Resolving Questions

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1 Introduction

Answers have, by and large, had the upper hand in contemporary semantic treatments of embedded interrogatives: interrogative sentences have been analyzed 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, Karttunen, Boër, Groenendijk and Stokhof).

In this paper I argue for what might seem an opposite perspective, characterising answers in terms of certain properties of or relations involving *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 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 such a resolvedness condition is one whose satisfaction by (the content of) their interrogative complements is presupposed by predicates such as 'know' and 'tell' 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,

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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 1991).

I turn attention to query uses in section 5; the account of resolvedness extends with certain modifications to provide 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 able 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 sections 6 and 7 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 than accounts that link such modification to partial exhaustiveness (see e.g. Berman 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 denote facts, and offer a specification for such an account.

2 Data

2.1 Exhaustiveness and context

I start by considering the meaning of interrogatives embedded by propositional 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 δ to the possibility of embedding d by a predicate drawn from the class of so called *factive* predicates:

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

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:

(2) 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.

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*:

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

(4) A certain fact is/has been V'ed (knows/discovered/told me/reported/guessed) .
Which fact? A fact that resolves the question of who left.
So, it is/has been V'ed (knows/discovered/told me/reported/guessed) who left.

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:

- **Rel-v.-Abs**: what, if any, are the other relatees of *resolves*?
- **Pot-Res**: given a question q how can one characterize the class of potentially resolving facts? (that is, facts f for which there exist $a, b, \ldots$ such that f resolves q relative to $a, b, \ldots$, 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 aproaches such as Karttunen 1977 and Groenendijk and Stokhof 1984, 1990. 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 $Exh - Ans(q)$. In Karttunen's system this is exemplified by the following meaning postulate:

(5) know(x,Q) $\leftrightarrow$ $\forall p$(if Q(p), then know(x,p)) and if $\neg\exists p$Q(q), then know(x, $^\wedge\neg\exists$ qQ(q))
(Karttunen 1977, footnote 11, page 18)

In Groenendijk and Stokhof's system the relationship is particularly transparent, since for a given interrogative sentence I, q is the *intension* of I, whereas Exh-Ans is the *extension* of I. The predicates I have dubbed *resolutive* are posited to be *extensional* interrogative embedders, and hence satisfy a version of (5):

(6) a. Who walks.

b. Groenendijk and Stokhof: extension at $< w >$: the partition class of w from among the set of possible worlds relative to the following equivalence relation: 'world w_0 is equivalent to world v_0 if and only for each x whether the property WALKS(w_0) holds of x is equivalent to whether the property WALKS(v_0) holds of x. The denotation at w is the set of worlds that determine the extension of the property WALKS equivalently, in other words the extension is a possible worlds semantics proposition. The intension of the interrogative is the partition of the set of possible worlds induced by this equivalence relation.

I call such approaches *absolute* since they presuppose a view of questions as *properties* of propositions; the notion of resolvedness they support does not involve other parameters.

Hintikka 1962, 1977, Boër 1978, and Boër and Lycan 1985 represent approaches, which although do not countenance an indepedent 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, they offer the following truth conditions for (7a):

(7) a. John knows who bought tickets. (Boër and Lycan's (13a)).

b. (13a) is true iff John knows-true at t_I a: The F and the G are the people who bought tickets: for "F" and "G" reflecting P_I important predicates. For some P_I, "F" and "G" might of course be "= Bob" and "= Ted"(B&L 1985 p. 99)

P_I 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 question. 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 **Relv.-Abs** and **PotRes** 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 Relativity

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.

I would venture that the airhostess in (9b) and taxi-driver in (10b) are each justified in their contradictory statements precisely because they associate different causal roles with the information Jill possesses: in the former case the information has no role beyond confirming that Jill has arrived at the right destination, in the latter case the information cannot be used, say, to walk to her destination. 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.[1] This is incompatible with the *absolute* view 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.

Arguably, such vagueness in the resolvedness conditions has gone relatively unremarked hitherto because of a concentration on who-questions rather than on other types of questions for which the underlying 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 the underlying goal. Similar remarks apply *mutatis mutandis* to 'when-questions' (see below example (84)). The vagueness of the resolvedness conditions of 'why-questions' is probably even more pronounced, in part at least because of the multiplicity of factors that can be viewed as *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):

(11) a. We have been told why he is writing this paper.

b. We haven't (really) been told why he is writing this paper.

c. He needs a journal publication.

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):

[1] As Boër and Lycan note, the optional hedge *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.

(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 a vague indication.

It is worth emphasising that data motivating the relative view arise even for predicates which do not describe mental or illocutionary activity:

(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.

2.3 Exhaustiveness

I have sofar 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 of the queried predicate, as required, for instance, by (5) or (7b)? The answer is, I will claim, negative.

