedness.

In Part II of the paper, I return to embedded uses. In Section 6, I suggest that adverbs of extent can modify the resolvedness associated with propositional attitude embedding of interrogatives. Partial resolvedness will turn out to link resolvedness and aboutness. I will suggest that this account of such adverbial modification is superior in the truth conditions it assigns to accounts that link such modification to partial exhaustiveness (see e.g. Berman 1990, 1991, Lahiri 1991, Groenendijk and Stokhof 1993.)

Finally, in Section 7, I return to perhaps the most basic semantic issue, the ontological nature of embedded interrogative and declarative sentences. I offer extensive evidence that both interrogatives and declaratives split in two classes. Whereas predicates such as 'ask' or 'investigate' can be shown to embed their question-denoting nominals in a purely referential way so that substitutivity and existential generalisation are satisfied, and whereas predicates such as 'believe' and 'claim' behave similarly with their proposition-denoting nominals, predicates such as 'know' and 'discover' fail on both counts. The class of nominals that 'know' and 'discover' do treat purely referentially turns out to be fact-denoting nominals. The conclusion I will draw from this, drawing on insights due to Austin and Vendler, will be that this latter class of predicates is applicable neither to questions, nor to propositions. Such data pose intrinsic problems for semantic approaches that assume the interrogative argument embedded by 'know' is a question (e.g. Karttunen), but equally for the far more widespread assumption that the interrogative argument is a proposition (Hintikka, Boër, Groenendijk and Stokhof). I will suggest such data can be accommodated by assuming that both interrogatives and declaratives can be coerced to describe facts, and offer a specification for such an account.

2. Exhaustiveness and Context

2.1. Resolutive Predicates

I start by considering the meaning of interrogatives embedded by proposi-
tional attitude predicates. I show that recasting the problem in terms that explicitly refer to *questions* yields important empirical insights.

There is a well known schema that relates the proposition expressed by a (use of a) declarative sentence $d$ to the possibility of embedding $d$ by a predicate drawn from the class of so called *factive* predicates:

\begin{equation}
(1) \quad \text{The claim is that } p. \\
\text{Bill } V's/\text{has } V'ed \text{ (knows/discovered) that } p. \\
\text{So, the claim is true.}
\end{equation}

There is a converse schema that provides a sufficient condition for (the content of) a declarative to be in the positive extension of a factive (and, as we shall see in Section 7, this schema is also satisfied by a class of non-factives). The schema relates $V'$ing of fact nominals to $V'$ing of that clauses:

\begin{equation}
(2) \quad \text{A certain fact is/has been } V'ed \text{ (known/discovered) } \\
\text{Which fact? One that proves the claim that } p. \\
\text{So, it is/has been } V'ed \text{ that } p.
\end{equation}

It turns out that analogous schemas exist relating questions expressed by interrogative sentences and a class of predicates that includes the factives but also predicates such as ‘tell’, ‘guess’, and ‘predict’. I dub such predicates *resolutive* predicates: whereas we can talk about the *truth* of a proposition, this is not possible with a question. What one can talk about is whether the question is *resolved*:

\begin{equation}
(3) \quad \text{The question is: who left.} \\
\text{Bill } V's/\text{has } V'ed \text{ (knows/discovered/told me/reported/managed to guess) who left.} \\
\text{So, the question is resolved/the question is no longer open.}
\end{equation}

\begin{equation}
(4) \quad \text{A certain fact is/has been } V'ed \text{ (known/discovered/told me/reported/guessed).} \\
\text{Which fact? A fact that resolves the question of who left.} \\
\text{So, it is/has been } V'ed \text{ (known/discovered/told me/reported/guessed) who left.}
\end{equation}

My concern here will be to characterise the relation *resolves* in the sense in which it is used in (3,4). The relatees of this relation include a question and a fact. It is quite common to identify facts and true propositions, though the account I develop distinguishes the two, distinctions that will be motivated in Section 7. For the moment, however, this issue is of little
import, so I will, frequently use the neutral term informational item or simply information. Two main issues suggest themselves:

- **Relative-or-Absolute**: what, if any, are the other relatees of resolves?
- **Potential-Resolvedness**: given a question q how can one characterize the class of potentially resolving facts? (That is, facts f for which there exist a, b, . . . such that f resolves q relative to a, b, . . . , where a, b, . . . are the other parameters of the resolves relation.)

Although this set of issues has not, to the best of my knowledge, received this particular formulation before, most existing accounts do address the issues explicitly or implicitly.

With respect to the first issue, we find some divisions. On the one hand, we find approaches such as Karttunen (1977) and Groenendijk and Stokhof (1982, 1984a,b, 1989, 1993). Such approaches assume the existence of a single true proposition ('the exhaustive answer'), Exh-Ans(q), determined by the denoted question that, for predicates from the resolutive class, license an inference relating V'ing q to V'ing Exh-Ans(q). This is exemplified by the following meaning postulate:

\[(5)\quad \text{know}(x, Q) \leftrightarrow \forall p (\text{if } Q(p), \text{ then } \text{know}(x, p)) \text{ and if } \neg \exists p Q(q), \text{ then } \text{know} (x, \Box p \neg \exists q Q(q)) \text{ (Karttunen 1977, footnote 11, page 18)} ('\text{knowing } Q \text{ is equivalent to knowing all propositions in the extension of } Q, \text{ or that the extension is empty}')\]

Thus, in Karttunen’s system the extension of an interrogative at a given world is a set of propositions the conjunction of which constitute Exh-Ans(q). In Groenendijk and Stokhof’s system the question/exhaustive answer relationship is particularly transparent: the extension of an interrogative is identified with the exhaustive answer. Hence, the intension is that function that maps a world to the proposition that constitutes the exhaustive answer in that world. Within a possible worlds semantics the picture that emerges is this: the extension at w is a set of worlds, those worlds that determine the extension of the queried property equivalently. The intension of the interrogative is the partition of the set of possible worlds induced by this equivalence relation. The predicates I have dubbed resolutive are posited to be extensional interrogative embedders, and hence satisfy a version of (5):

\[(6)a.\quad \text{whether Millie likes Bill.} \]

Extension at i: λj(like(m, b)(j) = like(m, b)(i)) (All worlds j that agree with respect to the truth value of ‘like(m, b)’ at i.)

Intension λi λj(like(m, b)(j) = like(m, b)(i))
b. who likes Bill. Assumed paraphrasable as: 'for all x whether x likes b'.

Extension at \(i\): \(\lambda j(\lambda x[\text{like}(x,b)(j)]) = \lambda x[\text{like}(x,b)(i)]\) (All worlds \(j\) that agree with respect to the extension of 'x likes b' at \(i\).)

Intension: \(\lambda i \lambda j(\lambda x[\text{like}(x,b)(j)]) = \lambda x[\text{like}(x,b)(i)]\)

It is important to point out that the notion of exhaustiveness that Groenendijk and Stokhof assume is intrinsically stronger than that implemented by Karttunen. Whereas Karttunen sees the end result of an inquiry into a question who \(P\)'s as the acquisition of knowledge of the positive extension of \(P\), Groenendijk and Stokhof build in the assumption that it involves knowledge of the negative extension as well. In other words, that 'Jill knows who left' is assumed to entail that Jill knows \(\text{whether} a_1 \text{ left}\), for all \(a_1\).

I call approaches such as Karttunen's and Groenendijk and Stokhof's absolute since the view of questions they propose assumes a notion of resolvedness that does not involve other parameters.

Hintikka (1962, 1975, 1983), Boër (1978), and Boër and Lycan (1985) represent approaches, which although they do not countenance an independent notion of question, can be construed to be providing notions of resolvedness which are parametrized. Boër and Lycan (1985)'s work on the semantics of 'knowing who', in particular, develops an account where these parameters can be identified with the reported agent's purpose and mental capacities. Thus, Boër and Lycan offer the following truth conditions for (7a):

\[(7)a. \text{John knows who bought tickets. (Boër and Lycan's (13a)).}\]

\[b. (13a) \text{ is true iff John knows-true at } t_1: \text{The } F \text{ and the } G \text{ are the people who bought tickets: for } \text{"F" and } \text{"G" reflecting } P_t \text{ important predicates. For some } P_t, \text{ "F" and } \text{"G" might of course be } \text{"=} Bob \text{" and } \text{"=} Ted" (Boër & Lycan 1985, p. 99)\]

\(P_t\) in (7b) is a mentalese predicate representing John's current purpose or goal.

Although we find disagreements in the literature regarding the first issue I raised above, there is, for the most part and with a caveat, agreement concerning the second issue: a necessary condition for information to be resolving is that it entail the exhaustive answer determined by the ques-

\footnote{See Groenendijk and Stokhof 1982, p. 181 ff. for discussion.}
\footnote{See Section 8, Resolving Questions, II for more detailed discussion of both approaches.}
tion. The caveat is that Hintikka has argued that wh-interrogatives are systematically ambiguous between a construal requiring exhaustiveness and an 'existential' reading, the latter brought out most strongly in examples such as

(8) Bill knows how to get from London to Oxford (namely, that the M1 is one such means.)

This view was developed by Berman 1990, 1991 into the view that (for those interrogatives embedded under the resolutive predicates) wh-interrogatives have an exhaustive reading as a default, but in the presence of an adverb of quantification, this force can fluctuate.

The data presented in Sections 2.2 and 2.3 is intended to offer the following answers to Relative-or-Absolute and Potential-Resolvedness respectively:

- Resolvedness is relative: whether information resolves a given question is relative to (at least) a purpose or goal and a belief/knowledge state.
- The class of informational items potentially resolving a given question properly includes the class of facts that entail the exhaustive answer. In other words, entailing the exhaustive answer is not a necessary condition for being resolving.

2.2. Resolvedness is Relative

I start by considering examples which indicate that the very same proposition can be resolving in one context but unresolving in a different context.

Consider first examples (9) and (10). They illustrate, respectively, how a particular proposition serves as resolving information in the one context, but no longer does so in another context:

(9)a. [Context: Jill about to step off plane in Helsinki.] Flight attendant: Do you know where you are? Jill: Helsinki.
b. Flight attendant: Ah ok. Jill knows where she is.

(10)a. [Context: (Based on a scene from Jim Jarmusch’s ‘Night on Earth’; quoted without permission of MGM.) Jill about to step out of taxi in Helsinki.] Driver: Do you know where you are? Jill: Helsinki.
b. Driver: Oh dear. Jill doesn’t (really) know where she is.
What is the difference between the two contexts? The difference seems to lie in the causal role associated with the information Jill possesses. In the former case the information has no role beyond confirming for Jill that she has arrived at the right destination; in the latter case the information cannot be used by Jill to locate the destination she needs. Assuming Jill’s knowledge state remains constant across the two contexts, this means that a single proposition, ‘Jill is in Helsinki’, can provide grounds for asserting two contradictory statements with regards to Jill’s knowing where she is.\footnote{This is incompatible with the absolute view, according to which resolvedness is a property of propositions. It indicates that additional parameters must be involved.} This is incompatible with the absolute view, according to which resolvedness is a property of propositions. It indicates that additional parameters must be involved.

The implication would appear to be the following: we cannot in general assume that each question is associated once and for all with a fixed propositional condition that constitutes a lower bound of resolvedness, for instance the exhaustive answer defined by the question. Instead, this lower bound should be seen as floating, fixed in particular context to a level identified by the goal.

Such vagueness in the resolvedness conditions can go relatively unremarked when attention is focussed on ‘who-questions’ rather than on other types of questions for which the answer range is mass-like: ‘where-questions’ can involve finer and finer subdivisions (universe, continent, country, town, neighbourhood and so forth.) and which is the appropriate level of grain can only be decided relative to an underlying goal. Similar remarks apply \textit{mutatis mutandis} to ‘when-questions’ (see below example (98)). The vagueness of the resolvedness conditions of ‘why-questions’ is probably even more pronounced, in part because of the multiplicity of factors that can be viewed as \textit{causes} of a particular eventuality. Thus, any one of (11c,d,e) could serve as justification for asserting (11a), relative to different audience interests, whereas the other propositions, relative to a fixed audience interest would be greeted with (11b):

\begin{itemize}
  \item[(11)a.] We have been told why he is writing this paper.
  \item[(11)b.] We haven’t (really) been told why he is writing this paper.
  \item[(11)c.] He needs a journal publication.
\end{itemize}

\footnote{As Boër and Lycan (1985) note, the optional hedge \textit{really} has two prominent uses: the first to distinguish between genuine ‘V’ing who’ and merely ‘V’ing who N is supposed to be’. The second: distinguishing within the realm of genuine ‘V’ing who’ between ‘V’ing who N is’ for a casual purpose and such a V’ing for a contextually salient purpose. (See Boër and Lycan, p. 39). In this case, the latter sense is used for a reason that will become clear in Section 6, where it will turn out that essentially any partially resolving answer can be described as constituting ‘to some extent V who/where . . .’. Hence the difficulty in completely negating a ‘V wh . . .’ statement.}
d. He is a junior researcher. In order to get a permanent job, at least three papers a year need to be published. This is his third. 

e. He's hoping it will be possible to provide an account that will finally deal with the Blumqvist examples while at the same time . . .

It is clear that similar data can be constructed that show, given a fixed purpose, that agent belief/knowledge are also parameters. For instance: Consider (12):

(12)a. [Querier asks the question at 11:10.] Q: How do I get from London to Oxford? 
   A: Take the 11:24 from Paddington.

b. (Querier, Jane, is knowledgable about London trains) Jane: I asked a stranger how I should get from London to Oxford, and without batting an eyelid he told me.

c. (Querier, Ileana, is a foreigner) Ileana: I asked a stranger how I should get from London to Oxford, and he provided me only with an instruction I couldn’t make use of.

It is worth emphasising that data motivating the relative view arise even for predicates which do not describe mental or illocutionary activity. Relative to the goal enunciated by A in (13a), discovering whether a specialist on tense or quantification will win, the question of who will win does not depend on the question of what year it is. Relative to the goal enunciated by A in (13b), discovering whether a linguist or logician will win, the dependence between the two questions exists: 4

(13)a. [Context: A prize is awarded on alternative years to a linguist or a logician.]

b. A: I wonder: who is going to win this year? A specialist on tense or on quantification?
   B: Oh well, who is going to win doesn’t depend on what year it is.

c. A: I wonder: who is going to win this year? A linguist or a logician?
   B: Well you see, who is going to win crucially depends on what year it is.

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4 This example is due to Robin Cooper.
2.3. *Exhaustiveness*

I have so far argued that the notion of resolvedness needed for the semantics of interrogatives embedded by propositional attitude predicates is contextually parametrised. The next issue I consider concerns exhaustiveness. Does a potentially resolving informational item necessarily convey the extension of the queried predicate, as required, for instance, by the accounts of Karttunen, Groenendijk and Stokhof or Boër and Lycan? The answer is, I will claim, negative.

Imagine, for instance, a scientist and an EC politician visiting an institute located in a distant country isolated from current academic activity. Both people are taken to visit a local research institute where the scientist gives a number of lectures. After the last lecture each asks (14a). It is clear that neither of them will satisfied with (14b) to which they would be entitled to react with (14c):

(14)a. Q: Who has been attending these talks?
   b. The director: (Provides list of names)
   c. I asked the director who had been attending the talks. She didn’t really tell me. All she did was recite a list of names, none of which meant much to me.
   d. The director was asked who had been attending the talks and she told us.

Note that in this case (14b) is an exhaustive answer since, if true, it fixes the extension of the predicate ‘has been attending these talks’.

Nonetheless, neither queriers’ wonderment about the question is at all satisfied by the exhaustive answer. By contrast, a contrast that emphasizes that the epistemic setting is a crucial parameter, if a local researcher, familiar with the lecture attendees, but who had not herself attended the lectures, happened to hear the dialogue in (14), she would, typically, react by saying (14d).

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5 Indeed, to remove a possible objection about the role of proper names in this example, one could change the example to one where the director responds deictically by pointing at the crowd: ‘this person and that person and that one and that one . . .’.  
6 Martin Stokhof suggests that the visitors might equally, or perhaps, more plausibly react by saying (i) I asked the director who had been attending the talks. She told me, i.e. she gave me a list of their names. But since I don’t know who these people are, I still don’t really know.

Even if we take (i) to be a more plausible reaction, note that the speaker feels obliged to hedge the fact that the director told who attended by following up with a more precise description of the telling. Furthermore, in (i) it remains the case that despite being provided with an exhaustive answer, the speaker does not see himself able to report himself as knowing who attended.
What the visitors would really have welcomed would be responses of the type provided in (15a,b), which could then be reported as (14d):

(15)a. [Querier is the high ranking EC politician.] The director: A number of linguists and psychologists.

b. [Querier is the researcher in the field covered by the institute.] The director: A number of cognitive phoneticians and Willshaw-net experts.

This seems to be the case even despite the fact that neither response conveys information that enables either one of them to determine the extension of the predicate ‘has been attending the talks’. Furthermore, unless the scientist is compiling an inventory or the politician an indictment of the skills existing in far flung territories but not in his own backyard, it is reasonable to assume that they do not presume that all attendees necessarily conform to the descriptions provided.

Moreover, permuting the responses results in inappropriateness: providing a specialised domain description to a politician completely unaware of basic information concerning a whole domain of research is pointless, as is the converse, providing a general response to a scientist aware of the intricacies of that field. It is important to note, nonetheless, that when regarded purely in terms of query/response coherence both responses are equally felicitous. The factors that discriminate in favour of one over the other depend on the belief/knowledge state and purpose of the querier. Hence it seems that on a semantic level the question expressed by uttering (14a) should characterise both propositions asserted, if true, as potentially resolving the question asked.

A variant of (9) demonstrates this phenomenon for ‘where’ – interrogatives:

(16)a. Can you tell me where I am?

b. [Late at night] You’re in a hostile neighbourhood.

c. [Midday] You’re in an area near the centre.

d. I was a bit unsure but luckily the taxi driver was willing to explain to me where I was.

In such a case any paraphrase of the type provided by a Karttunen style meaning postulate (5) or Boër and Lycan’s truth-conditions seems particularly unconvincing:

(17) Jill knows where she is if and only if Jill knows: The F and the G are (all) the places where she is.
2.4. Some Counterarguments

Let us now consider some counterexplanations of the data. One can concede that I have demonstrated that a given informational item can resolve \( q_0 \), the question expressed by the interrogative \( I \) in context \( c_0 \), while the same information does not resolve \( q_1 \) the question expressed by \( I \) in context \( c_1 \) without conceding that \( q_0 \) and \( q_1 \) are identical.

One reason for this could be domain selection involving the wh-phrase. Changing the context is often very plausibly associated with a change of the domain over which the values of a wh-phrase vary. Those same factors that I have appealed to as parameters of the \textit{resolves} relation could, arguably, be involved in fixing the domain. Once this were done, an absolute notion of resolvedness could be sufficient.