Imagine, for instance, a scientist and an EC politician visiting an institute located in a country located on the far periphery of observable academic activity. Both people are taken to visit a local research institute where the politician gives a talk after which 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 attended the talk?

b. The director: (Provides list of names)

c. I asked the director who attended the talk. She didn't really tell me. All she did was recite a list of names, none of which meant much to me.

What the visitors would welcome are responses of the type provided in (15a,b), which could then be reported as (15c):

(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.

c. I asked the director who attended the talk and she told me.

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 'attended X's talk'. 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 (1a) 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.[2] 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 resolves relation could, arguably, be involved in fixing the domain. Once this were done, an absolute notion of resolvedness could be sufficient. It is, of course, undeniable that such a strategy can, in principle, be made to work. The issue to consider is the plausability of the resulting semantics: it is often very difficult to specify exactly what the domain is. Nonetheless, presumably one of the tasks of a semantics is to specify a class of objects which the participants involved in dialogue can to a lesser or greater extent share.

In this light consider a slight variant of example (14): first the politician asks the question, then the scientist. Assume the director offers just (15b) as a response. Both visitors then report the conversation, one happily as (15c), the other annoyed along the lines of (14c). One could associate the conflicting reports with different domain selection processes but this seems like stretching the concept of domain selection beyond its useful limits.

A variant of this strategy which one might invoke as an explanation for the data in (2.3) involves a kind/individual ambiguity. One could suggest, as Hintikka 1977 seems to suggest,[3] that wh-phrases can vary over individuals or over kinds (e.g. 'who attended the talk' paraphrasable as 'what kind of person attended the talk'.) Once again, such a strategy is hard to defeat conclusively apart from considerations relating to parsimony.

[2]Martin Stokhof (p.c.) has pointed out to me the availability of such a strategy.

[3]Hintikka 1977 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.'

Thus, in light of examples such as (16), the ambiguity in question would have to apply across the entire spectrum of wh-phrases to include 'what', 'where', 'why' and 'when'. In addition to this, one would still need to invoke a purpose-like parameter to explain the contrasting resolvedness patterns in (15), where each "kind-specifying" response is resolving relative to different participants and distinct purposes. A solution that makes recourse to a purpose parameter without positing wholesale ambiguity unmotivated by other consideration is presumably 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 propositions which can each *potentially* be 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 g_0, which determines a lower bound for p, and the belief/knowledge state, ms_0, which determines the resources relative to which p has g_0 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'.

Not all information *about* a given question, a notion I discuss in more detail in section 5 , is *potentially resolving.* Thus, in (18) Bill's second response appears to be perfectly felicitous in this context. Nonetheless, it does not appear to constitute *fully* resolving information, hence cannot be disquoted under *tell* or *explain.* It does constitute what I will characterize in section 6 as partially resolving information and can therefore be disquoted by (18d,e):

(18) 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. # Following Bill's response, the issue of who was coming that night was resolved.

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

d. Bill's response indicated to some extent who was coming that night.

e. Bill explained to Jill only to a limited extent who was coming that night.

Given the data we have seen above (see e.g. examples 9, 12, 14, 15,16) I assume that:[4]

[4]It is commonly assumed that wh-interrogatives *presuppose* the existence of an instantiator. I believe that this "presupposition" is a (generalized) conversational implicature: negative universal quantifications do constitute information about a given unary wh-interrogative. Hence, they belong in the range of conveyable answers. Arguably, such quantifications constitute potentially resolving information.

Thus, in most circumstances when I ask my apartment-mate
(i) What should I buy at the store?
it is quite clear that I am moved to pose this query by a belief that
(ii) There exists something that I should buy at the store.
Nonetheless, it is possible to explicitly cancel the suspected presupposition without resulting infelicity:
(iii) What, if anything, should I buy at the store?
(iii) can be uttered felicitously. In contrast to (i), uttering (iii) does not obviously suggest that the querier believes (ii). If my friend responds with (iv), we would not hesitate to report that as (v):
(iv) Jill: Oh, nothing.
(v) Jill provided information about what I should buy at the store (namely, nothing.)
In fact, after further reflection it is possible to discover sentences the utterance of which under natural circumstances, even without explicit cancellation, does not seem to involve a belief of the type exemplified by (i):
(vi) Who is in favour of amending the Bill of Rights?
The Speaker of the House can felicitously utter the sentence in (vi) before a vote without a necessity that he *believe* (or think anyone else believes) that anyone supports amending the Bill.
(vii) What did you have for dinner last night?

(19) For for a unary wh-interrogative $q(x)$ the range of *potentially resolving* information is constituted by all information that entails instantiations $q(c)$ and quantifications $Quant(N, q(x))$, where $Quant$ is either a monotone increasing quantificational force, or the pure negative existential ('No one'/'Nothing').

A similar point applies to yes/no interrogatives: in (20) Bill's response is goal fulfilling and about the question but does not appear to constitute *fully* resolving information:

(20) a. Jill: If there's a likelihood that Millie will come, I'll bake a cake. Could you tell me: is Millie coming tomorrow?

Bill: She's not overworked, so I'd say she might come.

b. # Following Bill's response, the issue of whether Millie would be coming the following day was resolved.

c. (as report of the dialogue): # Bill told Jill whether Millie would be coming tomorrow.

d. Bill's response indicated to a certain extent whether Millie would be coming tomorrow.

Consequently, I assume that:

(21) for a yes/no interrogative 'whether p' the range of *potentially resolving* information is constituted by all information that entails one of the polar options

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 provides 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 expressions 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 1989, Barwise and Cooper 1991, Barwise and Etchemendy 1990, Westerståhl 1990, Fernando 1991, Aczel and Lunnon 1992) adopts in so doing,

This last sentence tends to suggest the existential assumption, though is clearly usable by a worried parent addressing an overworked son or daughter.

The fact that the subject matter of the question seems to influence the strength of the association of the implication is suggestive of its status as a conversational implicature. Further suggestive evidence comes from calculability, though as with any Gricean explanation, this feature must be taken with a grain of salt in the absence of a formal pragmatic calculus. An addressee might reason as follows: 'Why did the speaker use (vi) when the neutral 'Is anyone in favour of amending the Bill of Rights.?' could have been used? The speaker must have had grounds for using a form in which the role of 'person in favour of amending the bill of rights' is highlighted. Hence, he must have grounds for believing that, indeed, there must exist instantiators of this role.' etc.

Whether such quantifications constitute potentially resolving information is not entirely clear cut, though the data seems to tend towards an affirmative answer. Assume a certain issue is under debate, say the issue of who has worked on Buchwald's problem, and Joanna is the local know-all. I am referred to her:

(viii) Joanna must know who has worked on Buchwald's problem.

If Joanna reveals to me that no one has, in fact, worked on the problem, I would not be tempted to accuse the person who uttered (viii) of having uttered a false statement or even of having been misleading. It would be somewhat misleading of me, nonetheless, to utter (xi) at such a juncture without any further explanation. (x) is felicitous though witty:

(xi) Yeah, so she told me who has worked on Buchwald's problem and so I now know.

(x) I can now reveal to you who has worked on Buchwald's problem, to wit no one.

It seems a reasonable expectation that such wittiness can be explained as arising from the effects of defeased expectation rather than from blatantly violating a semantic felicity condition, as e.g. Boër and Lycan would have it, but I will not try to resolve this here. See 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; the schema in (70) provides a common source for this expectation.

shared with work in property theory (e.g. Bealer 1982, Chierchia and Turner 1988), is to offer a universe of objects of much finer grain than that of individuals existing in the world and relationships existing between them. 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, aboutness, resolvedness 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_0 she is attempting to characterize. Posing a question involves associating a (possibly) partially blurred snapshot i_0 with s_0. Responding involves finding a snapshot that fills in, in fine or coarse grain, the blurred features of i_0 and predicating that it actually depicts s_0. The question defined by associating i_0 with s_0, $(s_0?i_0)$, is *resolved* if the stack contains at a point accessible to the agent a genuine snapshot of s_0 that fills in the blurred features of i_0 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 $\langle$ R,f;i $\rangle$, individuated in terms of a relation R, a mapping f assigning entities to the argument roles of the R, and a polarity i, where $i \in \{+, -\}$.[5]

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 σ

(22) a. $\sigma = \langle$ R, $r_1 : a_1, r_2 : a_2, \ldots, r_n : a_n; + \rangle$

while the latter possibility is represented by the SOA $\overline{\sigma}$

b. $\overline{\sigma} = \langle$ R, $r_1 : a_1, r_2 : a_2, \ldots, r_n : a_n; - \rangle$

$\overline{\sigma}$ is referred to as the *dual* of σ. I follow the established convention of omitting the *polarity* '+', where no confusion arises

In (23) two SOA's are depicted: [6]

(23) a. $\langle$ **LIKE, liker:jill, likee:bill**; + $\rangle$

b. $\langle$ **HOT, location: cordura-hall, time: 3:45 pdt**; – $\rangle$

If the possibility represented by some SOA σ is realised, the assumption is that there must be some situation s_0 in the world that supports the factuality of σ. This is denoted

(24) $s_0 \models \sigma_0$

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 1991, specifically their idea that an appropriate algebraic structure for explicating inference is a *SOA algebra*, SOA-ALG$_0$ $= < Sit_0, SOA_0, \rightarrow, \models, 0, 1 >$: a non-empty collection of objects Sit_0 called situations, together

[5] '+/-' are variously notated as '1/0' or 'yes/no'.