Which division of labour is the more plausible one? In a dialogue, misunderstandings can arise from at least two sources: one arising solely from the fact that a content has been unsuccessfully communicated:

(18)a. A: John left.
   B: No, look, he's sitting outside, chatting up Milena.
   A: I meant John Schwitters.

b. A: Everyone will support the decision.
   B: Including the CS people?
   A: I meant every linguist.

The other arising from failure to attend to the fact that a relation is inherently “perspectival” and that the participants happen not to share the same perspective. Consider (19).

(19) A: [yawns] That was a boring talk.
    B: No it wasn't.

There are a number of possible sources for the disagreement between A and B in (19). One is semantic, that is, A and B have distinct relations associated with the lexical item ‘boring’, say ‘did not mention any new facts’ v. ‘did not contain any jokes’. But, surely even in the absence of such a disagreement as to the precise meaning of ‘boring’, an exchange such as (19) is possible, one which can be explained by saying ‘boredom is relative’, that is, by positing that the relation denoted by the use of ‘boring’ in (19) has an additional “perspectival” argument which is filled by, say, a mental state of an agent. In contrast to (18) where the impasse in the conversation is repaired by agreeing on a \textit{single} way to fix the

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7 Martin Stokhof has pointed out to me the availability of such a strategy.
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contextual parameter (fully disambiguating the referent of 'John' or establishing what the domain of quantification is), there is no such requirement with (19) where the disagreement can be patched up with each conversationalist still holding on to his perspective:

(20) A: Well I thought so: I've heard this sort of reasoning so many times before.
    B: Oh, I had never heard that style of analysis before.

Returning to resolvedness, the question to ask is this: is the context dependent nature of resolvedness one that resembles the purely semantic mismatch cases (18a,b) or the perspectival mismatch case (19)? Not surprisingly, my claim is that it is the latter to which the resemblance is stronger. Consider a slight variant of (14): the politician asks the question, while the scientist nods his approval at the question ('Yes, I'm interested in that question too'). Assume the director offers just (15a) as a response. In the aftermath, we would expect the following kind of exchange between the politician and the scientist:

(21) A: Good, so we now know who's been attending these talks.
    B: Oh yeah? Well I wouldn't say so.
    A: No? But you now know that they're the local linguists and psychologists.
    B: So what. How does that help me decide whether getting Smithers to come lecture here is a good idea.
    A: Oh well, each to his own . . .

This illustrates, I suggest, that at issue is a perspectival argument that can be filled in different ways by the participants rather than a parameter the value of which the participants need to fix identically, as with domain selection illustrated in (18).

A variant of the domain -- selection strategy which one might invoke as an explanation for the data in 2.3 involves a kind/individual ambiguity. One could suggest, as Hintikka (1975) seems to suggest,\(^8\) that wh-phrases

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\(^8\) Hintikka (1975, p. 289): '... Another piece of evidence for my criterion of answerhood is obtained by observing what happens when for some reason the range of the variables which there tacitly are in a wh-question tacitly changes. For instance in the question

Who administers the oath to the president?

the relevant alternatives might be the different officers (offices) (Secretary of State, Chief Justice, Speaker of the House, etc.) rather than persons holding them. Then my criterion of answerhood will require that the questioner knows which office it is that an answer refers to, not that he knows who the person is who holds it.'
can vary over individuals or over kinds (e.g. ‘who attended the talk’ paraphrasable as ‘what kind of person attended the talk’.)

Notice first, in light of examples such as (16), that the ambiguity in question would have to apply across the entire spectrum of wh-phrases to include ‘what’, ‘where’, ‘why’ and ‘when’. More crucially, positing such an ambiguity does not explain the contrasting resolvedness patterns in (15), where each “kind-specifying” response is resolving relative to different participants and distinct purposes. Given this, I assume that a solution that makes recourse to a perspectival parameter without positing wholesale ambiguity unmotivated by other considerations is to be preferred.

2.5. Potential Resolvedness v. Aboutness

In the previous sections, I have provided evidence that the notion of resolvedness required for capturing certain basic inferences involving interrogatives embedded by propositional attitude predicates is a relative one: information resolves a given question relative to a goal and a belief/knowledge state. That is, a given question defines a class of true propositions each of which is potentially resolving. Whether a given member of this class, p, is actually a resolving answer in a given context depends on two additional factors: the goal go, which determines a lower bound for p, and the belief/knowledge state, mso, which determines the resources relative to which p has go as a consequence. Formalising these notions will be a task undertaken in Section 4. For now, though, one issue remains: an empirical characterisation of the relation ‘potentially resolves’.

Such a characterisation is not straightforward because of the decontextualisation it involves: saying of an item of information τ that it is not potentially-resolving requires one to consider all possible goal/belief-state combinations and decide that in none of them would the information provided by τ be deemed resolving. An additional problem involves deciding which proposition a given utterance u should be taken to express in a particular context c: on occasion, conversational implicature causes the proposition conveyed, \( p(u, c) \), to be stronger than the literal content, \( l(u, c) \). But then, if this context is a test context for the resolvedness of \( l(u, c) \), it is hard to decide categorically that it is \( l(u, c) \) that is resolving.

It seems fairly clear, nonetheless, that not all information about a given question, a notion I discuss in more detail in Section 5, is potentially resolving. Thus, in (22) Bill’s second response appears to be perfectly felicitous and to be about, that is specifically address, the question. Nonetheless, it does not appear to constitute information that resolves the question, hence cannot be disquoted under tell or explain:
(22)a.  Jill: Who is coming tonight?
    Bill: Why do you ask?
    Jill: Well after the last party and my antics there I'm anxious.
    Bill: Oh well, no cause for worry: Jack and Melissa won't be coming.

b.  (as report of the dialogue): # Bill told/explained to Jill who was coming that night.

A similar point applies to yes/no interrogatives: in (23) Jill's response is goal fulfilling and about the question but does not appear to constitute resolving information:

(23)a.  Bill: If there's a likelihood that Millie will come, I'll bake a cake. Could you tell me: is Millie coming tomorrow?
    Jill: She's not overworked, so I'd say she might come.

b.  (as report of the dialogue): # Jill told/explained to Bill whether Millie would be coming tomorrow.

These, then, appear to be reasonably clearcut examples of information that even when the background epistemic/goal conditions are biased in their favour cannot be classified as resolving the question.

What common pattern shows up in the examples of information that is potentially resolving? For a yes/no interrogative 'whether p', it seems clear that any information that entails p is potentially resolving. Equally, the negative case: any information that entails that not p is potentially resolving. What of a wh-interrogative q(x)? The data we have seen (e.g. (9), (12), (14), (15), (16)) suggests that resolving information can be either quantificational (i.e. entailing statements of the form Quant(N, q(x)) where Quant is a monotone increasing quantificational force) as well as information that entails instantiations q(c) of q(x). I suggest that this data exemplifies two requirements: first, the information entails that the queried predicate is instantiated (henceforth: it is a witness for q) and second, it provides some non-vacuous sortal that applies to (at least) a subset of the instantiators (henceforth: it sortalizes q). For apparently similar intuitions, see Belnap 1982.9

One might think that the latter characteristic is merely a pragmatic

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9 'One appealing conjecture is that all and only existence-entailing (or presupposing) terms can be short answers to what-questions [Here 'short answer' means roughly, in current terms, 'term that provides resolving information and can be used to respond to a query use of the question' - J.G.] . . . Perhaps each term must be formed from a sortal in the sense of Gupta (1981), together with an existence entailing (or presupposing) quantifier.' Belnap 1982, p. 196.
epiphenomenon: most contexts in which a given wh-question, 'who/what/... P's', is used satisfy an existential implication, namely the pure existential ('Someone/something/... P's') (see footnote 10 for further discussion). In such contexts the goal associated with the question will be strictly stronger than a pure existential with the obvious consequence that the pure existential does not constitute fully resolving information. However the pragmatic explanation does not extend to contexts where the goal is not stronger than the pure existential. For instance, A, who discovers he's forgotten his keys, wishes to confirm that someone locked up the house. He asks (24a). B's response in (24b) is not reportable as (24e), whereas the responses in (24c,d) which are sortalized, even if somewhat weakly, appear much more amenable to be reported as (24e).

(24)a. A: Oh gosh, who locked up the house?
   b. B: Don't worry, someone did. I heard the keys turn as I walked below.
   c. B: It's okay: some guy did./someone who was passing by.
   d. B: It's fine, either Jane or Millie did: Millie informed me that they left the keys with Bill.
   e. B indicated to A who locked up.

I will take a simple-minded view of the sortal condition, namely that it involves being information that is not entailed by at least one of the instantiations of the queried predicate. In other words, it provides some characteristic that does not a priori apply to all instantiators. wh-interrogatives, like y/n interrogatives, also have a negative case constituted by information that entails that the queried predicate has no instantiators.10

10 Assuming that this negative case actually constitutes resolving information goes against a commonly held assumption that wh-interrogatives carry an existential presupposition. A number of people have argued against this assumption including Karttunen and Peters (1976) and Groenendijk and Stokhof (1984a, pp. 30–37). The former authors suggest that the putative presupposition be analyzed as a conventional implicature. With the latter authors, I have argued in Ginzburg (1992) that the presupposition possesses the characteristics of a conversational implicature, to wit cancellability determined in part by the subject matter of the question and calculability. For instance, although many uses of wh-interrogatives occur in contexts which enforce an existential implication, it is often possible to explicitly cancel the suspected presupposition without resulting infelicity:

(i) What, if anything, should I buy at the store?

Moreover, as (24) exemplifies, there are sentences the utterance of which under natural circumstances, even without explicit cancellation, does not seem to involve a belief in the requisite existential implication. See also Ginzburg (1994b) for an account based on considerations from the semantics of dialogue of the expectation that a yes/no question has a positive resolution, and that the queried predicate of a wh-question is instantiated.
In (25) is summarized this characterisation of sufficient conditions for potential resolvedness. The nomenclature chosen emphasizes the asymmetry introduced between the positive and negative cases; this asymmetry will be "defused" when we turn to characterize aboutness in 5.2.11

(25) An informational item \( \tau \) POTENTIALLY RESOLVES a question \( q \) if either:

a. \( \tau \) STRONGLY-POSITIVELY-RESOLVES \( q \) or \( \tau \) NEGATIVELY-RESOLVES \( q \)

b. An informational item \( \tau \) STRONGLY-POSITIVELY-RESOLVES \( q \) iff

- for ‘whether \( p \)’: \( \tau \) entails \( p \);
- for a wh-question \( q(x) \): \( \tau \) is a witness for \( q(x) \), i.e. \( \tau \) entails that the extension of the queried predicate is non-empty (e.g. for the question ‘who came’, \( \tau \) entails ‘someone came’.), and \( \tau \) sortalizes \( q \), i.e. \( \tau \) is not entailed by at least one instantiation of the queried predicate.

c. \( \tau \) NEGATIVELY-RESOLVES \( q \) iff

- for ‘whether \( p \)’: \( \tau \) entails \( \neg p \);
- for a wh-question \( q(x) \): \( \tau \) entails that the extension of the queried predicate is empty (e.g. for the question ‘who came’, \( \tau \) entails ‘no one came’.)

The remaining question is this: are these conditions also necessary for potential-resolvedness? There are some cases which seem to show that a more inclusive condition is needed:

(26)a. [Context: A is preparing for a talk in unfamiliar surroundings, needs to gauge audience level, phones B:]

A: Who will attend the talk?
B: Few people, if any, with knowledge of semantics (will attend the talk).

b. B explained/indicated to A who will attend the talk.

c. A has a reasonable idea of who will attend the talk.

d. Most attendees will have little knowledge of semantics.

e. Either no one with knowledge of semantics will attend the talk or if some group of attenders does have knowledge of semantics, it will be a small group.

11 As far as terminological consistency goes, these relations should be dubbed POTENTIALLY-STRONGLY-POSITIVELY-RESOLVES and POTENTIALLY-NEGATIVELY-RESOLVES. For increased euphony, I have omitted the ‘POTENTIALLY’.
B’s response in (26a) can apparently be reported as (26b,c). Given that the quantifier 'few' is monotone decreasing, statements in which it has maximal scope will neither positively nor negatively resolve a unary wh-question as in (26). It is not clear that this should lead us to weaken (25) above: the context of (26) is one where B’s response in (26a) would be construed as (26d) which is positively resolving rather than as (26e), the literal meaning of such a statement.

A more subtle example is (27): some activists make inquiries among a committee of politicians to discover voting intentions about a forthcoming bill. If and only if they find out that a majority is not assured, they will mobilize activists from around the country to lobby the politicians:12

A: Who do you think can be counted on for the vote?
   b. B: At most 2 members of the committee (i.e. clear indication that a majority is not assured)
   c. B: At least 3 members of the committee (i.e. clear indication that a majority is assured)
   d. B explained/indicated to A who she thinks can be counted on for the vote.

Both responses (27b) and (27c) are goal-fulfilling. In constrast to the case involving (26a), however, the statement in (26b) does not lend itself to “bolstering” as a statement that entails a positive resolution of the question. Consequently, the issue that arises is whether in this context (26b) licenses a statement as in (26d)? For that matter does (27c) do so? My own intuition is that a contrast does exist in that the latter does whereas the former does not license disquotation as (26d). This is consistent with the assumption that the schema in (25) also provides necessary conditions for potential resolvedness.

There are also some apparently tricky cases involving y/n interrogatives exemplified, for instance, by (28b). Here it would seem that the information provided is resolving despite the fact that, on the face of it, neither the positive nor the negative resolution of the question is entailed, but rather a statement of the form (28c):

12 Martin Stokhof has suggested to me that for a question ‘how many...’ a necessary condition for information to be potentially resolving is that it entail a specification of an exact number i.e. ‘exactly n...’. This seems to me to be too strong. For instance, unless A works in the ticket office or is a statistician, the information provided by B in (i) would seem to constitute telling how many people attended relative to most plausible purposes A might have:

(i) A: How many people attended the football game? B: Approximately 500 people.
(28)a. A: Is Bill busy?
   b. B: Only when he's in town.
   c. When he's in town: p, otherwise: not p.
   d. B explained to A whether Bill is busy.

One can explain away such a case as involving B's alerting A to the
fact that the property denoted by 'busy' is one that can vary over time,
and, subsequent to this, providing resolving information that is suitably
relativised.

I conclude, then, that there is some justification to assume that the
characterisation in (25) above can be taken to provide necessary as well
as sufficient conditions for potential resolvedness. Hence I assume that:

(29) An informational item \( \tau \) POTENTIALLY RESOLVES \( q \) if
and only either:
\( \tau \) STRONGLY-POSITIVELY-RESOLVES \( q \) or \( \tau \) NEGA-
TIVELY-RESOLVES \( q \)

3. Basics of Account

3.1. Basic Semantic Approach

In this section I describe the situation semantics framework within which
my account is to be couched. Situation semantics uses situation theory as
its underlying logical framework: actually existing situation theory pro-
vides notions such as property, informational item and proposition, which
can be used to provide contents for the utterances of the various NL
expressions. Before the requisite semantic rules for interrogative ex-
pressions can be provided, I need to show that the semantic universe
provided by situation theory can be expanded to provide a notion of
question.

The strategy situation theory (e.g. Barwise and Etchemendy 1987, Bar-
non 1991) adopts in so doing, shared with work in property theory (e.g.
Bealer 1982, Chierchia and Turner 1988), is to start out with a richer
inventory of primitive objects and use this to characterize semantic objects
such as properties, propositions, and in this case questions, in a way
that treats their identity conditions very much on a par with "ordinary"
individuals. In particular, relations are not modelled set theoretically by
means of their extensions/intensions, propositions are not modelled as sets
of possible worlds.

The basic universe includes individuals, relations, situations and
SOA's. Propositions, and as I shall propose here questions, are also conceived of non-reductively, but some of their fundamental properties, truth, resolvedness, aboutness etc., can be characterised in terms of the "basic" members of the universe.

The intuition underlying the account can be described in terms of the following metaphor: an agent possesses a stack of snapshots, some complete, others possessing certain blurred features, all of which putatively pertain to a situation $s$ she is attempting to characterize. Posing a question involves associating a (possibly) partially blurred snapshot $\sigma$ with $s$. Responding involves finding a snapshot that fills in, in fine or coarse grain, the blurred features of $\sigma$ and predicating that it actually depicts $s$. The question defined by associating $\sigma$ with $s$, $(s?\sigma)$, is resolved if the stack contains at a point accessible to the agent a genuine snapshot of $s$ that fills in the blurred features of $\sigma$ with a grain size appropriate to the agent's current purposes. The notion of aboutness that naturally emerges from this metaphor is one based on informational subsumption, whereas resolvedness is closely related to factuality.

SOA's are structured objects, denoted $(R, f; i)$, individuated in terms of a relation $R$, a mapping $f$ assigning entities to the argument roles of the $R$, and a polarity $i$, where $i \in \{+, -\}$. Assume as given a relation $R$ endowed with a set of argument roles $r_1, r_2, \ldots, r_n$. When appropriate objects $a_1, a_2, \ldots, a_n$ are assigned to all the argument roles of $R$ an issue arises: do these assigned objects stand in the relation $R$ or do they not? The former possibility is represented by the SOA $\sigma$, while the latter possibility is represented by the SOA $\bar{\sigma}$. $\bar{\sigma}$ is referred to as the dual of $\sigma$:

\[ \sigma = (R, r_1: a_1, r_2: a_2, \ldots, r_n: a_n; +) \]
\[ \bar{\sigma} = (R, r_1: a_1, r_2: a_2, \ldots, r_n: a_n; -) \]

I follow the established convention of omitting the polarity '+' where no confusion arises. In (31) two SOA's are depicted:

\[ (\text{LIKE}, \text{liker:} jill, \text{likee:} bill; +) \]

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13 The term 'SOA' is, historically, an acronym for 'state-of-affairs'. The acronym is preferred since SOA's are also used to describe non state-like entities such as events. In the situation theoretic literature SOA's are also referred to as infons'.

14 '+/-' are variously notated as '1/0' or 'yes/no'.

15 It is worth emphasising that these are solely depictions of SOA's, because SOA's are taken to be non-linguistic (abstractions), individuated in terms of real-world objects. They are not sentences in a formal language, though some of them can be profitably thought of as contents of uses of sentences. I use bold-face type when the non-linguistic nature of entities is to be emphasised.
If the possibility represented by some SOA \( \sigma \) is realised, the assumption is that there must be some situation \( s \) in the world that supports the factuality of \( \sigma \). This is denoted

\[
(32) \quad s \models \sigma
\]

The ontology developed here makes a clear distinction between "subject matter", represented by SOA's, and that which the subject matter pertains to, the situations. Both questions and propositions, however, are relational, that is, involve a certain relationship between the two types of entities. Before introducing them, it will be convenient to allow ourselves some algebraic structure.

In what follows I assume the framework of Barwise and Etchemendy (1990), specifically their idea that an appropriate algebraic structure for explicating inference is a SOA algebra, \( \text{SOA-ALG}_0 = (\text{Sit}_0, \text{SOA}_0, \rightarrow, \vdash, \bot, \top) \): a non-empty collection of objects \( \text{Sit}_0 \) called situations, together with a Heyting algebra of SOA's \( \text{SOA}_0, \rightarrow \) with distinguished members \( \bot, \top \), and a relation \( \vdash \) on \( \text{Sit}_0 \times \text{SOA}_0 \).\(^{16}\) The fact that the SOA's form a Heyting algebra means that:

- Given any not necessarily finite set of SOA's \( \Sigma \), there exists a SOA \( \wedge \Sigma \) ('the informational meet of \( \Sigma \)'), a SOA that represents the combined information in \( \Sigma \).
- Given any not necessarily finite set of SOA's \( \Sigma \), there exists a SOA \( \vee \Sigma \) ('the informational join of \( \Sigma \)'), a SOA that represents the weakest information specified by \( \Sigma \).
- The domain of SOA's is partially ordered by \( \rightarrow \): \( \sigma \rightarrow \tau \) is to be read as '\( \sigma \) is informationally stronger than \( \tau \)'.
- Given any SOA \( \sigma \), there exists a SOA \( \check{\sigma} \) such that \( \sigma \wedge \check{\sigma} = \bot \), and for any \( \tau \neq \check{\sigma} \) such that \( \tau \wedge \sigma = \bot \), it is the case that \( \tau \rightarrow \check{\sigma} \) ('\( \check{\sigma} \) is the weakest piece of information incompatible with \( \sigma \))'. In fact, in what follows, I will restrict attention to coherent SOA algebras. This means

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\(^{16}\) The conditions on a sextuple \( \langle \text{Sit}_0, \text{SOA}_0, \rightarrow, \vdash, \bot, \top \rangle \) required in order that it be a SOA algebra are:

1. If \( s \vdash \sigma \) and \( \sigma \rightarrow \tau \), then \( s \vdash \tau \).
2. \( s \nvdash \bot \), \( s \vdash \top \).
3. If \( \Sigma \) is any finite set of SOA's, then \( s \vdash \wedge \Sigma \) iff \( s \vdash \sigma \) for each \( \sigma \in \Sigma \).
4. If \( \Sigma \) is any finite set of SOA's, then \( s \vdash \vee \Sigma \) iff \( s \vdash \sigma \) for some \( \sigma \in \Sigma \).

Barwise and Etchemendy actually allow that the algebraic structure on the SOA's be weaker than Heyting, though for our purposes closure under arbitrary meets and joins is important.
that for no situation \( s \in SIT_0 \) and SOA \( \sigma \in SOA_0 \) is it the case that \( s \not\equiv \sigma \) and also \( s \not\equiv \bar{\sigma} \).

\( \bot \) is the least element of \( SOA_0 \) and represents incoherent information that no situation will support, whereas \( \top \) represents null information that all situations support vacuously. If \( \tau \wedge \sigma = \bot \), this means that \( \tau \) and \( \sigma \) are incompatible, whereas if \( \tau \vee \sigma = \top \), this means that \( \tau \) and \( \sigma \) are an exhaustive case. An important feature of the SOA algebra that is exploited below in our characterisation of aboutness is the fact that it is not in general the case that for a SOA \( \sigma \):

\[
\sigma \vee \bar{\sigma} = \top
\]

That is, given a SOA \( \sigma \) and a situation \( s \), it is not guaranteed that \( s \not\equiv \sigma \) or \( s \not\equiv \bar{\sigma} \).\(^{17,18}\)

### 3.2. Questions and Propositions

In what follows let us assume a fixed SOA algebra \( SOA-ALG_0 = \langle SIT_0, SOA_0, \rightarrow, \vdash, \bot, \top \rangle \). Questions and propositions will not be analysed reductively: I will postulate a universe which contains for any situation-SOA \((s, \sigma)\) pair in \( SIT_0 \times SOA_0 \) a question, the question whether \( \sigma \) is a fact of \( s \), notated as \((s?\sigma)\) and a proposition, the proposition/claim that \( \sigma \) factually describes \( s \) notated as \((s!\sigma)\). What the situation/SOA components provide us with are the means for characterising truth and decidedness, a context independent notion for questions from which resolvedness will later emerge by appropriate relativisation:

- \((s?\sigma)\) is decided iff \( s \not\equiv \sigma \) or \( s \not\equiv \bar{\sigma} \).
- \((s!\sigma)\) is true iff \( s \not\equiv \sigma \).

\(^{17}\) The initial motivation for this, due to Barwise (1981), concerns direct perception reports. Barwise's claim was that the objects of perception in these cases are partial segments of the world. Hence the report \((ia)\) describes Jill as seeing a situation \( s \) in which the SOA \( \langle WALK, \text{walker:bill:}+, \rangle \) is factual. However, the question \((s_0? (\text{TALK, talker: mike:}+))\) need not be resolved, since e.g. \text{mike} might be an entity external to \( s \). Hence, the inference from \((ia)\) to \((ib)\) is not licensed (although the reverse direction is licit.):

\(\begin{align*}
\text{(ia)} & \quad \text{Jill saw Bill walk.} \\
\text{(ib)} & \quad \text{Jill saw Bill walk and Mike talk or Mike not talk.}
\end{align*}\)

\(^{18}\) A legitimate question to ask is why within this framework all meets of the form \( \sigma \wedge \bar{\sigma} \) collapse to a unique bottom element \( \bot \). For instance, if we want the SOA's to represent contents of cognitive states, it seems plausible to require different kinds of contradictory states to be individuated. In order to accommodate this one will be lead to adopt an algebraic structure somewhat weaker than assumed here, see e.g. Schulz (1993). In the current work, I will not explore the issue further. My attention to this issue was drawn by Gennaro Chierchia.
RESOLVING QUESTIONS, I

It is at this point that the partiality of situation theory is exploited: given a SOA $\sigma$ and a situation $s$, it is not guaranteed that $s \vDash \sigma$ or $s \nvDash \sigma$. A given situation need not, in fact in most cases will not, decide all questions. Equally, if a proposition $(s!\sigma)$ is false, it does not, on this view, follow that $\sigma$ represents non-veridical information, rather it follows that $s$ lacks "positive proof" of $\sigma$'s accuracy.

So far we have accommodated propositions and yes-no questions "on top of" a basic ontology containing situations and SOA's. However, given the intuition described above concerning the nature of questions, the general schema for questions involves associating "SOA's" containing $n$ "blurred features" with a situation. How to conceive of these blurred SOA's? Here we can take two tacks: the first is to expand the class of SOA's by allowing in a new kind of SOA, dubbed *partial* in Crimmins (1993b) and (confusingly from the current point of view) *unresolved* in Ginzburg (1992). These SOA's differ from the ones described above in that the argument-role to entity assignment component of the SOA is a strictly *partial* mapping: for instance in (34) the argument-roles assigned a '−' do not get an entity associated with them:

(34)a. 〈LIKE, liker:jill, likee:−; +〉

b. 〈HOT, location:−, time:−; +〉

The second tack, one which I will adopt in the current work, is, in some sense, more ontologically conservative.\(^{19}\) I identify "blurred" SOA's with $n$-ary abstracts. Thus, each "hole" corresponds to an argument role that has been abstracted over:

(35)a. $\lambda x$〈LIKE, liker:jill, likee:x; +〉 (abstract corresponding, roughly, to 'who does Jill like')

b. $\lambda x, y$〈HOT, location:x, time:y; +〉 (abstract corresponding, roughly, to 'when is it hot where')

I assume these abstracts are construed situation theoretically: see Aczel and Lunnon (1991), Lunnon (1992) for a mathematical account of a requisite notion of abstraction, Barwise and Cooper (1991), Cooper (1993) for a reworking of this notion into situation theory. I offer here a sketch of the notion of abstract used here. This draws heavily on the exposition in Cooper (1993).

\(^{19}\) In fact, the idea for countenancing partial SOA's for this kind of purpose derives from Crimmins (1993b) [the work predates Ginzburg (1992) in unpublished form], whose intention was to provide an entity that could perform many of the functions required of states-of-affairs containing *parameters* while avoiding the ontological commitment to parameters as semantic entities.
Aczel and Lunnon develop a notion of abstraction in terms of generalized set theory, set theory with the addition of abstracts as non-sets. The idea is that abstracts are a particular kind of object in a structured universe. If the universe contains objects of sort \( \phi \) (e.g. relations, SOA’s or propositions), one can define an operation that expands the universe to contain also objects of sort \( \phi \)-abstract, objects that when applied to an assignment \( f \) yield objects of sort \( \phi \) in which substitution as specified by \( f \) has taken place.

What kind of abstracts does my account require as members of the universe? In order to formulate the theory of questions proposed here all we need to assume is that the universe also contains a class of SOA-abstracts, SOA-ABST\(_0\). Indeed in the sequel when I make use of the term ‘\( n \)-ary abstract’ this will always be shorthand for ‘\( n \)-ary SOA-abstract’. In addition to this, the semantics proposed for attitude reports in Section 3.4.2 will assume a background theory of mental states whose formulation for attitudes that are propositional (e.g. belief) requires the existence of proposition abstracts, whereas for attitudes that are interrogatory (e.g. wonderment) requires the existence of question abstracts. It should be emphasized that this latter requirement, the need for proposition-abstracts and question-abstracts, is quite independent of the theory of questions developed here, but rather is a consequence of a particular approach to representing mental states.

Within the Aczel Lunnon theory what is being abstracted over is an indexing set of parameters (the members of such set are said to be ‘role indices’). Hence, arguments to the abstract can be supplied simultaneously and there is no required order. Thus, let \( a(X, Y) \) be a parametric object with the parameters \( X \) and \( Y \). Then we represent the result of abstracting over \( X \) and \( Y \) and indexing the two roles of the resulting abstract with the role indices \( r_1 \) and \( r_2 \) as

\[
\lambda\{(r_1, X), (r_2, Y)\} a(X, Y)
\]

Once the parameters are abstracted over they are not present in the object and thus it does not matter which parameters you started from in the parametric object. This is known as \( \alpha \)-equivalence.

In what follows I will make use of a notational convention introduced in Barwise and Cooper (1991) which suppresses the role indices in an

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20 This contrasts with a view received from Montague’s semantics of abstracts as \( \lambda \)-expressions which are interpreted as functions.

21 That is,

\[
\lambda\{(r_1, X), (r_2, Y)\} a(X, Y) \text{ is an identical object to } \lambda\{(r_1, Z), (r_2, V)\} a(Z, V).
\]
abstract by using (finite subsets of) the natural numbers beginning with 1 as the indexing set. Hence (37a) will be notated as (37b) and linear order in the notation corresponds to the ordering within the natural numbers. Within this view of abstraction, abstracts can be applied to assignments. An assignment for an abstract is a function whose domain includes the role indices of the abstract. Our notational convention will extend to assignments in the same way. Hence, (37c) is notated as (37d):

\begin{align}
(37) & \text{a. } \lambda \{(1, X), (2, Y)\}a(X, Y) \\
 & \text{b. } \lambda X, Y a(X, Y) \\
 & \text{c. } [1 \mapsto a, 2 \mapsto b] \\
 & \text{d. } [a, b]
\end{align}

Applying an abstract to an assignment is identical with the result of substituting the objects b and c for the parameters in the parametric object \( a(X, Y) \) that was abstracted over. This is exemplified in (38) where a SOA-abstract is applied to an assignment with resulting output a SOA. I call such a SOA an application instance of the abstract:

\begin{align}
(38) & \text{a. } \lambda X\langle \text{LIKE, liker:jill, likee:X}; + \rangle[mike] = \\
 & \langle \text{LIKE, liker:jill, likee:mike}; + \rangle \\
 & \text{b. } \lambda X, Y \langle \text{HOT, location:X, time:Y}; + \rangle[\text{HCRC, 3am}] = \\
 & \langle \text{HOT, location:HCRC, time:3am}; + \rangle
\end{align}

Hence, the notion of an application-instance-set defined and exemplified in Figure 1.

With this sketch of the properties of abstracts, I can describe how questions fit into the universe. In general: I assume that any situation \( s \in \text{Sit}_0 \) and \( n \)-ary \((n \geq 0)\) abstract \( \lambda X_1, \ldots, X_n \sigma(X_1, \ldots, X_n) \in \text{SOA-ABST}_0 \) give rise to a question \( (s?\lambda X_1, \ldots, X_n \sigma(X_1, \ldots, X_n)) \).

In Figure 2 a general definition of decidedness is offered. A question \( (s?\mu) \) is decided, according to this definition, iff the exhaustive answer
(s?λX₁,...,Xₙσ(X₁,...,Xₙ)) is decided iff

\[ s \models \text{Fact-} \land \text{SIT}_0(λX₁,...,Xₙσ(X₁,...,Xₙ)) \]

Face- \( \land \text{SIT}_0 \) represents the most exhaustive application-instance determined by the n-ary abstract component of a question relative to the given set of situations \( \text{SIT}_0 \):

\[ \text{Fact-} \land \text{SIT}_0(\mu) = \text{def} \]

Either

\[ \land \{(τ ∈ \text{SOA}_0 | τ ∈ \text{APPL-INST}(\mu) \land ∃s(s ∈ \text{SIT}_0 ∧ s \vdash τ)\} \text{ iff this set} \]

\[ \neq \emptyset \]

Or

\[ \land \{(τ ∈ \text{SOA}_0 | ∃σ(σ ∈ \text{APPL-INST}(\mu) ∧ τ = σ ∧ ∃s(s ∈ \text{SIT}_0 ∧ s \vdash τ))\} \]

Otherwise

Figure 2. Decidedness conditions for a question.

defined by \( \mu \) and \( \text{SIT}_0 \) is a fact of \( s \). Specifically, given the definition above, Fact- \( \land \) amounts to the following:\textsuperscript{22}

- For a yes/no-question \((s?σ)\): Fact- \( \land \text{SIT}_0(σ) \) is whichever of \( σ \) or \( \bar{σ} \) is factual relative to \( \text{SIT}_0 \), if either is.
- For a wh-question \((s?λX₁...Xₙσ(X₁...Xₙ)), n ≥ 1\), Fact- \( \land \text{SIT}_0(λX₁...Xₙσ(X₁...Xₙ)) \) is the maximal factual application-instance if any factual application-instances exist; otherwise, it is the negative universal quantificational answer (if that is made factual by \( \text{SIT}_0 \)).

3.3. Compound Questions

What of compound questions and propositions? Barwise and Etchemendy show how, given any SOA algebra \( S_0 \), a Boolean algebra of propositions, \( \text{PROP}(S_0) \), can be defined above \( S_0 \). Thus, although the algebraic structure on the SOA’s in \( S_0 \) is not classical, the propositions can be provided with a classical logic in which identities such as the following hold:

\[
\text{(39)a. } (s!σ ∨ / \land τ) = (s!σ) ∨ / \land (s!τ) \\
\text{b. } (s!σ) ∨ (s!\bar{σ}) = \top
\]

\text{Fig. 2.} Decidedness conditions for a question.

\text{Fact-} \land \text{SIT}_0 \text{ represents the exhaustive answer according to the objective “available information”, which is, intuitively, represented here by \( \text{SIT}_0 \), rather than, say, according to what information is present in \( s \). Hence, if \( s \) is “small” enough (e.g. it is not a world), it will not contain enough information (i.e. support sufficiently many SOA’s) to make the case that a question \((s?μ)\) is decided, for various choices of \( μ \).

\textsuperscript{22} Fact- \( \land \) represents the exhaustive answer according to the objective “available information”, which is, intuitively, represented here by \( \text{SIT}_0 \), rather than, say, according to what information is present in \( s \). Hence, if \( s \) is “small” enough (e.g. it is not a world), it will not contain enough information (i.e. support sufficiently many SOA’s) to make the case that a question \((s?μ)\) is decided, for various choices of \( μ \).
The reader is referred to Barwise and Etchemendy's paper for details. I show how to follow a similar strategy for questions. I discuss some further issues concerning coordination, specifically the status of mixed declarative/interrogative compounding in 'Resolving Questions, II', Section 7.

Note first that the meet/join operations of the SOA algebra can be naturally extended to SOA-abstracts as follows:

\[
\begin{align*}
\lambda X_1, \ldots, X_n \sigma(X_1, \ldots, X_n) \lor / \land & \lambda Y_1, \ldots, Y_m \tau(Y_1, \ldots, Y_m) \\
= & \text{def} \lambda X_1, \ldots, X_n, Y_1, \ldots, Y_m \sigma(X_1, \ldots, X_n) \lor / \\
& \land \tau(Y_1, \ldots, Y_m) \\
= & \text{(Cooper 1993)}
\end{align*}
\]

The idea would then be to extend compounding to the class of questions such that the following get identified:

\[
\begin{align*}
(s?a) & \land (s?b) = (s?(a \land b)) \\
(s?a) & \lor (s?b) = (s?(a \lor b))
\end{align*}
\]

Given (40), we obtain fairly natural results such as

\[
\text{APPL-INST}(a \land b) = \{ \tau \in SOA_0 | \exists \sigma, \mu \in SOA_0((\tau = \sigma \land \mu) \land \\
(\sigma \in \text{APPL-INST}(a), \mu \in \text{APPL-INST}(b)))\}
\]

Similarly, since \( s \models \tau \land (\lor) \sigma \) entails \( s \models \tau \) and (or) \( s \models \sigma \)), it is straightforward to show that \((s?(a \land (\lor)b))\) is decided iff \((s?a)\) and (or) \((s?b)\) are decided (and ultimately for resolvedness too).

3.4. Semantic Rules

3.4.1. Introduction

In this section, I provide a set of compositional rules for the semantics of declaratives, y/n and wh-interrogatives using the situation semantics framework of Gawron and Peters (1990) (for a recent exposition see Cooper and Poesio 1994) and an HPSG syntax (Pollard and Sag 1994); I adopt typographical conventions that are minor but transparent variants of both frameworks. I outline here some basic situation semantics notions and notation.

In situation semantics an utterance is reified as a situation, one that supports the various contextual facts needed to obtain a content from a meaning. A meaning for an expression will be an n-ary abstract in which the contextual parameters are abstracted away subject to certain restrictions, facts that must hold in any utterance (situation) of that expression.
For example: a simplified, tenseless meaning for an assertoric use of (43a) is given in (43b):

(43)a. Bill likes me
   b. \( \lambda b, a, s \langle \text{ASSERT}, a, (s! \langle \text{LIKE}, b, a; + \rangle) \rangle \)
      RESTRICTIONS:
      \( u \vdash \langle \text{NAMED}, \text{Bill}, b; + \rangle \land \langle \text{SPEAKER}, a; + \rangle \land \langle \text{DESCRIBING}, a, s; + \rangle \)

For its full effect to go through, the utterance situation needs to provide values for a speaker \( a \), the situation described \( s \), and a referent \( b \) for the NP 'Bill'.