[6] It is worth emphasisising 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.

with a Heyting algebra of SOA's $< SOA_0, \rightarrow >$ with distinguished members **0**, **1**, and a relation $\models$ on Sit_0 x SOA_0.[7] This means that:

- Given any not necessarily finite set of SOA's Σ, there exists a SOA $\bigwedge\Sigma$ ('the informational meet of Σ'), a SOA that represents the combined information in Σ.
- Given any not necessarily finite set of SOA's Σ, there exists a SOA $\bigvee\Sigma$ ('the informational join of Σ'), a SOA that represents the weakest information specified by Σ.
- The domain of SOA's is partially ordered by $\rightarrow$: $\sigma \rightarrow \tau$ is to be read as 'σ is informationally stronger than τ'.
- Given any SOA σ, there exists a SOA $\overline{\sigma}$ such that $\sigma \wedge \overline{\sigma} = \mathbf{0}$, and for any τ such that $\tau \wedge \sigma = \mathbf{0}$, it is the case that $\tau \rightarrow \overline{\sigma}$ ('$\overline{\sigma}$ is the weakest piece of information incompatible with σ.) In fact, in what follows, I will restrict attention to *coherent* SOA algebras. This means that for no situation $s_0 \in SIT_0$ and SOA $\sigma_0 \in SOA_0$ is it the case that $s_0 \models \sigma_0$ and also $s_0 \models \overline{\sigma_0}$.

An important feature of the SOA algebra that exploited below in our characterisation of *aboutness* is the fact that it is **not** in general the case that for a SOA σ:

(25) $\quad \sigma \vee \overline{\sigma} = 1$

That is, given a SOA σ and a situation s_0, it is not guaranteed that $s_0 \models \sigma$ *or* $s_0 \models \overline{\sigma}$.[8],[9]

3.2 Questions and Propositions

In what follows let us assume a fixed SOA algebra SOA-ALG$_0$ $= < Sit_0, SOA_0, \rightarrow, \models, 0, 1 >$. Questions and propositions will not be analysed *reductively*: I will postulate a universe which contains for any situation-SOA (s_0, σ_0) pair in Sit_0 x SOA_0 a question, the question *whether* σ_0 *is a fact of* s_0, notated as $(s_0?\sigma_0)$ and a proposition, the proposition/claim *that* σ_0 *factually describes* s_0 will be notated as $(s_0!\sigma_0)$. 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:

- $(s_0?\sigma_0)$ is *decided* iff $s_0 \models \sigma_0$ or $s_0 \models \overline{\sigma_0}$.
- $(s_0!\sigma_0)$ is *true* iff $s_0 \models \sigma_0$.

[7] The conditions on a sextuple $< Sit_0, SOA_0, \rightarrow, \models, 0, 1 >$ required in order that it be a SOA algebra are:

1. If $s \models \sigma$ and $\sigma \rightarrow \tau$, then $s \models \tau$.
2. $s \not\models 0$, $s \models 1$.
3. If Σ is any finite set of infons, then $s \models \bigwedge\Sigma$ iff $s \models \sigma$ for each $\sigma \in \Sigma$.
4. If Σ is any finite set of infons, then $s \models \bigvee\Sigma$ iff $s \models \sigma$ for some $\sigma \in \Sigma$.

Thus, 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.

[8] One illustration of this, originally due to Barwise, 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_0 in which the SOA $\langle$ WALK, walker: **bill**;+ $\rangle$ is factual. However, the question (s_0 ? $\langle$ TALK, talker: **mike**;+ $\rangle$) need not be resolved, since e.g. **mike** might be an entity external to s_0. Hence, the inference from (ia) to (ib) is not licensed (although the reverse direction is licit.):
(ia) Jill saw Bill walk.
(ib) Jill saw Bill walk and Mike talk or Mike not talk.

[9] A legitimate question to ask is why within this framework all meets of the form $\sigma \wedge \overline{\sigma}$ collapse to a unique bottom element 0. 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.

It is at this point that the partiality of situation theory is essentially exploited: given a SOA σ and a situation s_0, it is not guaranteed that $s_0 \models \sigma$ *or* $s_0 \models \overline{\sigma}$. A given situation need not, in fact in most cases will not, decide or settle all *questions.* Equally, if a proposition $(s_0!\sigma_0)$ is false it does not, on this view, follow that σ_0 represents non-veridical information, rather it follows that s_0 lacks "positive proof" of σ_0's accuracy.