As a notational convention, I will generally write meaning descriptions as follows:

(44)a. \( ['a'](x_1, \ldots, x_n) = B \)
      RESTRICTIONS: \( C(x_1, \ldots, x_n, \ldots, y_1, \ldots, y_m, B) \)

Here \( x_1, \ldots, x_n \) are contextual parameters introduced by this grammar rule, usually including the utterance notated as \( \text{utt} - \text{sit} \). \( y_1, \ldots, y_m \) are contextual parameters (possibly) introduced by the constituents. If the expression 'a' has immediate constituents 'a_1' and 'a_2', the restrictions specified for a use of 'a', \( \text{RESTR}(a) \), will frequently be specified by a rule of the form 'combine \( \text{RESTR}(a_1) \) and the \( \text{RESTR}(a_2) \)'. This means that \( \text{RESTR}(a) \) is constituted by conjoining the SOA that makes up the restrictions associated with an utterance of \( a_1 \) with the SOA that make up the restrictions associated with an utterance of \( a_2 \).

Compositionality is assumed to hold of meanings. For instance, a tenseless meaning description of a (simple, quantifier-less, declarative) sentence is the following:

(45)a. \( S \rightarrow \text{NP}, \text{VP} \)
   b. \( [S](\text{utt} - \text{sit}) = \langle \text{Cont}(\text{VP}), \text{Cont}(\text{NP}) \rangle \); 
      RESTRICTIONS: conjoin \( \text{RESTR}(\text{NP}) \) with \( \text{RESTR}(\text{VP}) \).

with the following simplified example of a derivation:

(46)a. ['You walk'](\( \text{utt} - \text{sit} \)) = \langle \text{WALK}, s \rangle.
      RESTRICTIONS: \( \text{utt} - \text{sit} \vdash \langle \text{ADDRESSED-WITH}, \text{You}, s \rangle \).
   b. ['walk'](\( \text{utt} - \text{sit} \)) = \text{WALK}.
      RESTRICTIONS: (none).
   c. ['You'](\( \text{utt} - \text{sit} \)) = s.
      RESTRICTIONS: \( \text{utt} - \text{sit} \vdash \langle \text{ADDRESSED-WITH}, \text{You}, s \rangle \).
3.4.2. **Attitude Reports**

I start by considering the rules for embedding sentences. As I noted above, situation theory provides us with a semantic universe consisting of fine-grained objects such as SOA’s, propositions, and questions. One influential view prevalent within the philosophical literature of the past 15 years has been the view that the semantics of attitude reports requires some kind of fine-grained/structured informational/propositional entities; but in addition to this, also a means of representing the reported agent’s “perspective” on the attitude (in the case of belief this is often referred to as a ‘way of believing’). The semantics offered here is in this spirit and is based on Cooper and Ginzburg’s (1994) semantics for belief reports, which is, to a large extent, a compositional reformulation of philosophical accounts in the style of Barwise and Perry (1983), Richard (1990), Kamp (1990), and Crimmins (1993a).

The basic difference between Cooper and Ginzburg’s account and the one provided by Montague (1973) is that Cooper and Ginzburg posit a *triadic* belief relation, one that holds between an agent, a proposition *and* a mental situation, where the latter represents the currently reported mental perspective of the agent, and the proposition represents the belief content of that situation. 23 Note that such a situation can, in principle, also have contents of other attitudes, e.g. goals, a feature which will be of some importance in capturing resolvedness.

Cooper and Ginzburg’s account works on the basis of the rule in (47b), coupled with constraints stated in (48a,b) that relate an agent’s belief (lack of belief in (48b)) in a proposition to facts about the agent’s mental situation.

\[
\begin{align*}
(47) & \quad \text{a. } VP[\text{fin}] \rightarrow H: V[\text{fin}], C: S[\text{fin}, + \text{DECL}] \\
& \quad \text{b. } [VP\ (utt - sito, ms)] = \lambda x(\text{CONT}(H), \text{subj-role}: x, \\
& \quad \quad \text{content-role: } \text{CONT}(C), \text{cog-role: } ms); \\
& \quad \text{RESTRICTIONS: } \text{conjoin RESTR}(H) \text{ with RESTR}(C). \\
(48) & \quad \text{a. } s \vDash \langle \text{BELIEVE}, \text{subj-role: } a, \text{content-role: } p, \text{cog-role: } ms; + \rangle \rightarrow \\
& \quad \exists T, f(ms \vDash \langle \text{BELIEVE}\#, \text{agent: } a, \text{internal-type: } T, \\
& \quad \quad \text{external-assignment: } f; + \rangle \land T[f] = p)
\end{align*}
\]

23 In common with the remainder of the paper, issues pertaining to tense are ignored. A treatment that did take tense into account would see ‘believe’ as denoting a 4-place relation.
b. \( s \models (\text{BELIEVE}, \text{subj-role: a, content-role: p, cog-role: ms}; -) \rightarrow \neg \exists T, f(ms \models (\text{BELIEVE#}, \text{agent:a, internal-type:T, external-assignment: f; +}) \land T[f] = p) \)

The first constraint amounts to linking a positive belief attribution of proposition \( p \) relative to the mental situation \( ms \) with the existence of an internal belief state whose content is \( p \). The internal belief state is a situation that is part of \( ms \), and is describable by SOA’s of the form \( \langle \text{BELIEVE#}, \text{agent:a, internal-type:T, external-assignment: f; i} \rangle \), where \( i \) can be + or −. Here ‘BELIEVE#’ is a predicate used to classify an internal state as a belief state, \( T \) is a proposition-abstract and \( f \) is an assignment appropriate for that abstract such that applying \( T \) to \( f \) yields \( p \). \( T \) is intended to represent the internal, agent dependent perspective on the belief (corresponding to what Barwise and Perry (1983) call a “frame of mind”). This comes along with various roles which may be linked to the world external to the agent. This linkage is what \( f \) represents.\(^{24}\)

An account of this type allows for a principled resolution of the apparent paradoxes dyadic accounts of belief face exemplified most famously by Kripke’s Pierre who can be reported, simultaneously as in (49a) and as in (50a). If we make the distinction between internal and external aspects of the belief, this gives us a finer grain than just propositions. There can be several different \( T \) and \( f \) such that the result of applying \( T \) to \( f \) all yield the same proposition. In order to achieve this we have to postulate that our semantic universe contains in addition to propositions also a set of proposition-abstracts.

\(^{24}\) The constraint as stated contains one simplification. In certain cases, not all roles in the abstract need have actual, external objects that will fill the roles. For instance, a belief that might be reported as: ‘Billy believes Santa Claus is asleep’ would plausibly be analysed in terms of a belief state \( ms \) where

\[
\begin{align*}
(i) & \quad ms \models (\text{BELIEVE#}, \text{billy}, T_2; f_2; +), \\
(ii) & \quad T_2 = \lambda X, Y(s! (\text{ASLEEP}, X; +) \land \langle \text{NAMED}, \text{'Santa Claus', X} \rangle).
\end{align*}
\]

\( f_2 = [\] \), the empty assignment (since there is no external object to anchor the role of entity named Santa Claus that is asleep to.) In this case, then, applying \( T_2 \) to \( f_2 \) yields a proposition-abstract, not a proposition. The general solution is to affect an existential closure over roles that are not filled by the external assignment. So, the revised final clause in the constraint would read: \( \exists^* T[f] = p \). Here \( \exists^* \alpha \) is defined as follows: If \( \alpha \) is a type, \( \exists^* \alpha \) is \( (\alpha \land \exists) \) (the proposition that \( \alpha \) is instantiated); If \( \alpha \) is a proposition \( \exists^* \alpha \) is \( \alpha \).
In (49b) and (50b) mental situations of a kind that corresponds to the two beliefs Pierre has are exemplified.\footnote{The formulation provided here is simplified relative to Cooper and Ginzburg (1994) in that here I have not separated away background beliefs which an agent might use to identify the objects but rather conjoined them to the foreground belief (in this case: that London is/isn’t pretty.) In Cooper and Ginzburg (1994), the background beliefs are modelled as restrictions on the proposition-type.}

(49)a. Pierre believes that London is pretty (when talking about Pierre’s French, travel brochure inspired perspective on London.)

\[ ms_1 \models \langle BELIEVE\#,agent : pierre,internal − type : T_1,external − assignment : f_1;+\rangle, \text{ where:} \]
\[ T_1 = \lambda X, Y(s!(PRETTY, X) ∧ \langle NAMED, ‘Londres’, X⟩ ∧ \langle APPEARS − IN, X, Y⟩ ∧ \langle TRAVEL − BROCHURE, Y⟩); \]
\[ f_1 = [\text{London, travel-brochure}] \]

(50)a. Pierre does not believe that London is pretty (when talking about Pierre’s East End – squalor – inspired perspective on London.)

\[ ms_2 \models \langle BELIEVE\#,agent : pierre,internal − type : T_2,external − assignment : f_2;+\rangle, \text{ where:} \]
\[ T_2 = \lambda X, Y(s!(PRETTY, X;−) ∧ \langle NAMED, ‘London’, X⟩ ∧ \langle LIVES − IN, X, Y⟩ ∧ \langle SEE, Y, X⟩); \]
\[ f_1 = [\text{London, Pierre}] \]

A variant of the rule in (47) will also hold for interrogative embedding. The sole difference is that the content of the embedded sentence in such cases is a question rather than a proposition, whereas the internal type of the corresponding mental state, e.g. a wonderment state, is a question-abstract. My initial account of interrogatives (declaratives) embedded by resolutives (factives) will involve assuming that such predicates respect additional constraints that capture the resolvedness (factive) inferences discussed in Section 2.1. Before I go into such details, concerning how to enforce resolvedness inferences, let us consider a more mundane issue: how does a question complement get compositionally constructed.

3.4.3. Syntax

HPSG assumes the existence of a number of Immediate Dominance (ID) schemata analogous to the X-bar schemata of GB. These schemata can be cross-classified by means of a sort pertaining to different sentential types. I assume that the possible sub-attributes of this sort (i.e. the sub-
sorts) include DECL(ARATIVE), corresponding, intuitively to a declarative specification, and INT(ERROGATIVE), corresponding to an interrogative specification. This sort is analogous to the feature wh used in GB to subclassify CP's. The resulting schema/sentence-type cross-classifications provides different syntactic structures, each of which will be provided with its own meaning description. This means that an embedded interrogative structure receives the same description as the declarative in (47) save for the fact that the complement is C: S[fin, + INT].

The ID schemata I assume to be cross-classified in this way provide us with a NP/VP rule:

\[(51) \quad S[\text{fin}] \rightarrow H: V[\text{fin}], \text{SUBCAT} \langle [2] \rangle, \text{C: [2] NP[\text{nom}]}\]

and a rule for dislocated phrases:

\[(52) \quad S[\text{fin}] \rightarrow H: S[\text{fin, INHER | SLASH([1])}, \ldots, \text{TO-BIND | SLASH([1])}, F:[1]}\]

This schema is supposed to license 'dislocation' structures such as sentences with fronted interrogatives and topicalisation. It is assumed to diverge into two subschemas, one for root sentences that contains the specification [+INV] on the head, the other for embedded sentences, which must contain the specification [−INV]. Matrix y/n interrogative sentences are described by the following inverted sentence structure:

\[(53) \quad S[\text{fin, + AUX, + INV}] \rightarrow H: V[+INV, + AUX, + INV], C1: \text{NP[nom]}, C2: \text{VP[bse]}\]

### 3.4.4. Semantic Categories and Clauses

Let me start by explaining which semantic objects I will associate with the different kinds of clauses at hand. For expository simplicity let us put wh-phrases aside for a brief while. Consider first a 'that'-less declarative. This

\[26\quad \text{Certain details relevant to a more detailed fragment are omitted, for instance an additional syntactic distinction between wh-interrogatives and y/n interrogatives: a wh-interrogative sentence that is +INT is entailed to contain a wh-phrase marked +QUE. This feature motivated in part by issues concerning pied-piping is also used to state constraints on the scope of the wh-phrase that bears this feature: essentially that that phrase must be closed within the minimal clause that contains it. Such a wh-phrase is also entailed to be the leftmost in its clause. See the appendix for some further details.}\]

\[27\quad \text{In assuming the existence of syntactically interrogative sentences of this structure, I follow the GPSG analysis of subject questions as not involving a dislocation of the subject interrogative. Nothing in the semantic analysis proposed here rides on this.}\]
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appears as a constituent of the following contents (... signifies omitted arguments of the relation):

(54)a. Assertion: Bill left. Required content:
   Assert(... (s!(LEFT,b)) ...)
b. (Intonation) Query: Bill left. Required content:
   Query(... (s?(LEFT,b)) ...)
c. (Embedded) That clause: Jill believes that Bill left.
   BELIEVE(... (s!(LEFT,b)) ...)
d. Whether clause: Jill asked whether Bill left. Required content:
   ASK(... (s?(LEFT,b)) ...)
e. Embedded clause: Jill believes Bill left.
   BELIEVE(... (s!(LEFT,b)) ...)

These data provide some motivation for assigning the SOA ⟨LEFT,b⟩ as the basic content-type, since it is the "lowest common denominator". In the embedded case, 'that' and 'whether' respectively form propositions and questions in conjunction with a contextually supplied situation. In the "illocutionary uses", the proposition (question) will similarly emerge when the content provided by the matrix sentence becomes an argument of an assertion (query) operator. (See Section 5 for such a query operator.) Such a proposal is very much in the spirit of Austin's original view of assertion (Austin 1950), which motivates the situation semantics ontology, since Austin viewed an assertion as involving the juxtaposition of a situation type (here a SOA), provided by the descriptive conventions of the language, with an external (in his terminology 'historical') situation supplied by what he termed 'demonstrative conventions'.

(54e) is a slight "glitch" due to an "idiosyncracy" of English which allows complementiser-less phrases to be embedded. We can patch this problem either by postulating an ambiguity or by positing a null 'that'. I opt for the former here.

Thus, an initial version of our semantic rule for an S-rule will be:

(55)a. [S](utt - sito) = (CONT(H), CONT(C)))
   REQUIREMENTS: conjoin RESTR(C) with RESTR(H)
b. [S](utt - sito, descr - sito) = (descr-sito ! (CONT(H),
   CONT(C)))
   REQUIREMENTS: conjoin RESTR(C) with RESTR(H)

(55a) is the SOA-denoting rule, whereas (55b) is a rule that outputs a proposition whose constituents are a contextually provided situation and the denoted SOA.

Similar considerations apply with yes/no interrogatives: whereas we
ultimately require a y/n question content in (56a), in all other cases the contribution required of 'has Bill left' is a SOA. Hence, again, the "lowest common denominator" is a SOA. Thus, (56a) can be accommodated in similar fashion to (54a,b).

(56)a. Query use: Has Bill left? Required content:
Query(\ldots (s?\langle LEFT,b\rangle) \ldots)

b. Dislocation structure: who has Bill left? Required content:
Query(\ldots (s?\lambda x\langle LEFT,b,x\rangle) \ldots)

c. Dislocation structure/sentential adjunct: why has Bill left? Required content:
Query(\ldots (s?\lambda P\langle BECAUSE,P,\langle LEFT,b,;\rangle\rangle) \ldots)

d. Nor has Bill left. Required content:
Assert(\ldots (s!\langle NOR,\langle LEFT,b,;\rangle\rangle) \ldots)

From this we conclude: the basic descriptive content of the sentence is modified by the modal relation denoted by the (inverted) auxiliary verb.

(57)a. S[fin,+AUX,+INV,+INT] \rightarrow H: (V[+INV,+AUX]), C1: NP[nom], C2: VP[bse]

b. \([S](utt - sito) = ((fONT(H), (CONT(C1), CONT(C2)))) \)

RESTRICTIONS: conjoin RESTR(H) with RESTR(C1) and with RESTR(C2)

We can use this rule to generate a meaning for 'does Bill like Mary' as follows:

(58)a. ['like Mary'] (utt - sito) = \lambda x\langle LIKE, liker:x, likee: m\rangle
RESTRICTIONS: utt - sito \vDash (\text{NAMED}, 'Mary', m)

b. ['Bill'](utt - sito) = b,
RESTRICTIONS: utt - sito \vDash (\text{NAMED}, 'Bill', b)

c. ['does'] = \text{IDENTITY} (the identity operator)

d. ['does Bill like Mary'](utt - sito) = \langle LIKE, liker:b, likee:m\rangle
RESTRICTIONS: utt - sito \vDash (\text{NAMED}, 'Bill', b) \land (\text{NAMED}, 'Mary', m)\textsuperscript{28}

3.4.5. Wh-phrase Semantics

Let us now bring wh-phrases and nominal quantifiers into the picture. The account provided here is based on that of Ginzburg (1992) where an

\textsuperscript{28} This is based on the assumption that the SOA's \(\sigma\) and (IDENTITY, \(\sigma\)) are informationally equivalent.
account of wh-phrase meaning is developed in which wh-phrases denote restriction carrying variables that get \textit{closed} in with wider scope than nominal quantifiers. I limit myself here to a discussion of individual uses of wh-phrases, though the account in Ginzburg (1992) also includes functional and echo uses. The issue of scopal ambiguity treated in Ginzburg (1992) by extending the Gawron and Peters implementation of a Cooper storage-like mechanism is relegated to the appendix. This is described by the following modification to (55), which should also apply to (57):

\begin{align}
(59)a. & \quad S[\text{fin}, +\text{INT}] \rightarrow H: V[\text{fin}], C: \text{NP}[\text{nom}] \\
& b. \quad [S](\text{utt} \rightarrow s_{t_0}) = \\
& \quad \lambda \text{CLOSURE}(\text{QUANT-CLOSURE}((\text{CONT}(H), \\
& \quad \text{CONT}(C)))) \\
& \quad \text{RESTRICCTIONS: conjoin RESTR}(C) \text{ with RESTR}(H)
\end{align}

Here QUANT-CLOSURE and \textit{A-CLOSURE} are operators that, respectively, serve to closure nominal and wh-phrases.

Motivation for this view of scopal interaction includes evidence, based on data from Berman (1990), that whereas indefinite descriptions interact scopally with adverbs of quantification, wh-phrases do not. Similarly, whereas it is possible to get crossing co-reference readings in multiple-wh versions of Bach Peters sentences, this does not seem possible in such sentences containing a wh phrase and quantifier. A non-quantificational view of wh-phrase meaning is, in addition, particularly well suited to deal with echo uses of wh-phrases, where the echo-wh-phrase(s) scope over all other constituents, including a contextually supplied illocutionary matrix representing the force of the previous speech act. See Ginzburg (1992) for further details.

What then does interrogative closure consist of? If we restrict attention to individual uses, the answer is simple. I posit the existence of an operation, \textit{A-CLOSURE}, that abstracts over the variables introduced by each wh-phrase that gets closed at that sentential level to form an abstract. We appeal here to the existence of a notion of simultaneous abstraction (as in e.g. Aczel and Lunnon 1991):

\begin{align}
(60) \quad \lambda x_1, \ldots, x_n(Q, \ldots, r_1 : x_1, \ldots, r_n : x_n) = & \text{def} \\
\lambda x_1, \ldots, x_n(Q, \ldots, r_1 : x_1, \ldots, r_n : x_n)
\end{align}

Notice that the output of this operator is an abstract, say \( \mu \), which means that we leave the question \( (s?\mu) \) to be formed at a "later" stage in conjunction with a contextually supplied situation \( s \). With matrix wh-sentences this is unproblematic, given that a similar strategy is followed with unmarked (i.e. complementiser-less) declaratives and matrix y/n in-
terrogatives. What of embedded wh-clauses? Embedded subject wh-interrogatives are syntactically indistinguishable from matrix ones. So here, just as with that-less declaratives we can either posit an ambiguity or assume the existence of a null marker in English subject wh-clauses. I follow the first option:

(61)a. \[ S[\text{fin}, + \text{INT}, - \text{INV}] \rightarrow \text{H}: \text{V}[\text{fin}], \text{C}: \text{NP}[\text{nom}] \]

b. \[ [S](\text{utt} - \text{sit}_0, \text{descr} - \text{sit}_0) = (\text{descr} - \text{sit}_0) \Lambda \text{-CLOSURE-(QUANT-CLOSURE((CONT(H), CONT(C))))} \]

RESTRICTIONS: conjoin RESTR(C) with RESTR(H)

A similar rule will be needed for embedded filler/gap clauses, which in HPSG are \[ S[+ \text{INT}, \text{inv}, - \text{marked}] \], syntactically distinct from matrix filler/gap sentences which are inverted and, therefore, \[ S[+ \text{INT}, + \text{inv}, \text{marked}] \]. Note that the ambiguity in (61), just like (55) is not problematic in the sense that an embedding predicate which requires a question content as its argument will reject the content outputted by the meaning generated via (59) i.e. an abstract (and vice versa with a query operator that requires as argument an abstract.)

This, given the lexical entries for ‘who’ and ‘what’ in (62a,b) and the rule in (59) will yield the following derivation for ‘who likes what’:

(62)a. \[ ['who'](\text{utt} - \text{sit}_0) = \nu; \]

RESTRICTIONS: \[ \text{utt} - \text{sit}_0 \vdash (\text{PERSON}, \nu); \]

b. \[ ['what'](\text{utt} - \text{sit}_0) = \tau; \]

RESTRICTIONS: \[ \text{utt} - \text{sit}_0 \vdash (\text{INANIMATE}, \tau) \]

c. \[ ['\text{likes what}'](\text{utt} - \text{sit}_0) = \lambda x(\text{LIKE}, \text{liker}:x, \text{likee}: \tau) \]

RESTRICTIONS: \[ \text{utt} - \text{sit}_0 \vdash (\text{INANIMATE}, \tau) \]

d. \[ ['\text{who likes what}'](\text{utt} - \text{sit}_0) = \lambda \nu, \tau(\text{LIKE}, \text{liker}:\nu \ \text{likee}: \tau) \]

RESTRICTIONS: \[ \text{utt} - \text{sit}_0 \vdash (\text{INANIMATE}, \tau) \ \land \ (\text{PERSON,} \nu) \]

In order to accommodate a sentence such as ‘who does Bill like’, we need an analogue of (59) for filler/gap structures:

(63)a. \[ S[\text{fin}, + \text{INT}, + \text{INV}] \rightarrow \text{H}: S[\text{fin}, \text{INHER-SLASH([1])}, \text{TO-BIND-SLASH([1])}], \text{F}[1] \]

b. \[ [S](\text{utt} - \text{sit}_0) = \Lambda \text{-CLOSURE(\text{CONT(H)})} \]

RESTRICTIONS: conjoin RESTR(H) with RESTR(F)

\[ 29 \] For simplicity, I am assigning the same domain situation, the utterance situation, to all NP’s here; in a more careful treatment, each NP could, in principle, be assigned its own domain situation.
Hence, and exploiting similar derivations in (58) we obtain:

\[(64)\]

a. ['like'] \((uutt - sitt_0) = \langle \text{LIKE, liker:x, likee: r} \rangle\)

RESTRICTIONS: \(uutt - sitt_0 \vdash \langle =, r, \text{CONT('who')} \rangle\)

b. ['does Bill like'] \((uutt - sitt_0) = \langle \text{LIKE, liker:b, likee:r} \rangle\)

RESTRICTIONS: \(uutt - sitt_0 \vdash \langle \text{NAMED,'Bill',b} \rangle \land \langle =, r, \text{CONT('who')} \rangle\)

c. ['who'] \((uutt - sitt_0) = \langle \text{PERSON, r} \rangle\)

RESTRICTIONS: \(uutt - sitt_0 \vdash \langle \text{PERSON, r} \rangle\)

d. ['who does Bill like'] \((uutt - sitt_0) = \lambda r \langle \text{LIKE, liker:b, likee:r} \rangle\)

RESTRICTIONS: \(\text{domain} - sitt_0 \vdash \langle \text{NAMED,'Bill',b} \rangle \land \langle \text{PERSON, r} \rangle\)

I treat 'when', 'where', and 'why' as sentential modifiers, whose argument is a SOA, restricted to be factual. Given the rule in (65a–c), we get the derivation for 'why does Bill like Mary' in (65d,e):

\[(65)\]

a. \(S[\text{+fin,-marker}] \rightarrow ADJ: \text{ADVP, H: S[\text{+fin,-marker}]}\)

b. \([S](uutt - sitt_0) = \Lambda-\text{CLOSURE}((\text{CONT(ADJ), CONT(H)}))\)

RESTRICTIONS: conjoin \text{RESTR(ADJ)} with \text{RESTR(H)}.

c. \(\text{CONT('why')} = \lambda P(\text{BECAUSE, cause: c, effect: P})\)

RESTRICTIONS: \(uutt - sitt_0 \vdash P\)

d. ['does Bill like Mary'] \((uutt - sitt_0) = \langle \text{LIKE, liker:b, likee:m} \rangle\)

RESTRICTIONS: \(uutt - sitt_0 \vdash \langle \text{NAMED,'Bill',b} \rangle \land \langle \text{NAMED, 'Mary', m} \rangle\)

e. ['why does Bill like Mary'] \((uutt - sitt_0) = \lambda c \langle \text{BECAUSE, cause: c, effect: \langle \text{LIKE, liker:b,likee:m} \rangle} \rangle\)

RESTRICTIONS: \(uutt - sitt_0 \vdash \langle \text{LIKE, liker:b, likee:m} \rangle \land \langle \text{NAMED,'Bill',b} \rangle \land \langle \text{NAMED,'Mary', m} \rangle\)

'when' and 'where' are identical save that instead of an operator 'BECAUSE', 'when' will have an operator 'DURING' with argument roles \text{time} and \text{event}, whereas 'where' will have an operator 'IN' with argument roles \text{location} and \text{event}.

3.4.6. Basic Sentence Rules

HPSG analyzes that-clauses as consisting of an \text{unmarked} (i.e. comple-
mentiser-less) declarative clause and a marker. Given the discussion concerning (54), the content of a 'that clause' is a proposition, one whose constituents are the SOA provided by the unmarked clause and a contextually provided situation:

(66)a. \( S[\text{fin}, +\text{DECL}, +\text{marked}] \rightarrow \text{Marker}: \text{that}, H: S[\text{fin}, +\text{DECL}, -\text{marked}] \)
b. \([S[\text{fin},\text{that}]](\text{utt} - s_{i0},\text{descr} - s_{i0}) = (\text{descr-sit}_0 ! \text{CONT}(H))\)

RESTRICIONS: Identical with \(\text{RESTR}(H)\)

I analyze 'whether-clauses' analogously. Hence, in line with the discussion above, the content of a 'whether clause' is a question, one whose constituents are the SOA provided by the unmarked clause and a contextually provided situation:

(67)a. \( S[\text{fin}, +\text{INT}, +\text{marked}] \rightarrow \text{marker}: \text{whether}, H: S[\text{fin}, +\text{DECL}, -\text{marked}] \)
b. \([S[\text{fin},+\text{INT},+\text{marked}]](\text{utt} - s_{i0},\text{descr} - s_{i0}) = (\text{descr-sit}_0 ? \text{CONT}(H))\)

RESTRICIONS: Identical with \(\text{RESTR}(H)\)

Finally, an interrogative embedding rule with which we derive a meaning for the VP 'ask who likes what':

(68)a. \( \text{VP[fin]} \rightarrow H: V[\text{fin}], C: S[\text{fin}, +\text{INT}] \)
b. \([\text{VP}](\text{utt} - s_{i0},\text{ms}) = \lambda x(\text{CONT}(H), \text{subj-role}: x, \text{content-role}: \text{CONT}(C), \text{cog-role}: \text{ms});\)

RESTRICIONS: conjoin \(\text{RESTR}(C)\) with \(\text{RESTR}(H)\).
c. \('[\text{who likes what}](\text{utt} - s_{i0},\text{descr} - s_{i0}) = \text{descr-sit}_0 ? v, r(\text{LIKE}, \text{liker}: v \text{ likee}: r)\)

RESTRICIONS: \(\text{utt} - s_{i0} \equiv \langle \text{INANIMATE}, r \rangle \land \langle \text{PERSON}, v \rangle\)

(\text{an alternative derivation of (62) via rule (61)})
d. \('[\text{ask who likes what}](\text{utt} - s_{i0},\text{descr} - s_{i0},\text{ms}) = \lambda x(\text{ASK}, \text{subj-role}: x, \text{content-role}: (\text{descr-sit}_0 ? v, r(\text{LIKE}, \text{liker}: v \text{ likee}: r)), \text{cog-role}: \text{ms})\)

RESTRICIONS: \(\text{utt} - s_{i0} \equiv \langle \text{INANIMATE}, r \rangle \land \langle \text{PERSON}, v \rangle\)

In line with the general treatment of sentence embedding discussed previously, \(\text{ms}\) will be constrained via the interrogative analogue of the constraints in (48). However, resolutive predicates are constrained to satisfy additional constraints. I turn now to specifying these.
4. Resolvedness/Factivity Presuppositions

(Interim Account)

4.1. Factivity and Resolutivity Constraints

How are we to capture inferential behaviour of the kind discussed in Section 2.1? In this section I offer a preliminary account, one that is compatible with a fairly conservative, "surfacey" view of what declarative and interrogative complements denote. An alternative, in some sense more radical, account will be offered in Section 7, motivated in part by an attempt to offer a more explanatory account of the current data, in part by data introduced in that section.

Thus, the approach to declarative/interrogative complementation taken here is a uniform one: the content of an embedded declarative is uniformly a proposition, whereas the content of an embedded interrogative is uniformly a question. However, certain predicates carry with them additional presuppositions that involve the notions of factivity and resolutivity.

For the factive case, we need to relate fact-embedding V to proposition-embedding V so that the inference patterns in (1, 2) repeated here as (69) get captured:

(69)a. The claim is that p.
    Bill V's/has V'ed (knows/discovered) that p.
    So, the claim is true.

b. A certain fact is/has been V'ed (known/discovered)
    Which fact? One that proves the claim that p.
    So, it is V'ed that p.

I state the following constraint:

(70)  \( \langle P_{\text{factive}}, P_{\text{er}} : x, \text{content} - \text{role} : p, \text{cog} - \text{role} : ms \rangle \leftrightarrow \exists f [\text{PROVES}(f, p, ms) \land \langle P_{\text{factive}}, P_{\text{er}} : x, \text{content} - \text{role} : f, \text{cog} - \text{role} : ms \rangle] \)

Two comments about this constraint: first, since I am not identifying facts and true propositions. The constraint assumes the existence of two distinct \( P \) predicates, one whose arguments are propositions, the other whose arguments are facts, or the existence of a single relation which predicates of both propositions and facts. I will ultimately argue against the existence of the first of the two predicates (or, for the second option, that such predicates take propositions as their arguments.). Second, I am assuming that the relation PROVE relates a fact \( \tau \), a proposition \( p = (s!\sigma) \) and a mental state \( ms \) as follows:
(71) \[ \text{PROVE}(\tau,(s!\sigma),ms) \iff \]
\[ a. \quad \tau \Rightarrow_{ms} \sigma \]
\[ b. \quad s \models \tau \]

Here \( \Rightarrow_{ms} \) is taken to be a sound notion of consequence available to the mental state \( ms \) of an agent \( a \). I offer nothing concrete on the nature of this notion: minimally, it could be identified as the transitive closure of the conditionals represented in \( ms \). In other words, the transitive closure of a relation \( \Rightarrow' \) between SOA's such that:

(72) \[ \exists T.f[ms \models (\text{KNOW}^#,a,T,f;+)], \text{where } \exists^*Tf = \sigma \Rightarrow' \tau \]

In particular, though, I will assume that \( \Rightarrow_{ms} \) is reflexive, that is \( \forall \tau[\tau \Rightarrow_{ms} \tau] \). In that case, it follows that:\[^{33}\]

(73) \[ \exists \tau,ms \text{ PROVE}(\tau,(s!\sigma),ms) \iff \text{TRUE}[(s!\sigma)] \]

I use the first formulation since it is more general and could serve as a basis for a framework distinct from the current one, where facts, SOA's and propositions would be related differently.

Thus, we directly obtain as a special case the "standard" view of factivity:\[^{34,35}\]

(74) \[ (P_{factive}^{prop}, \text{P'er: } x, \text{content-role: } (s!\sigma)) \rightarrow \text{TRUE}[(s!\sigma)] \]

The resolutivity inferences can be formulated similarly:

(75)a. The question is: q
Bill V's q
So, q is resolved.

[^{32}]: See e.g. Barwise (1986) for one such situation theoretic notion of \( \Rightarrow \). For more recent developments, see Barwise (1993). Of course, nothing hinges, in the current paper, on the particular notion of \( \Rightarrow \) chosen.

[^{33}]: Quantification over \( ms \) here is not to be taken as assent to an agent-based theory of truth in which a proposition's truth presupposes the existence of an agent. \( ms \) can be any situation which supplies a notion of consequence.

[^{34}]: This formulation serves both for full factives, predicates for which this inference survives embedding under negation, y/n questioning and conditionalisation, and for semi-factives, for which the inference gets filtered away in some/all these environments.

[^{35}]: An anonymous reviewer points out that this formulation is actually weaker than the standard notion because it is formulated in terms of implication rather than presupposition. I assume a view standard in situation semantics (see e.g. Gawron and Peters 1990) in which presupposition is construed as a restriction constraining an utterance situation, i.e. a fact that characterizes a felicitous utterance situation for a use of a given expression. Given this, a presuppositional formulation of (74) can be achieved by requiring that the right-hand-side of (74) serve as a restriction in a meaning description for a factive embedded declarative complement.
b. A certain fact has been discovered
   Which fact? A fact that resolves q
   So, it's been V'ed q

So we posit the following constraint:

\[ (76) \quad \langle P_{nquesti \cdots}^{\text{resolutive}}, P_{r \cdots}^{\text{content}} : r, \text{cog} - \text{role} : q, \text{cog} - \text{role} : ms \rangle \leftrightarrow \exists f[\text{RESOLVES}(f, q, ms) \land \langle P_{\text{fac} \cdots}^{\text{resolutive}}, P_{r \cdots}^{\text{content}} : r, \text{cog} - \text{role} : ms \rangle] \]

Once again, this constraint involves positing distinct \( P \) predicates predicing of questions and facts respectively (or one compatible with both types of arguments). I assume the relation RESOLVES relates a fact \( \tau \), a question \( q = (s?\mu) \) and a mental state \( ms \) as follows:

\[ (77) \quad \text{RESOLVES}(\tau, (s?\mu), ms) \text{ iff} \]

a. \( s \vdash \tau \)

b. POTENTIALLY-RESOLVES(\( \tau, \mu \))

c. \( \tau \Rightarrow_{ms} \text{goal} - \text{SOA}(ms) \)

The relation POTENTIALLY-RESOLVES motivated in Section 2.5, and the operator goal-SOA(ms), roughly the goal currently represented in \( ms \), will be further specified in Sections 4.2, 4.3.

Finally, let us observe that the notion of resolutivity allows us to get a handle on the semantics of verbs such as 'depend-on' and 'determine', which as (13) indicates, displays goal/ms relativisation. Such predicates satisfy a variant of the above resolutivity inferences, based on an insight due to Karttunen 1977.36

\[ (78) \]

\[ (78)a. \quad \text{The first question/issue was } q_0 \]
   \text{The second question/issue was } q_1 \]
   \[ q_0 \lor q_1 \]
   \[ q_0 \text{ is resolved} \]
   \[ \text{So, } q_1 \text{ is resolved} \]

b. The first issue was who would show up. The second issue was how long our food would last. How long our food would last depended-on/was determined by who would show up. Who would show up was resolved (quite soon). Hence, how long our food would last became a resolved issue.

36 See also his discussion there footnote 6, p. 10.
This can be captured via the following constraint.\footnote{Thanks to Dan Hardt for pointing out to me an error in an earlier formulation.} \footnote{A more detailed analysis might involve strengthening this constraint, for instance by establishing some form of dependence of $f_2$ on $f_1$ which, depending on context, might be causal, nomic etc. Something along this line already exists here since if $q_2 = (s_2?\mu_2)$, the constraint enforces the existence of a fact $f_2$ which, since it resolves $q_2$, is supported by $s_2$ whenever there exists $f_1$ which resolves $q_1 = (s_1?\mu_1)$, hence is supported by $s_1$. That is, a connection is enforced between the facts supported by the two situations $s_1$ and $s_2$.}

\begin{align}
(79) \langle p^{\text{question }}_{\text{conditional-resolution}}, \text{independent-content : } q_1, \text{dependent-content : } q_2, \text{cog-role : } ms \rangle \rightarrow \\
\forall f_1[\text{RESOLVES}(f_1, q_1, ms) \rightarrow \exists f_2[\text{RESOLVES}(f_2, q_2, ms)]]
\end{align}

4.2. Characterising Potential Resolvedness

In order to be potentially resolving, a SOA needs to be factual and satisfy certain informational properties determined by the question, as discussed previously in 2.5. I turn now to a characterisation of the relation that underpins these informational properties, which I dubbed above POTENTIALLY-RESOLVES, a relation which I assume to be entirely determined on the level of information, i.e. SOA's and abstracts, so that for a SOA $\tau$ it is the case that POTENTIALLY-RESOLVES($\tau, (s?\mu)$) iff POTENTIALLY-RESOLVES($\tau, \mu$) regardless of the identity of $s$. These remarks and the methodological remarks in the following paragraph will apply equally to the characterisation of aboutness I offer in Section 5.4.