Sofar 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 1992a. 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 (26) the argument-roles assigned a '–' do not get an entity associated with them:

(26) a. $\langle$ **LIKE, liker:jill, likee:**–; + $\rangle$

b. $\langle$ **HOT, location:**–, **time:** –; + $\rangle$

The second tack, one which I will adopt in the current work, is, in some sense, more ontologically conservative.[10] I identify "blurred" SOA's with n-ary abstracts. Thus, each "hole" corresponds to an argument role that has been abstracted over:

(27) a. $\lambda x\langle$ **LIKE, liker:jill, likee:x**; + $\rangle$ (abstract corresponding, roughly, to 'who does Jill like')

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

I assume these abstracts are construed situation theoretically: see Aczel and Lunnon 1992 for a mathematical account of a requisite notion of abstraction, Barwise and Cooper 1991 for a reworking of this notion into situation theory. In addition to SOA's and situations, the universe also contains a class of SOA-abstracts, SOA-ABST$_0$.[11]

Within this view of abstraction, abstracts can be *applied* to assignments, assignments to the parameters abstracted over, with output a SOA. I call such a SOA an *application instance* of the abstract:

(28) a. $\lambda x\langle$ **LIKE, liker:jill, likee:x**; + $\rangle[x \mapsto$ **mike**$] =$
$\langle$ **LIKE, liker:jill, likee:mike**; + $\rangle$

b. $\lambda x, y\langle$ **HOT, location:x, time:y**; + $\rangle[x \mapsto$ **HCRC**$, y \mapsto$ **3am**$] =$
$\langle$ **HOT, location:HCRC, time:3am**; + $\rangle$

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

With this sketch of the properties of abstracts,Ican describe how questions fit into the universe. **In general: I assume that any situation $s_0 \in$ Sit$_0$ and n-ary ($n \geq 0$) abstract $\lambda X_1, \ldots, X_n\sigma(X_1, \ldots, X_n) \in$ SOA-ABST$_0$ give rise to a question $(s_0?\lambda X_1, \ldots, X_n\sigma(X_1, \ldots, X_n))$.**

[10] What side the balance of ontological conservatism/parsimony/plausability tilts to in this case is, of course, far from clear: 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. Thus, in terms of the underlying metaphor developed here, the reductive analysis of partial SOA's to relation-like entities, SOA-abstracts, might be argued to be unfortunate. Nonetheless, since abstracts appear to perform the semantic tasks required of them here quite adequately, I do not attempt to fully satisfy my own ontological "intuitions". Whether this proves to be a substantive issue must await more direct attempts at cognitive modelling. I am indebted to Robin Cooper for discussion and proposals concerning this issue.

[11] Barwise and Cooper 1991 assume also the existence of a class of proposition abstracts; these are irrelevant to the current discussion.

(29) $\text{APPL-INST}(\lambda X_1,\ldots,X_n\sigma(X_1,\ldots,X_n)) =_{def}$
$\{\tau \in SOA_0 | \exists f(\tau = \lambda X_1,\ldots,X_n\sigma(X_1,\ldots,X_n)[f])\}$

For instance:

(30) a. $\{\langle$ R,a;+ $\rangle\}$ = APPL-INST($\langle$ R,a;+ $\rangle$) (For a SOA, the APPL-INST set is a singleton.)

b. Any $\langle\langle$ R,a;+ $\rangle\rangle$ that is in SOA_0 will be $\in$ APPL-INST($\lambda X\langle$ R,X;+ $\rangle$)

Figure 1: The APPL-INST defined by a SOA-abstract

(31) $(s_0?\lambda X_1,\ldots,X_n\sigma(X_1,\ldots,X_n))$ is **decided** iff
$s_0 \models \text{Fact-}\bigwedge_{Sit_0}(\lambda X_1,\ldots,X_n\sigma(X_1,\ldots,X_n))$

Fact-$\bigwedge_{Sit_0}$ represents the most exhaustive application-instance determined by the n-ary abstract component of a question *relative to the given set of situations* Sit_0:

(32) $\text{Fact-}\bigwedge_{Sit_0}(\lambda X_1,\ldots,X_n\sigma(X_1,\ldots,X_n)) =_{def}$

Either

$\bigwedge(\{\tau \in SOA_0 | \exists f(\tau = \lambda X_1,\ldots,X_n\sigma(X_1,\ldots,X_n)[f]) \wedge \exists s_0(s_0 \in Sit_0 \wedge s_0 \models \tau]\})$ **if this set** $\neq \emptyset$

Or

$\bigwedge(\{\tau \in SOA_0 | \exists f(\tau = \overline{\lambda X_1,\ldots,X_n\sigma(X_1,\ldots,X_n)[f]}) \wedge \exists s_0(s_0 \in Sit_0 \wedge s_0 \models \tau]\})$ *Otherwise*

Figure 2: Decidedness conditions for a question

In figure 2 a general definition of decidedness is offered, which for a question $(s_0?\mu)$ amounts to the exhaustive answer defined by μ and Sit_0 being a fact of s_0. Specifically, given (30), Fact-$\bigwedge$ amounts to the following:

- For a yes/no-question $(s_0?\sigma)$: Fact-$\bigwedge_{SIT_0}(\sigma)$ is whichever of σ or $\overline{\sigma}$ is factual relative to Sit_0, if either is.
- For a wh-question $(s_0?\lambda X_1\ldots X_n\sigma(X_1\ldots X_n))$, Fact-$\bigwedge_{SIT_0}(\lambda X_1\ldots X_n\sigma(X_1\ldots X_n))$ 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 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, $PROP(S_0)$, 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:

(33) a. $(s!\sigma \vee / \wedge \tau) = (s!\sigma) \vee / \wedge (s!\tau)$

b. $(s!\sigma) \vee (s!\overline{\sigma}) = 0$

The reader is referred to Barwise and Etchemendy's paper for details. I show how to follow a similar strategy for questions, then offer some speculative remarks on a more optimal approach.

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

(34) $\lambda X_1, \ldots, X_n \sigma(X_1, \ldots, X_n) \vee / \wedge \lambda Y_1, \ldots, Y_m \tau(Y_1, \ldots, Y_m)$
$=_{def} \lambda X_1, \ldots, X_n, Y_1, \ldots, Y_m \sigma(X_1, \ldots, X_n) \vee / \wedge \tau(Y_1, \ldots, Y_m)$ (Cooper 1993)

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

(35) a. $(s?a) \wedge (s?b) = (s?(a \wedge b))$

b. $(s?a) \vee (s?b) = (s?(a \vee b))$

Given (34), we obtain fairly natural results such as

(36) $\textsc{appl-inst}(a \wedge b) = \{\tau \in SOA_0 | \exists \sigma, \mu \in SOA_0((\tau = \sigma \wedge \mu) \wedge (\sigma \in \textsc{appl-inst}(\mathrm{a}), \mu \in \textsc{appl-inst}(\mathrm{b})))\ \}$

Similarly, since $\models$ distributes over both $\wedge$ and $\vee$, (i.e. $s_0 \models \tau \wedge (\vee)\sigma$ entails $s_0 \models \tau$ and (or) $s_0 \models \sigma$).), it is straightforward to show that $(s?(a \wedge (\vee) b))$ is decided iff $(s?a)$ and (or) $(s?b)$ are decided (and ultimately for resolvedness too).

Whether we actually want compound questions so tightly reduced to an operation such in (35) might be called into question in light of examples (based on examples due to Lahiri 1991) as:

(37) What I find really odd is who came at 4 and who left at 6. (Does not follow: What I find really odd is who came at 4 and also what I find really odd is who left at 6.)

This suggests that rather than identifying compound questions in the manner of (35), what is required is a weaker sort of equivalence. One way to achieve this, as Lahiri points out, would be to follow the approach of Chierchia 1982 where the denotata of that clauses are treated on a par with the denotata of NP's individuals, a view which would seem to cohere with the situation theoretic slogan that every entity is a first class entity. I discuss some further motivation for such a view in section 7 focussing on the status of mixed declarative/interrogative compounding.

3.4 Semantic rules

3.4.1 Attitude Reports

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 and an HPSG syntax (Pollard and Sag 1994); I adopt typographical conventions that are minor but transparent variants of both frameworks For more extensive discussion, see Ginzburg 1992. Although I presuppose basic familiarity with situation semantics, a short introduction describing the requisite apparatus is provided in the appendix.

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 both some kind of structured informational/propositional entities as well as 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 the philosophical accounts of Barwise and Perry 1983 and Crimmins 1993.

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. 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 (38b), coupled with constraints stated in (39a,39b) that relate an agent's belief in a proposition to facts about the agent's mental situation; 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 classified by a type T and an assignment f such that applying T to f yields p. Here, T represents the *internal*, agent dependent perspective on the belief, whereas f represents the external, agent independent perspective. The second constraint supplies the required analogue for negative belief attributions:

(38) a. VP[fin] $\rightarrow$ H: V[fin], C: S[fin,+DECL]

b. [VP]$(dis - sit_0, ms) = \lambda x \langle$ Cont(H), subj-role:x,
content-role: Cont(C) cog-role: ms$\rangle$;
RESTRICTIONS: Restr(H) conjoined with Restr(C).

(39) a. $s \models \langle\!\langle BELIEVE, a, p, ms, t; + \rangle\!\rangle \rightarrow$
$\exists T, f(ms \models \langle\!\langle BELIEVE*, a, T, f, t; + \rangle\!\rangle \wedge \exists^* T f = p)$

b. $s \models \langle\!\langle BELIEVE, a, p, ms, t; - \rangle\!\rangle \rightarrow$
$\neg \exists T, f(ms \models \langle\!\langle BELIEVE*, a, T, f, t; + \rangle\!\rangle \wedge \exists^* T f = p)$

(If α is a type $\exists^* \alpha$ is $(\alpha \; ! \; \exists)$. If α is a proposition $\exists^* \alpha$ is α.)