The basic tool utilised is the informational partial-ordering $\rightarrow$ among the SOA's: the range of SOA's potentially resolving a given abstract $\mu$ will involve subsuming a certain SOA (or SOA's) determined by $\mu$. This means that the particular notion of potential resolvedness we obtain is a consequence of the particular $\rightarrow$ we pick as our notion of informational subsumption. My assumption about this partial order is that is at least as rich as needed for generalised-quantifier subsumption between SOA's (so that e.g.

\begin{align}
\langle \text{MANY, } & \lambda Z(Q, Z; +), \lambda X(R, X; +); + \rangle \rightarrow \langle \text{EXISTS, } \\
& \lambda Z(Q, Z; +), \lambda X(R, X; +); + \rangle.
\end{align}

The definition I offer for POTENTIALLY-RESOLVES is given in
Given a SOA \( \tau \) and a SOA-abstract \( \mu \),

\[
\text{POTENTIALLY-RESOLVES}(\tau, \mu) \iff
\begin{align*}
\tau & \text{ STRONGLY-POSITIVELY-RESOLVES } \mu \text{ or } \\
\tau & \text{ NEGATIVELY-RESOLVES } \mu.
\end{align*}
\]

- \( \tau \) STRONGLY-POSITIVELY-RESOLVES \( \mu \) iff
  1. \( \tau \) is a witness for \( \mu \): \( \tau \rightarrow \bigvee \text{APPL-INST}(\mu) \) AND
  2. \( \tau \) sortalizes \( \mu \): IF \( \text{CARDINALITY}(\text{APPL-INST}(\mu)) > 1 \), THEN
     \[ \{ \sigma | \sigma \in \text{APPL-INST}(\mu) \wedge \sigma \rightarrow \tau \} \nsubseteq \text{APPL-INST}(\mu) \]

- \( \tau \) NEGATIVELY-RESOLVES \( \mu \) iff
  \[ \tau \rightarrow \bigvee \text{APPL-INST}(\mu) \] [Here \( \bigvee \text{APPL-INST}(\mu) \) denotes the dual of \( \bigvee \text{APPL-INST}(\mu) \)]

Figure 3. Potential resolvedness conditions.

Figure 3. As with the (empirical) characterisation offered in Section 2.5 it is formulated in terms of two auxiliary subrelations, STRONGLY-POSITIVELY-RESOLVES and NEGATIVELY-RESOLVES.

Let us apply this definition. In (25) I suggested an empirical characterisation of potential resolvedness for yes/no interrogatives, repeated here as (80):

\[(80)\text{ Given a y/n question 'whether } p \text{'} and an informational item } \tau, \tau \text{ STRONGLY-POSITIVELY-RESOLVES } q \iff \tau \text{ entails } p; \tau \text{ NEGATIVELY-RESOLVES } q \iff \tau \text{ entails } \neg p;\]

Thus, applying the definition of the set of application instances of an abstract, (Figure 1), to 0-ary abstract, a SOA, \( \bigvee \text{APPL-INST}(\mu) \) is simply \( \mu \). Hence, \( \bigvee \text{APPL-INST}(\mu) \) is \( \bar{\mu} \). Also, since in this case \( \text{APPL-INST}(\mu) \) is a singleton, the sortalizing condition in the definition of STRONGLY-POSITIVELY-RESOLVED holds vacuously. So for yes/no-questions, potential resolvedness reduces to the desired:

\[(81)\begin{align*}
a. & \text{ STRONGLY-POSITIVELY-RESOLVES}(\tau, \mu) \iff \tau \rightarrow \mu \\
b. & \text{ NEGATIVELY-RESOLVES}(\tau, \mu) \iff \tau \rightarrow \bar{\mu}
\end{align*}\]

Similarly, in (25) I suggested an empirical characterisation of potential resolvedness for wh-interrogatives repeated here as (82):

\[(82)\text{ Given a wh-question } q(x), \text{ an informational item } \tau \text{ STRONGLY-POSITIVELY-RESOLVES } q(x) \iff \tau \text{ entails that the extension of the queried predicate is non-empty and } \tau \text{ is not entails by at least one instantiation of the queried predicate; } \\
\tau \text{ NEGATIVELY-RESOLVES } q \iff \tau \text{ entails that the extension of the queried predicate is empty.}\]
For $n \geq 1$: $\forall \text{APPL-INST}(\mu)$ is $\exists X_1, \ldots , X_n \sigma(X_1, \ldots , X_n)$, hence $\forall$ APPL-INST$(\mu)$ is $\forall X_1, \ldots , X_n \sigma(X_1, \ldots , X_n)$. Thus, for wh-questions, potential resolvedness reduces to:

\begin{enumerate}
  \item[(83)a.] STRONGLY-POSITIVELY-RESOLVES$(\tau, \lambda X_1, \ldots , X_n (\sigma(X_1, \ldots , X_n)))$ iff
  \[
  \tau \rightarrow \exists X_1, \ldots , X_n \sigma(X_1, \ldots , X_n) \wedge \\
  \{\sigma | \sigma \in \text{APPL-INST}(\mu) \wedge \sigma \rightarrow \tau \} \subseteq \text{APPL-INST}(\mu)
  \]
  \item[b.] NEGATIVELY-RESOLVES
  \[
  (\tau, \lambda X_1, \ldots , X_n (\sigma(X_1, \ldots , X_n))) \text{ iff } \\
  \tau \rightarrow \forall X_1, \ldots , X_n \sigma(X_1, \ldots , X_n)
  \]
\end{enumerate}

Hence the relation classifies as potentially resolving application-instances and quantifications of the abstract for which the quantificational force is monotone increasing or stronger than the pure negative universal:

\begin{enumerate}
  \item[(84)a.] $\langle R, a; + \rangle \wedge \langle R, b; + \rangle$ STRONGLY-POSITIVELY-RESOLVES $\lambda X\langle R, X; + \rangle$
  \item[b.] $\langle R, a; + \rangle$ STRONGLY-POSITIVELY-RESOLVES $\lambda X\langle R, X; + \rangle$
  \item[c.] $\langle \text{SEVERAL}, \lambda Z\langle Q, Z; + \rangle, \lambda X\langle R, X; + \rangle; + \rangle$ STRONGLY-POSITIVELY-RESOLVES $\lambda X\langle R, X; + \rangle$
  \item[d.] $\langle \text{NO, THING}, \lambda X\langle R, X; + \rangle; + \rangle$ NEGATIVELY-RESOLVES $\lambda X\langle R, X; + \rangle$
\end{enumerate}

However, as desired, both monotone decreasing quantificational forces (e.g. 'few', 'at most one') and negative application-instances (e.g. $\langle R, a; - \rangle$) are not classified as potentially resolving since they are neither STRONGLY-POSITIVELY-RESOLVING nor NEGATIVELY-RESOLVING. Of course, in particular contexts, as discussed in Section 2.5, such contents can be used to implicate contents that are resolving. In addition, the sortalizing condition on positive-resolvedness rules out information that carries no sortal import whatever such as pure existential statements from being potentially resolving.\textsuperscript{39}

4.3. Goal Content

The final component in our definition of resolvedness concerns goals. The discussion in the current work of this aspect the work is restricted to a

\textsuperscript{39} 'Pure' depends on the appropriateness restrictions carried by the abstract: for the content of 'who'-interrogatives the restriction is 'personhood', so sortalizing information needs to non-vacuously restrict personhood, whereas for a 'which P'-interrogative, which I have not discussed here, sortalizing would involve non-vacuously restricting $P$. 

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skeletal sketch. I draw to a large extent here on the work of and surveyed in Bennett 1989.

Given an agent $a$, a course of events $F - G$ is a sequence of (not necessarily realised, causally related) events $F_1 = F, \ldots, F_n = G$, where $F$ consists of an action performed by $a$ and $G$ is some ultimately achieved state.

At any given time, given what she believes, there will be a set of courses of events which are open (i.e. it is not known that the initial action cannot be performed) and whose end states are preferred. Call such end states the current goals of the agent. For current analysis, it suffices to assume that one such goal exists, since this idealisation can be repaired by means of an analysis that assumes the existence of multiple goals together with a preference function that assigns to each goal an appropriate weighting. Hence, the goal-SOA is a SOA which describes the goal situation.

As a simplifying assumption, I restrict my attention to goals that can be described either by propositions or by questions. For instance:

(85)a. A: I'd like to know where Jill lives nowadays.
   B: Why do you ask?
   b. A: I need to find her house this afternoon.
   c. A: Oh. I'm curious what city she's chosen to live in.

Not surprisingly, I identify the goal specified by a proposition with its SOA component, whereas I identify the goal specified by a question with the SOA that describes its decidedness conditions, i.e. its Fact-$\land$ :

(86)a. When goal-content(ms) is described by a proposition $(s_1!g_0)$, that is:
   $\exists T, f[ms \vDash \langle \langle \text{GOAL}^*, a, T, f, t; + \rangle \rangle \land \exists^* T f = (s_1!g_0)]$, then goal-SOA(ms) = $g_0$

b. When goal-content(ms) is described by a question $(s_1?q_0)$, that is:
   $\exists T, f[ms \vDash \langle \langle \text{GOAL}^*, a, T, f, t; + \rangle \rangle \land \exists^* T f = (s_1?q_0)]$, then goal-SOA(ms) = Fact-$\land_{SIR}$ $(g_0)$

The first case here, where the goal is described by a proposition, corresponds to the assumption concerning the modelling of goals within a body of work in the AI community. Cohen and Levesque (1990), for instance, model an agent's goal by means of (possible worlds) propositions; informally, those worlds in which the goal desired by the agent is fulfilled. The second case corresponds to an assumption of Hintikka's (see e.g. Hintikka 1975), that with each interrogative is associated a fixed desideratum, which describes the epistemic condition whose fulfillment a querier desires.
RESOLVES(τ,(s?μ),ms) holds iff

(i) s ∈ τ
(ii) POTENTIALLY-RESOLVES(τ,σ)

And either:

(iii) τ ⇒\text{ms} \text{ Fact-} \land (g_0), \text{ if goal-content(ms) is a question (s_1?g_0)}.

Or:

(iii) τ ⇒\text{ms} \! g_0, \text{ if goal-content(ms) is a proposition (s_1!g_0)}.

Figure 4. Resolvedness conditions.

Given this, our definition of resolvedness in (76) can be reformulated as in Figure 4.⁴⁰

A proposition (s!τ) where τ satisfies the above clauses will be referred to as a ms-resolving answer.

It is simple to see that for a given question q_0, if goal-content(ms) is fixed to be q_0, and ⇒\text{ms} to be →, then resolvedness reduces to decidedness, in other words truth conditions resembling those provided by Karttunen. Indeed, the assumption in (86b) means that a question q_0 still has what one might call a ‘default’ goal associated with it, namely the exhaustive answer it determines. I will exploit this assumption later when explaining why exhaustiveness is often an implication that arises in query uses. The way things have been set up here, nonetheless, allows explanations to be provided for the variety of cases in which goals distinct from the exhaustive answer get associated with uses of q_0. To this I now turn.

4.4. Some Examples Reconsidered

As an example for this consider the examples (9) and (10). We need to show why the fact, call it τ, in (87a) conveyed by Jill’s utterance in both cases resolves the question (87b) in the context described in (87c), but not in (87d). My constraint on resolutive predicates will then ensure that (87e) is true relative to the parameters of context A, but not relative to the parameters of context B.

(87)a. Jill is in Helsinki; s ∈ (IN,location : Helsinki, event : \langle LOCATED, j\rangle,)

⁴⁰ This definition excludes unfactual SOA’s from resolving a question, which, given the tight connection I have stressed between resolving a question and proving a proposition, is not surprising. Of course in some cases false information can be useful and, in fact, goal-fulfilling, as discussed in footnote 57.
b. Where is Jill; \( s?\lambda l(IN, \text{location } l, \text{event } \langle \text{LOCATED}, j \rangle, l) \)

c. Context A: Jill about to step off plane in Helsinki. Flight attendant needs Jill to confirm that she knows she is in Helsinki.

d. Context B: Jill about to step out of taxi in Helsinki. Driver wants Jill to confirm that she knows she is now outside the Nurmi memorial.

e. Jill knows where she is.

(87a) indicates that the first condition for resolvedness is met. It is also easy to verify that \( \tau \) POTENTIALLY-RESOLVES the question. The difference in these two cases must boil down to the goal condition. In the first case we can say that the goal is described by (88a), so the goal condition is (88b):

(88a) \( \text{Jill knows that she is in Helsinki.} \)

b. \( \langle \text{KNOW, knower:} j, \text{content-role: } \langle \text{IN, location: Helsinki, event: } \langle \text{LOCATED, } j \rangle, \rangle, \text{cog-role:ms} \rangle \)

This type of conversation (viz. flight attendant/passenger dialogue) is one in which Gricean principles are, with a few curmudgeonly exceptions, maintained quite scrupulously. Hence, given that \( \tau \) is a fact and that Jill stated it, the flight attendant can safely assume that Jill was not making a statement for which she lacked adequate evidence. Hence, the third condition for resolvedness is met.

On the other hand, in context B, the goal is described by

(89a) \( \text{Jill knows she is now outside the Nurmi memorial.} \)

b. \( \langle \text{KNOW, knower:} j, \text{content-role: } \langle \text{IN, location: Nurmi-memorial, event: } \langle \text{LOCATED, } j \rangle, \rangle, \text{cog-role:ms} \rangle \)

Jill’s response will not furnish evidence for this condition, and hence the taxi-driver’s claim is reasonable.

In these examples what was important was allowing for goals associated with a question to vary. Let me now also indicate how the fact that resolvedness is also relativised to a notion of consequence provided by a particular mental-situation helps account for examples such as (14). In this case, we need to explain why, for instance, it can be the case that the fact conveyed by an utterance such as (90a) does not resolve the question relative to context A, even if it is exhaustive:

(90a) \( \text{The director: Jill Smith and Bob Jones attended the talk; } \langle \text{ATTENDED-THE-TALKS, } j\text{ill smith} \rangle \land \langle \text{ATTENDED-THE-TALKS, } b\text{ob jones} \rangle \)

b. \( s?\lambda x(\text{ATTENDED-THE-TALKS}, x) \)
Context A: Phil needs to know if famous computational linguist figures attended the talk; Phil has never heard of Jill Smith or Bob Jones before.

d. In context A, true to say: Phil does not really know who attended the talk.

Given the contextual conditions prevailing, in particular the fact that the scientist has no prior acquaintance with the two attendees, the kind of mental situation which he might enter into subsequent to the director's utterance is:

(91)a. Phil knows that Jill Smith and Bob Jones attended the talk.
b. \[ ms_1 \vdash \langle KNOW\#, phil, T_1, f_1; + \rangle, \]

\[ T_1 = \lambda X, Y[\langle ATTENDED-THE-TALKS, X \rangle \wedge \langle NAMED, 'JillSmith', X \rangle \wedge \langle ATTENDED-THE-TALKS, Y \rangle \wedge \langle NAMED, 'BobJones', Y \rangle]; \]
\[ f_1 = [jill-smith, bob-jones] \]

The important point is that since Phil has no prior acquaintance with the two attendees, the sole background information he acquires about them is their names.\(^{41}\) Relative to the inferential resources of this mental situation, Phil's goal, described as in (92), will not be entailed by the facts conveyed in (90a):

(92)a. Phil's goal: whether a famous computational linguist attended the talk. \[ g_0 = (s \ ? \langle SOME, FAMOUS-COMPUTATIONAL-LINGUIST, ATTENDED-THE-TALKS, \rangle) \]
b. \[ \text{goal-SOA}(ms) = \langle \text{Fact-sit}_{g_0} \wedge (g_0) = \langle SOME, FAMOUS-COMPUTATIONAL-LINGUIST, ATTENDED-THE-TALKS; + \rangle \]

(assuming, for instance, that Jill Smith is a famous computational linguist.)

Of course, if we change the contextual conditions, this same information can be resolving. For instance, if Phil had prior acquaintance with the attendees, knowing, say, that Jill Smith is a famous computational linguist, Phil's mental situation after (90a) could be describable as (93), which will entail the goal if \( ms \) is attuned to a basic logic of quantification:

(93)a. \[ ms_2 \vdash \langle KNOW\#, phil, T_2, f_2; + \rangle, \]

\[ T_2 = \lambda X, Y[\langle ATTENDED-THE-TALKS, X \rangle \wedge \]

\(^{41}\) This is something of a simplification; Phil presumably acquires some additional information about the attendees just by virtue of knowing that they have been present at the talks. But such information need not be of any use relative to the goal at hand.
Similarly, a context in which Phil just needed the names of the attendees could be analyzed as involving a goal that is transparently described by the question in (90b):

\[(94)\begin{align*}
  \text{Phil’s goal: who attended the talk } g_1 &= (s?\lambda x (\text{ATTENDED-THE-TALKS}, x)) \\
  \text{goal-SOA}(ms) &= \text{Fact}_{srt_0} \land (g_1) = (\text{ATTENDED-THE-TALKS}, \text{jill smith}) \land (\text{ATTENDED-THE-TALKS}, \text{bob jones})
\end{align*}\]

In such a case, the goal is the exhaustive answer conveyed by (90a). In such a context, we would be licensed to assert that:

\[(95)\quad \text{Phil knows who attended the talks.}\]

Before reconsidering further examples, it is a good idea to bring query uses of questions into the picture.

5. Query Uses

5.1. Introduction

Perhaps the most obvious adequacy criterion for how well a theory of questions extends to account for query uses involves the theory’s ability to characterize the response space generated by a particular query: describe which are the felicitous responses, and from among the felicitous responses, which are differentially preferred. Such a criterion seems problematic once we take seriously the fact that all speech acts, not just queries, are constituents (moves) in dialogue; one would not want to criticize a theory of propositions as providing an inadequate basis for a notion of assertion simply because the theory on its own could not explain the felicity of responses such as the following, neither of which concern the claim that Bill is tired:

\[(96)\begin{align*}
  \text{a. } & \text{A: Bill is tired.} \\
  \text{b. } & \text{B: Bill?} \\
  \text{c. } & \text{B: I’ve heard you.}
\end{align*}\]

Equally, then, I would claim that a theory of questions is not in the business of explaining why responses such as (97b,c) arise:
(97)a. A: Who does Bill like?
b. B: Bill?
c. B: Better ask Terry.

The point is that one needs to find a well motivated dividing line between (a) the range of responses which arise as a direct consequence of the descriptive content of a particular move, and (b) the various other follow ups that can occur, e.g. those that arise as a consequence of the particular move type that has occurred, clarification queries which can occur as followups to any utterance and so forth. In fact, it is quite straightforward to demonstrate that dialogue has a richer structure than can be captured with reference to the most recent move made. The proper domain for a theory of the (b) class of responses, is therefore, a theory of dialogue structure (see e.g. Hamblin 1970, Carlson 1983, Van Kuppevelt (to appear), Ginzburg 1994a, 1994b). 42

The conclusion, then, is that once we find the right dividing line, we can then demand proper characterisation of class (a) responses, in this case those that arise as a consequence of the fact that a particular question q has been asked, as an adequacy condition on a theory of questions. In what follows, I start by proposing one test as a means for establishing the dividing line. This criterion will consist of interrogative disquotatability under the predicate about. I then show how, on the basis of this notion and a variant of the notion of resolvedness, one can characterize two distinct illocutionary forces a theory of queries seems to require: one that describes the perspective of the querier and the kind of response she desires, the other describes (one of the possible) perspectives of a responder, the kind of response he can provide regardless of his anchoring to the context. This latter perspective is one that, for the most part, has been ignored in past accounts of queries (for instance Searle 1969, Hintikka 1975).

42 Hamblin's work, an early instance of a dynamic conception of meaning, includes formal descriptions of a number of distinct dialogue games which provide options for providing responses that are not "answers", for instance a no-commitment (e.g. 'I don't know') response to a query. Carlson offers an account of the possibility of responding to a query with a query based on a notion of entailment between questions. Van Kuppevelt offers a classification of the possible sources of "unsatisfactoriness" of responses to queries and uses this in an account of how questions can be used to model the notion of the topic of a segment of dialogue. Ginzburg proposes a characterisation of the possible clarification query follow-ups to an utterance on the basis of the meaning of the utterance.
5.2. Aboutness

Many factors go into characterising the full range of options available to a responder, in particular into figuring out what an optimal response might be. Nonetheless, even someone who is not clued into either the querier's goals or to her belief/knowledge state, knows of a class of propositions he can assert which, quite independently of their truth or specificity relative to current purposes, can be recognized as "intimately related" to the specific question posed, call it \( q_0 \). My suggestion is that this class consists of those propositions characterisable as providing information about \( q_0 \).\(^{43}\) This criterion is illustrated in (98):

\begin{align*}
\text{(98)a. Q: When is the train leaving?} & \\
a1. Jill: At 2:58, 17.333398 seconds, according to our caesium clock/At 2:58/In about an hour/In a short while. & \\
a2. Jill provided information (whose accuracy I will not vouch for) about when the train is leaving. & \\
b1. Jill: I haven't got a clue./We should be informed of this quite soon./Why do you ask?/Go talk to that guard over there, he'll put you on it. & \\
b2. Jill responded to the question, but could/did not provide any information about when the train is leaving. & 
\end{align*}

Thus, responses that provide information that need not be useful or even factual can be described as being about the question as long as their subject matter is "appropriate". Conversely, many felicitous responses even helpful ones cannot be described as providing information about the question, even if they can be described as suggesting how to obtain information about the question.

The data in (98) suggest a basic criterion of adequacy for a theory of questions, namely the ability to characterize the aboutness relation specified by a given question: it is this relation, I suggest, that underlies a responder's ability to intuit that a response "coheres" with the query regardless of the facts of the matter, of the speaker's goals, her mental state etc.\(^{44}\)

Aboutness is of course a more inclusive notion than potential resolvedness. For yes/no-questions, it needs to include the various modalities weaker than the polar answers:

\(^{43}\) 'Concerning', 'on', 'as to', and 'regarding' are close synonyms of this sense of 'about'.

\(^{44}\) Of course such intuitions and the "thought experiments" that elicit them are somewhat artificial since in practice a responder will either guess or try to ascertain why he is being asked what he's being asked, and what the querier knows or believes.
(99)a. Jill: Is Millie leaving tomorrow?  
Bill: Possibly/It’s unlikely/Yes/No.
b. Bill provided information about whether Millie is leaving tomorrow.

For wh-questions, it needs to include “weak” information such as negative instantiations and quantificational statements where the quantificational force is monotone decreasing:

(100)a. Jill: Who is coming tonight?  
Bill: Chuck definitely isn’t/Few people I’ve heard of./Some friends of Mike’s or maybe noone.
b. Bill provided information about who was coming that night.

In addition to these “base cases”, it seems to be the case that if $p$ constitutes information about $q_0$, then $(p, \text{if } r)$ does too: 45

(101)a. A: Will Mary come? B: She probably will, if it isn’t raining.
b. A: Who is coming tonight? B: Mary, if John doesn’t dissuade her.

Hence, whatever characterisation we offer for the base cases needs subsequently to be closed under some notion of conditionalisation.

The characterisation I proposed for potential resolvedness contains an asymmetry between a positive and a negative case. The asymmetry derives from the fact that strong-positive-resolvedness involves both a witnessing condition and a sortalizing condition, whereas the negative case involves merely the negation of the witnessing condition. For aboutness, however, this asymmetry is not called for, I believe. Let us call a question $q$ positively-resolved just in case there exists a fact $\tau$ which is a witness for $q$, whereas $q$ is negatively-resolved just in case there is a fact $\tau$ such that $\tau$ negatively-resolves $q$. My proposal, formalised in Section 5.4, is that what characterizes the base cases of information about a question $q$ is that they subsume the fact that the question $q$ is positively resolved or that $q$ is negatively resolved. In other words, $\tau$ is about $q$ iff $\tau$ is an informational item that is logically stronger than a fact determined by $q$, the strongest fact compatible with the two alternatives (i.e. their join), the alternative that the question is positively-resolved and the alternative that the question is negatively-resolved. 46

For this characterisation to be non-vacuous, crucial use is made of a

45 I owe this observation to David Milward.
46 I am indebted to Stanley Peters for discussion and suggestions on this issue.
basic property of the logical framework assumed here, namely that the fact that the question $q_1$ is positively resolved or that the question $q_1$ is negatively resolved is neither null information nor necessarily identical to the fact that the question $q_2$ is positively resolved or that the question $q_2$ is negatively resolved where $q_1$ and $q_2$ are distinct questions.

Summarizing for the moment, I have suggested that

\[ (102) \quad \text{An informational item } \tau \text{ is about a question } q \text{ iff } \tau \text{ is in the conditional closure of the set } BASIC - ABOUT(q), \text{ where } \tau \in BASIC - ABOUT(q) \text{ iff } \tau \text{ subsumes the fact that } q \text{ is positively-resolved or that } q \text{ is negatively-resolved.} \]

5.3. Some Previous Analyses

To what extent do previous accounts accommodate aboutness? Boër 1978 provides an account of interrogative embedding by 'about'. Boër's view of 'about' is that it filters away the factivity but not the exhaustiveness, both of which he assumes interrogative clauses are specified to carry. Thus, the truth conditions his analysis would supply for 'provides information about' can be paraphrased as follows: 47

\[ (103) \quad \text{B provides information about who ran (whether J ran) } \iff \text{There is some (consistent) proposition } p \text{ such that B provided } p \text{ and B's being correct in his information provision would necessarily result in his providing information that } a \text{ ran when and only when a did in fact run. (That J ran if J ran and that J ran if J didn't run.) (See Boër 1978, p. 327.)} \]

Boër's analysis does not capture the fact that information can be described as being about the question even when it is factual and inexhaustive as exemplified in (99) and (100).

Groenendijk and Stokhof (1984b) define a notion of answerhood, 'partial answerhood', which goes part but not full way towards capturing aboutness. Briefly, a partial answer is a disjunction of some, but not all possible exhaustive answers defined by the question. For a yes/no interrogative 'whether p' the partial and exhaustive answers coincide, to

47 In the afore-mentioned paper, the case Boër considers is actually an analysis of 'about' that will work for the complex predicate 'speculates about'.
wrt \( p \) and \( \neg p \). For a wh-interrogative, however, partial answerhood is a richer notion than (exhaustive) answerhood. Thus, for an interrogative 'who left', a Groenendijk and Stokhof partial answer will have a form paraphrasable as:

\[
p = \text{No one left or only John left or only John and Mary left or only John and Mary left or... or only John and Mary and Bill left or...}
\]

This means that one type of quantified answer can be accommodated, namely "exhaustified" quantified answers:

\[
\begin{align*}
(104)a. \quad \text{"Only several firemen left"} & \iff \text{The (set of) leavers consisted of several firemen (and no one else).} \\
& \\
(104)b. \quad \text{"Only few journalists left"} & \iff \text{The (set of) leavers consisted of few journalists (and no one else). (That is, either no one left or the ones who left were journalists and few.)} \\
& \\
(104)c. \quad \text{"Only every man left"} & \iff \text{The (set of) leavers consisted of every man (and no one else).}
\end{align*}
\]

What this notion of 'partial answer' does not accommodate is non-exhaustified information about the question, exemplified in (105) which need not be construed as in (104a,b):

\[
(105) \quad \text{Q: Who left? A: (All I know is that:) several firemen left/few journalists left.}
\]

Hamblin's (1973) semantics is, apparently, motivated by his earlier work on modelling dialogue (Hamblin 1970): the intent being to view a question \( q \) as a semantic object that characterises the options available to a responder responding to a query with descriptive content \( q \). Thus, with a yes/no interrogative 'whether \( p \)' Hamblin associates the set \( \{ p, \neg p \} \), whereas with a wh-interrogative \( q(x) \) he associates the set \( \{ p \exists m[p = q(m)] \} \), the set of the instantiations of the open sentence underlying the wh-interrogative. Hamblin's proposal has undergone a number of refinements, for instance in the accounts of Belnap (19823, Higginbotham and

\[\text{Groenendijk and Stokhof are aware of this issue (pp. 162–165). A solution they explore on the pragmatic level is to introduce a distinct notion of an indirect answer. \( p \) is an indirect answer to a question \( q \) iff for some question \( r \) represented in an information state \( i \) updating \( i \) with \( p \) leads to an information state \( i' \) where \( q \) depends on \( r \) more than it did prior to updating with \( p \). Roughly, an indirect answer to a question \( q \), in their sense, is one that makes the link between \( q \) and another question \( r \) more apparent than previously. Consequently, obtaining information that resolves \( r \) might lead also to resolving \( q \).} \]
May (1981) or Lahiri (1991), so that in effect the set of all possible answers is assumed to be modelled by the power set of the Hamblin answer-set.

In sum, these three diverse accounts do not allow for answers weaker than the polar answers in the case of yes/no questions, and either ignore quantified answers (Hamblin) or only allow exhaustified variants thereof (Boër, Groenendijk and Stokhof).

5.4. Characterising Aboutness

The proposal I offer for characterising aboutness is very much in the same style as that for potential resolvedness: based on subsumption within the SOA algebra. The definition I offer is in Figure 5. 49

My main concern here is with “base case” aboutness, as defined in (a) in Figure 5: unless explicitly subscripted ABOUT is henceforth shorthand for ABOUT_{base-case}; clause (b) provides, for concreteness’ sake, one possible notion of conditionalisation of aboutness achieved by taking the closure of “base case” aboutness under relative pseudo-complementation in the SOA algebra.

49 I could have offered a more precise analogue of POTENTIALLY-RESOLVES, to wit

\[ \text{About}_{base-case}(\tau, \mu) \text{ holds iff} \]
\[ \tau \rightarrow \bigvee \text{APPL-INST}(\mu) \lor \bigvee \text{APPL-INST}(\mu) \]

This is stronger than the definition given since within a SOA-algebra \( \tau \rightarrow \sigma \) implies but is not implied by: whenever \( s \models \tau \), it is the case that \( s \models \sigma \). I would adopt the stronger condition if I could, for instance, assume that in a SOA algebra

\[ (\text{MIGHT, } \sigma) \rightarrow \sigma \lor \overline{\sigma} \]

I believe that there are good arguments for positing (i). However, due to the undeveloped state of work on modal extensions of SOA-algebras, I adopt the weaker condition with which the requisite facts about y/n interrogatives can be established.
The main point to note about the definition provided here is the strong use of partiality: whereas on a traditional model-theoretic conception this defining condition is vacuous, in the current setting, given that in the SOA algebra $\sigma \lor \bar{\sigma} \neq \top$, the condition is restrictive. On the one hand, then, \langle LEAVE, leaver:j; + \rangle will not be about $\lambda X<$LIKES,$X;+$$. However, some classes of SOA's that were classified as not being potentially resolving are accommodated. Let me consider first yes/no interrogatives. The condition reduces to

\[(106) \text{About}(\tau, \sigma) \text{ holds iff whenever } s \models \tau \text{ it is also the case that } s \models \sigma \lor \bar{\sigma}\]

We want to show that “weak” modal information, e.g. ‘possibly/probably/unlikely $p$', is about ‘whether $p$’. I confine myself here to showing the existence of a notion of ‘might’ which satisfies the desideratum. The remainder follow by monotonicity.

There exist relatively few situation semantics analyses of modality as yet. For an analysis worked out in a different framework but of similar spirit, see Veltman (1984); for a recent logical analysis within ST see Schulz (1993). Neither of these accounts is “local” in the sense of characterising what information we can gather about a situation $s$ that supports a SOA bearing the information ‘might $\sigma$’. Roughly, these accounts characterize ‘might’ in terms of situations (or worlds) that extend $s$.

Here I confine myself to an analysis of ‘might’ that seems implicit in Barwise and Etchemendy (1990), which is local in this sense.50 The intuition is simple: any information expressing the possibility that $\sigma$ is a conceivable option, as $\text{MIGHT}(\sigma)$ should allow one to conclude, should also allow one to conclude that either things are as described by $\sigma$ or they’re not. (Though of course this should not allow one to conclude that either things are as described by $\tau$ or they’re not, for arbitrary $\tau$.)

Define:

\[(107)a. \ s \models \langle \text{MIGHT}, \sigma \rangle \iff \exists \tau [s \models \sigma \lor \tau \land s \not\models [\sigma \land \tau] \land s \not\models \bar{\sigma}]\]

b. Paraphrase: There is no proof that $\bar{\sigma}$ isn’t the case and $\sigma$ is among the current alternatives.

It is clear from this definition that whenever $s \models \langle \text{MIGHT}, \sigma \rangle$, $s \not\models \sigma \lor \bar{\sigma}$, since $\bar{\sigma}$ is defined to be the minimal SOA incompatible with $\sigma$. Hence, the aboutness condition is fulfilled. Also, it follows that if $s \models \sigma$, then $s \not\models \langle \text{MIGHT}, \sigma \rangle$, though because of partiality the reverse does not hold. Similarly, when $s \not\models \langle \text{MIGHT}, \sigma \rangle$, then $s \not\models \bar{\sigma}$; and it is simple to show that

50 For further motivation and details see Ginzburg (in preparation).
distributions over disjunction hold and that this definition yields truth conditions at least as strong as the classical possible worlds account.

Thus, we have a notion that has some pretences to represent ‘might’, and more importantly for current purposes, a modality that allows in information weaker than the polar options.

For wh-questions, it also emerges that certain SOA’s that are not potentially resolving are about:

(108)a. \( \mu = \langle \text{AT-MOST-3, } \lambda Z(Q,Z;+), \lambda X(R,X;+);+ \rangle \) ABOUT \( \lambda X(R,X;+) \) (Intuitively: ‘at most one person left’ subsumes the disjunction ‘There exists some person that left or no one left’.)

b. \( \mu = \langle R,a;+ \rangle \lor \langle R,b;− \rangle \) ABOUT \( \lambda X(R,X;+) \) (Intuitively: ‘John left or Mary didn’t leave’ subsumes ‘John left or someone other than Mary left or no one left’.)

5.5. The Illocutionary Force of Queries

With a notion of aboutness available to us, we can proceed to offer characterisations of two possible perspectives on queries. The first one describes what I take to be the minimal sense a responder can make of a query use of question \( q \). In line with the previous remarks on aboutness, then, I suggest that the most general guess a responder can make in this regard, is that the response desired of him needs to provide information about the question posed:

(109)a. Minimal responder’s construal of query:
\[ \langle \text{QUERY}^{\text{MIN-RESPONDER}}, \text{querier} : a, \text{responder} : b, \text{query} - \text{sit} : s, \text{content} : \mu \rangle → \langle \text{WANT}, \text{desirer} : a, \text{provider} : b, \text{desired} - \text{object} : \lambda Q\exists r[(\text{ABOUT}, \text{CONTENT}(r), s?\mu)] \rangle \]

b. Paraphrase: The Querier, \( a \), wants from the responder, \( b \), a response that conveys information about \( (s?\mu) \).

In (109a) I provide a constraint that describes the force of this query operator: any utterance situation in which a query is posed involves a querier \( a \), a responder \( b \), a situation \( s \) and an abstract \( \mu \) in such a way that the querier desires from the responder a response whose content

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51 That is, assuming perfect communication on the linguistic front, an oft unattainable ideal. For current purposes, we hold on to this idealisation.
provides information about the question \((s?\mu)\).\(^{52}\) Here, for concreteness, I have used Montague's analysis of the relation WANT so that the desired-object role is filled by a property of properties.\(^{53,54}\)

Actually, we can say slightly more before bringing in the querier and her intentional/mental parameters into the picture: in line with our assumption that the goal-SOA specified by a question \((s?g)\) is FACT-\(\wedge (g)\), the responder knows that if the question asked transparently reflects the querier's goal, then that goal is indeed FACT-\(\wedge (g)\). Hence, the implicat-

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\(^{52}\) Recall that the fragment described above assumed that matrix interrogatives have abstracts as their contents.

\(^{53}\) See Cooper (1993) for a situation semantics formulation of PTQ along these lines.

\(^{54}\) One additional issue worth noting concerns the precise meaning to be associated with the phrase 'a response whose content provides information'. Hitherto I have, for the most part, considered solely cases where this could be identified with the literal content of \(r\) is. But this will obviously not be sufficient in general (cf. in this regard the notion discussed in Groenendijk and Stokhof (1984b, p. 153ff.) under the rubric 'gives an answer', which is contrasted with the notion of 'is an answer'). This is because many responses are crucially dependent for their felicity on the context, in the sense that the felicity is not a function solely of their content, literal or otherwise. These include elliptical responses of various kinds and indirect responses. In an example such as the following, it is the intention underlying the act of pointing, coupled with the prevailing contextual conditions that result in an answer being conveyed:

(i) Q: Who is Jill's best friend?
(ii) Response: [responder points to Mike.] (Conveys:) 'Mike is Jill's best friend'.

Note that, if we assume it conveys resolving information, say, this act can be interrogatively disquoted:

(iii) (With that gesture) Bill indicated to me who Jill's best friend was.