An account of this type allows for a principled resolution of the apparent paradoxes dyadic accounts of belief face as exemplified most famously by Kripke's Pierre who can be reported, simultaneously as in (40a) and as in (41a). In (40b) and (41b) mental situations of a kind that corresponds to the two beliefs Pierre has are exemplified:

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

b. $ms_1 \models \langle BELIEVE*, pierre, T_1, f_1; + \rangle$, where:
$T_1 = \lambda X, Y[\langle PRETTY, X \rangle \wedge \langle NAMED, \text{'}Londres', X \rangle$
$\wedge \langle APPEARS - IN, X, Y \rangle \wedge \langle TRAVEL - BROCHURE, Y \rangle];$
$f_1 = [X \mapsto \mathbf{London}, Y \mapsto \mathbf{travel - brochure}]$

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

b. $ms_2 \models \langle BELIEVE*, pierre, T_2, f_2; + \rangle$, where:
$T_2 = \lambda X, Y[\langle PRETTY, X; - \rangle \wedge \langle NAMED, \text{'}London', X \rangle$
$\wedge \langle APPEARS - IN, X, Y \rangle \wedge \langle SEE, Y, X \rangle];$
$f_1 = [X \mapsto \mathbf{London}, Y \mapsto \mathbf{Pierre}]$

Variants on the rule in (38) will also hold for interrogative embedding with the sole difference that the content of the embedded sentence is a question in such cases. 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 previous sections. BeforeIgo into such details, concerning how to enforce resolvedness inferences, let us consider a more mundane issue: how does a question complement get compositionally constructed.

3.4.2 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, roughly, by means of a sort pertaining to different sentential types. I assume that the possible sub-attributes of this sort (i.e. the subsorts) 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 (38) save for the fact that the complement is C: S[fin,+INT].[12]

The ID schemata I assume to be cross-classified in this way provide us with a NP/VP rule:[13]

(42) S[fin], H:[1], SUBCAT:<> → H: V[fin],H:[1],SUBCAT < [2] >),
C: [2] (NP[nom]

and a rule for dislocated phrases:

(43) S[fin] → H:S[fin, INHER | SLASH([1]),..., 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:

(44) a. S[fin,+AUX,+INV] → H: (V[+INV,+AUX,+INV])), C1: NP[nom], C2: VP[bse]

3.4.3 Content types

Let me start by explaining the content-types 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 appears as a constituent of the following contents (... signifies omitted arguments of the relation):

(45) a. Assertion: Bill left. Required content: Assert$(\ldots(s!\langle LEFT, b\rangle)\ldots)$

b. (Intonation) Query: Required content: Query$(\ldots(s?\langle LEFT, b\rangle)\ldots)$

c. (Embedded) That clause: Jill believes that Bill left. BELIEVE$(\ldots(s!\langle LEFT, b\rangle)\ldots)$

d. Whether clause: Jill asked whether Bill left. Required content: ASK$(\ldots(s?\langle LEFT, b\rangle)\ldots)$

e. Embedded clause: Jill believes Bill left. BELIEVE$(\ldots(s!\langle LEFT, b\rangle)\ldots)$

These data provide some motivation for assigning the SOA $\langle LEFT, b\rangle$ 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

[12]Certain details relevant to a more detailed fragment are omitted: a 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 closured 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 further details.

[13]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.

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'.

(45e) is a slight "glitch" due to an "idiosyncracy" of English which allows complementiser-less phrases to be embedded. We can either patch this problem 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:

(46) S $(dis-sit_0) = \langle$ Cont(H), Cont(C) $\rangle))$
RESTRICTIONS: combine the Restr(C) with the Restr(H)

S $(dis-sit_0, descr-sit_0) =$ (descr-sit$_0$! $\langle$ Cont(H), Cont(C) $\rangle))$
RESTRICTIONS: combine the Restr(C) with the Restr(H)

(46a) is the SOA-denoting rule, whereas (46b) 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 (47a), in all other cases the contribution required of 'has bill left' is a SOA. Hence, again, the "lowest common denominator" is a SOA. Thus, (47a) can be accommodated in similar fashion to (45a,b).

(47) 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$(\ldots(s!\langle NOR, \langle LEFT, b\rangle; \rangle)\ldots)$

Thus, we get the following: the basic descriptive content of the sentence is modified by the modal relation denoted by the (inverted) auxiliary verb.