Indirect responses, similarly, cannot be adjudged felicitous independently of specific contextual conditions that prevail:

(iv) Who committed the crime?
(v) Jill: Well, put it this way: Dan Quayle was out of town.

(v) is a response that would not be adjudged felicitous on a context independent basis. A reasonable reaction might be 'You must have misheard me: I didn't ask who was out of town, I asked who committed the crime'. However, if, for instance, it is known that only George Bush or Dan Quayle could possibly have committed the crime, then the response can be taken to implicate that Dan Quayle did not commit the crime, or perhaps even that George Bush was the culprit. Hence, it could justify saying:

(vi) Jill was finally willing to inform me, albeit somewhat indirectly, who committed the crime.

There would seem to be two, not necessarily complementary, moves to reconstruing \(r\) conveys in such a way as to accommodate such responses. One involves a resort to a notion of speaker meaning by means of which one can relate a responder and the intention underlying a communicative act to how an answer gets conveyed. Arguably, such a move is needed for quite independent reasons in any model of natural language dialogue. The second option involves a change in the underlying logic: weakening \(\rightarrow\) in certain ways, e.g. in the direction of defeasibility, will enrich POTENTIALLY-RESOLVES and ABOUT in the requisite way.
ure that not only the response should satisfy (110a), in fact it should satisfy (110b):

(110)a. \((ABOUT, CONT(r), \mu)\)

b. \((CONT(r) \rightarrow FACT \land (\mu))\)

This is, however, a defeasible expectation.

Taking the querier’s perspective forces us to take into account her goals and belief/knowledge. Adopting the perspective on goals described in 4.3, querying involves a course of events where the responder poses a question in the belief that the response offered will be sufficient, given what she believes she knows, to bring about her goal \(G\). Given that she has actually posed the question \(q\), rather than some other question, forces on her the pretence of being someone that expects to be provided with information about \(q\), and it is indeed somewhat hard to defease this expectation:

(111)a. [Context: Jill wants to get onto the next train to Edinburgh but does not see where the queue for that train is. She goes to a guard and asks:] excuse me, could you please tell me – why can’t I find the queue to the Edinburgh train?

b. As follow up: # Not that I care about that. All I want is to find the queue.

A responder who believes he has figured out the querier’s goal can cut the exchange to a minimum and respond directly, providing information that fulfills the goal and ignores the question asked, even if the resulting dialogue appears to be somewhat “shortcircuited”. For instance, if in the context of (112) the responder assumes the querier posed her question with the aim of catching the train, by providing (112b) he has supplied information that can turn out to be goal-fulfilling: nonetheless, by associating as part of the illocutionary force of a query the querier’s commitment to requesting information about the question she asks, we also have some

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55 I use the neutral, SOA algebra \(\rightarrow\) here rather than a notion of consequence pertaining to a particular mental state in order to avoid, for the moment, any intentional/mental parameters.
account of why information that is more than sufficient to fulfill the goal is often provided, as in (112c):^{56}

(112)a. A: When is the train leaving?
   b. B: Go now to platform 12.

Thus, I offer the following as an approximation to the force the speaker intends it to have, to be denoted as QUERY^{speaker-intended}, relative to a goal content and beliefs of mental state ms0:

(113)a. Speaker's intended construal of Query:
\[ \langle \text{QUERY}^{\text{SPEAKER-INTENDED}}, \text{querier} : a, \text{responder} : b, \text{query-sit} : s, \text{content} : \mu, \text{cog - role} : \text{ms} \rangle \rightarrow \langle \text{WANT}, \text{desirer} : a, \text{provider} : b, \text{desired-object} : \lambda Q \exists r[\langle \text{ABOUT}, \text{CONTENT}(r), (s?\mu) \rangle \wedge (\Rightarrow_{\text{ms}}, \text{CONTENT}(r), \text{goal} - \text{SOA}(\text{ms})) \wedge (Q, r)] \rangle \]

b. Paraphrase: The Querier, a, wants from the responder, b, a response that conveys information about (s?\mu) that fulfills her goal relative to the inferential capacities of mental state ms0.

Hence the SOA-content of a desired response, call it a goal-fulfilling response, say \( \sigma \), will, according to this view, satisfy:

(114)a. \( \langle \text{ABOUT}, \sigma, \mu \rangle \)

b. \( (\Rightarrow_{\text{ms}}, \sigma, \text{goal} - \text{SOA}(\text{ms})) \)

There are some obvious consequences: first, the notion of goal-fulfilling response although related to is still strictly more inclusive than a response that conveys information that resolves the question asked. This is because: first, (114) imposes no factuality requirement, which resolvedness does carry, and second, the relation ABOUT is more inclusive than POTENTIALLY-RESOLVES. Hence we can accommodate false answers as goal-

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^{56} I am indebted to an anonymous reviewer for pointing out this issue to me. Nonetheless, it is certainly true to say that not all cases of "surplus information" can be handled in this way. I believe some such cases require giving up the assumption that there is a single goal that can be associated with an agent in a particular context, a simplifying assumption I have explicitly made in the analysis of resolvedness and of being goal fulfilling. As noted in Section 4.3, a successful analysis of the single goal case should, in principle, be expandable to an analysis that assumes the possibility of multiple goals together with a preference function that assigns each goal a weighting.
fulfilling,\textsuperscript{57} as well as explain why non-resolving answers can arise and be entirely felicitous, exemplified by data such as (115):

(115)a. Jill: Who is coming tonight?
Bill: Why do you ask?
Jill: Well after the last party and my antics there I'm anxious.
Bill: Oh well, no cause for worry: few people who saw you at the last party.

b. (as report of the dialogue): \# Bill told Jill who was coming that night.

The question expressed here is, say:

(116) \( s?\lambda x\langle\text{DURING},\text{time} : \text{tonight},\text{event} : \langle\text{COME},\text{comer} : x\rangle,\rangle \)

Whereas, the goal could be described as in (117a), the goal-SOA will be something along the lines of (117b):

(117)a. Jill wants to confirm that (her antics at) the last party won't embarrass her tonight.

b. goal-SOA: \( y = \langle\text{DURING},\text{time} : \text{tonight},\text{event} : \langle\text{EMBARASS}, \text{embarrassing - event} : \text{last - party, embarassee : j; -}\rangle\rangle \)

Now Bill's response conveys a proposition whose SOA-content is:

(118)a. \( \sigma = \langle\text{FEW, restrictor} : \lambda z\langle\text{PERSON, z}\rangle \land \langle\text{IN, location} : \text{last-party},\text{event} : \langle\text{SAW, see'er : z, seen : j}\rangle\rangle,\text{nuclear} : \lambda x\langle\text{DURING, time} : \text{tonight},\text{event} : \langle\text{COME,comer} : x\rangle\rangle\rangle \)

Assume that a conditional such as (119) is represented in Jill's \( ms \), an instance presumably of some, more general social convention:

(119)a. If few people who were at the last party come tonight, then Jill will not be embarassed by that event tonight

b. \( \langle\rightarrow,\sigma, y\rangle \)

\textsuperscript{57} I thank an anonymous reviewer for emphasising to me the need to demonstrate this. Cases where this would be needed include the following example: A is in a foreign country escorted by a local, B. The two are surrounded by hostile inhabitants. A asks: 'How do you say 'Honoured friends, I have no money on me, in your language?'' B realizes A is interested in survival, not linguistics, and tells him how to say 'Go away, I'm armed'. A would not thank B if she told him how to say 'Honoured friends, I have no money on me', which, unbeknownst to him, involves sounds he cannot pronounce.
In that case, \( \sigma \) satisfies the requirements in (114). However, (115b) follows since it is not the case that

\[
(120) \quad \text{POTENTIALLY-RESOLVES}(\sigma, \mu)
\]

and therefore resolving information has not been conveyed. Why is it the case, nonetheless, that (121) holds?

\[
(121) \quad \text{Bill's response indicated to some extent who was coming that night.}
\]

An explanation for this will emerge in the first section of the sequel to this paper, 'Resolving Questions, II'. In that sequel a notion of partial resolvedness is developed which brings out the connection between the two key notions involving questions, resolvedness and aboutness, investigated in this part of the paper. Here I have argued that the notion of resolvedness needed for the semantics of embedded interrogatives is intrinsically relative to such factors as an agent's beliefs and goals. This is why, I believe, one cannot hope to offer a semantic analysis of interrogatives in terms of a notion akin to resolvedness, as often proposed in past accounts. Consequently, I have shown how questions can be added to a situation theoretic universe in which notions such as property, informational item and proposition have already received certain explications. Nonetheless, in one sense, the semantics proposed for embedded sentences in this part of the paper has been "conservative": all interrogative complements have been taken to denote questions, whereas all declarative complements have been taken to denote propositions. The fact that certain predicates embed interrogatives, declaratives and fact-denoting NP's whose content is systematically related to the question denoted by the interrogative complement has been captured by means of certain constraints (e.g. (76)). In 'Resolving Questions, II', an alternative approach will be proposed, motivated by the need to capture contrasts among predicates both with respect to inference patterns involving various types of nominals (e.g. 'the question', 'the claim', 'the fact') and with respect to the predicates' applicability to different types of complements (e.g. 'believe' embeds declaratives but not interrogatives, whereas 'wonder' embeds interrogatives but not declaratives.)

**Appendix**

*Accommodating Scopal Ambiguity*

In this section I sketch how scopal ambiguities for individual uses of wh-
phrases are treated in the fragment for interrogatives of Ginzburg (1992), using a storage technique developed within the situation semantics framework of Gawron and Peters (1990). Further details and motivation for such a treatment of wh-phrases, including the treatment of functional and reprise/echo uses of wh-phrases, are provided in the former work.

**Nominal Quantifier Phrases**

Gawron and Peters (1990) assume a Generalised Quantifier analysis of quantificational expressions. Thus, a meaning description for a quantificational expression specifies a variable, a Quant(ificational)-Force, and a Restr(ictive)-Term. Gawron and Peters assume that the quantificational force of any quantificational expression is fixed context independently. Similarly, for simplicity, here I ignore the contextual variability of the restrictive term:

(122) 

\[ \text{['Every man']}(\text{utt} - \text{sit}_0, \text{scope} - \text{of} - \text{use}_0) = y; \text{Quant-Force:} \quad \text{EVERY, Restr-Term:} \text{MAN} ; \text{RESTRICTIONS:} \quad t: \text{utt} - \text{sit}_0 \models \langle \text{SCOPING-POINT}, '\text{each man}', \text{AT:} \text{scope} - \text{of} - \text{use}_0 \rangle \]

The generalised closure function is called ‘QUANT-CLOSURE’. QUANT-CLOSURE is a function that takes as input a SOA with certain variables free and a use of an expression \( A_0 \), and returns a SOA, in which each variable associated with a use of a quantifier or indefinite expression \( a_i \), denoted as Var-Cont(\( a_i \)), is scoped as specified by the SCOPING-POINT facts, where the narrowest scoping NP is specified to terminate at \( A_0 \):

(123) 

\[
\text{QUANT-CLOSURE}(A_0, \sigma) = \\
\exists \text{Var}-\text{CONT}(a_1), \ldots, \exists \text{Var}-\text{CONT}(a_{i-1}) \\
\langle \text{QUANT-FORCE}(a_i), \text{RESTRICTIVE-TERM}(a_i), \lambda \text{Var}-\text{CONT}(a_i) \\
\exists \text{Var}-\text{CONT}(a_{i+1}), \ldots, \exists \text{Var}-\text{CONT}(a_{i+j}) (\text{QUANT-FORCE}(a_n), \text{RESTRICTIVE-TERM}(a_n), \lambda \text{Var}-\text{CONT}(a_n) \\
\exists \text{Var}-\text{CONT}(a_{n+1}), \ldots, \exists \text{Var}-\text{CONT}(a_{n+j}) (\sigma) \ldots) \]

where \( a_1, \ldots, a_{n+j} \) is the longest sequence of NP sub-utterances of \( A_0 \) such that for any \( i(\text{SCOPING-POINT}, a_i, \text{AT:} a_{i+1} \ldots \text{SCOPING-POINT}, a_{n+j}, \text{AT:} A_0) \)

For example:

(124a) 

\[ \text{['Every man squints.']}(\text{utt} - \text{sit}_0) = \langle \text{EVERY, MAN,} \lambda t(\text{SQUINT, squint-er:} t); \rangle \]

RESTRICTIONS:
\[ utt - sit_0 \vDash \langle \text{SCOPING-POINT}, \text{‘every man’}, \text{AT: ‘Every man squints’} \rangle \]

t is no longer a parameter of this meaning description. It has been bound in the nuclear scope. Why? Because of the presence of a SCOPING-POINT fact which specified that this was to occur at the S-level.

A sentence such as the following has three possible meanings, differing with respect to the SCOPING-POINT facts occurring in their meaning descriptions:

(125)a. Every woman likes some person.
   b. \( \langle \text{SCOPING-POINT}, \text{‘every woman’}, \text{AT: ‘Every woman likes some person’} \rangle \langle \text{SCOPING-POINT}, \text{‘some person’}, \text{AT: ‘Every woman’} \rangle \)
      (OBJ has wide scope)
   c. \( \langle \text{SCOPING-POINT}, \text{‘every woman’}, \text{AT: ‘some person’} \rangle \langle \text{SCOPING-POINT}, \text{‘some person’ AT: ‘Every woman likes some person’} \rangle \) (SUBJ has wide scope)
   d. \( \langle \text{SCOPING-POINT}, \text{‘every woman’}, \text{AT: ‘every woman likes some person’} \rangle \langle \text{SCOPING-POINT}, \text{‘some person’}, \text{AT: ‘likes some person’} \rangle \)
      (OBJ has scope at VP)

\textit{Independent Uses of wh-Phrases}

I start with a slight amendment of the meaning descriptions for wh-phrases, exemplified here for ‘who’:

(126) \[ [\text{‘Who’}] (utt - sit_0, \text{absorption - point}_0) = t; \]
   \text{RESTRICTIONS:}
   \( utt - sit_0 \vDash \langle \Lambda\text{-SCOPING-POINT}, \text{‘who’}, \text{AT: absorption - point}_0 \rangle; \)
   \( domain - sit_0 \vDash \langle \text{PERSON}, t \rangle; \)

The condition \( utt - sit_0 \vDash \langle \Lambda\text{-SCOPING-POINT}, \text{‘who’}, \text{AT: absorption - point}_0 \rangle \), links the argument role associated by the utterance of ‘who’ to the maximal subutterance in which it has scope. This is quite analogous to the ‘SCOPING-POINT’ conditions occurring in quantificational uses of indefinites. Their respective contributions to meaning will be different because of the different closure operators that apply to them.

The choice of which level to be closed at is free for any interrogative phrase subject to the following syntactic constraint: an interrogative phrase marked with the feature QUE is forced to be closed locally. I assume
that in English QUE is attached (uniquely) to the left-most element of any given syntactically interrogative sentence. This effect is achieved by imposing as a defining characteristic of interrogative sentential sorts that they (or a distinguished constituent of theirs) must contain at least one element marked with QUE, optionally marking all interrogative phrases with QUE, and imposing a linear precedence rule that forces a phrase marked with QUE to precede all phrases. QUE, as a non-local feature, is inherited exactly like SLASH is. Given these constraints on the feature QUE, that it must be present in any interrogative sentence and be left-most, this ensures that solely one wh-phrase in an interrogative sentence will be specified for QUE. The rule for interpreting dislocated structures which we previously had as (63) can now be restated as follows:

\[(127)\text{a. } S[\text{fin}, \text{+INT}] [3] \rightarrow H:S[\text{fin}, \text{INHER-SLASH([1])}, \text{TO-BIND-SLASH([1])}, \text{TO-BIND\{QUE([2])\}}], \]
\[\text{F:}[1](\text{INHER\{QUE([2])\}}]
\[\text{INHER-QUE} < X \]
\[\text{b. } [S](\text{utt - sito, descr - sito}) = (\text{descr-sito}\?\text{A-CLOSURE(Var-CONT(H)))}) \]
\[\text{RESTRICTIONS: conjoin RESTR-CONT(H) with RESTR-CONT(F);}
\[\text{utt - sito} \vdash \langle \text{A-SCOPING-POINT}[2], \text{AT: [3]} \rangle \]

The amendment for the subject-interrogatives rule is entirely analogous.

Two points require comment to understand the workings of the rule: the first point concerns \(\Lambda\)-closure. This is a function entirely analogous to QUANT-CLOSURE in its workings. Given a SOA with some free variables \(\sigma\) and a use of an expression \(A_0\), it returns an abstract, the product of \(\lambda\)-abstraction over those variables associated with argument roles, specified to be absorbed by the facts in the meaning description of that use of \(A_0\).

Formally:

\[(128) \ \Lambda\text{-CLOSURE}(A_0, \sigma) = \]
\[\lambda \text{Var-CONT}(a_1), \ldots, \text{Var-CONT}(a_n)\sigma, \text{where } a_1, \ldots, a_n \text{ is the longest sequence of NP sub-utterances of } A_0 \text{ such that for any } i, \langle \text{A-SCOPING-POINT, } a_i, \text{ AT: } A_0 \rangle \]

The second point to notice concerns the one scopal restriction specified by the rule: the role associated with the utterance of the expression stored in QUE must be scoped at the current sentential level.

58 I owe this particular proposal for capturing the syntactic scopal restriction to Ivan Sag.
As a brief illustration, I consider ambiguities that arise in interrogative sentence embedding. The basic idea is that the scoping possibilities, just like other scopal ambiguities, are not fixed by the syntax. However, the syntax can act to constrain the scopal possibilities quite drastically. One motivation for an account of scope like the present one is that it transfers to cases where the existence of no syntactic embedding operator can be motivated, as is the case for reprise/echo uses.

Consider the sentence:

(129) Who asked who likes whom

Both subjects are forced to be specified for QUE and hence be absorbed at their respective sentential levels. However, the in situ interrogative phrase is free to be absorbed at either level. The crucial factor is the A-Scoping-Point specification for 'whom'. If it is (130a), then we get the reading schematically described as (130b):

(130)a. \( \text{utt} \rightarrow \text{sit}_0 \vdash \langle \text{A-SCOPING-POINT}, \text{'whom'}, \text{AT: 'Who likes whom'} \rangle \)

b. \( \lambda x \langle \text{ASK, asker:} x, \lambda y, z \langle \text{LIKES, liker-er:} y, \text{likee:} z; \rangle \rangle \)

Whereas if the scoping specification is as in (131a), we obtain the reading schematically described as (131b):

(131)a. \( \text{utt} \rightarrow \text{sit}_0 \vdash \langle \text{A-SCOPING-POINT}, \text{'whom'}, \text{AT: 'Who asked who likes whom'} \rangle \)

b. \( \lambda x, z \langle \text{ASK, asker:} x, \lambda y \langle \text{LIKES, liker:} y, \text{likee:} z; \rangle \rangle \)

References


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