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

S $(dis-sit_0) = (\langle$ Cont(H), $\langle$ Cont(C1), Cont(C2) $\rangle\,\rangle))$
RESTRICTIONS: combine the Restr(H) and the Restr(C1) and the Restr(C2)

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

(49) a. ['like Mary'] $(dis-sit_0) = \lambda x\langle$ LIKE, liker:x,likee: m $\rangle$
RESTRICTIONS: $dis-sit_0 \models \langle$ NAMED,'Mary' m $\rangle$

b. ['Bill']$(dis-sit_0) =$ b,
RESTRICTIONS: $dis-sit_0 \models \langle$ NAMED,'Bill',b $\rangle$

c. ['does'] = IDENTITY (the identity operator)

d. ['does Bill like Mary']$(dis-sit_0) = \langle$ LIKE, liker:b, likee:m $\rangle$
RESTRICTIONS: $dis-sit_0 \models \langle$ NAMED,'Bill',b $\rangle \wedge \langle$ NAMED,'Mary' m$\rangle$[14]

[14] This is based on the assumption that the SOA's σ and $\langle IDENTITY, \sigma\rangle$ are informationally equivalent.

3.4.4 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 account of wh-phrase meaning is developed in which these denote restriction carrying variables that get *closured* 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 (46), which should also apply to (49):

(50) a. S[fin,+INT][1] $\rightarrow$ H: V[fin], C, NP[nom]

b. [S]($dis-sit_0$) = Λ-CLOSURE(QUANT-CLOSURE($\langle$ Cont(H), Cont(C) $\rangle$))
RESTRICTIONS: combine the Restr(C) with the Restr(H)

Here QUANT-CLOSURE and Λ-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 in? If we restrict attention to individual uses, the answer is simple.I posit the existence of an operator, Λ-CLOSURE, that abstracts over the variables introduced by each wh-phrase that gets closured 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 1992):

(51) Λ-CLOSURE$(\langle Q, \ldots r_1 : x_1, \ldots, r_n : x_n \rangle) =_{def}$
$\lambda x_1, \ldots, x_n \langle Q, \ldots r_1 : x_1, \ldots, r_n : x_n \rangle$

Notice that the output of this operator is an abstract, say μ, 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 interrogatives. 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:

(52) a. S[fin,+INT,-INV][1] $\rightarrow$ H: V[fin], C, NP[nom]

b. [S]($dis-sit_0, descr-sit_0$) = ($descr-sit_0$?Λ-CLOSURE(QUANT-CLOSURE($\langle$ Cont(H), Cont(C) $\rangle$))
RESTRICTIONS: combine the Restr(C) with the Restr(H)

A similar rule will be needed for embedded filler/gap clauses, which in HPSG are S[+INT,-INV,-marked], syntactically distinct from matrix filler/gap sentences which are inverted and, therefore, S[+INT,+INV,-marked]. Note that the ambiguity in (52), just like (46) 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 (50) 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 (53a,b) and the rule in (50) will yield the following derivation for 'who likes what':[15]

(53) a. ['who']($dis-sit_0$) = t;
RESTRICTIONS: $dis-sit_0 \models \langle$ PERSON, t $\rangle$;
['what']($dis-sit_0$) = s;
RESTRICTIONS: $dis-sit_0 \models \langle$ INANIMATE, s $\rangle$

b. ['likes what'] ($dis-sit_0$) = $\lambda x\langle$ LIKE, liker:x, likee: s $\rangle$
RESTRICTIONS: $dis-sit_0 \models \langle$ INANIMATE, s $\rangle$

c. ['who likes what]($dis-sit_0$) = $\lambda t, s\langle$ LIKE, liker:t likee: s $\rangle$
RESTRICTIONS: $dis-sit_0 \models \langle$ INANIMATE, s $\rangle \wedge \langle$ PERSON, t $\rangle$

In order to accommodate a sentence such as 'who does Bill like', we need an analogue of (50) for filler/gap structures:

(54) a. S[fin,+INT,+INV] $\rightarrow$ H: S[fin, INHER—SLASH([1]), TO-BIND—SLASH([1])], F: [1]

b. [S]($dis-sit_0$) = Λ-CLOSURE(Cont(H))
RESTRICTIONS: combine the Restr(H) with the Restr(F)

Hence,[16] and exploiting similar derivations in (49) we obtain:

(55) a. ['like'] ($dis-sit_0$) = $\lambda x\langle$ LIKE, liker:x,likee: s $\rangle$
RESTRICTIONS: $\langle$ = s, Cont('who')$\rangle$

b. ['does Bill like']($dis-sit_0$) = $\langle$ LIKE, liker:b, likee:s $\rangle$
RESTRICTIONS: $domain-sit_0 \models \langle$ NAMED,'Bill',b $\rangle \wedge \langle$ = s, Cont('who') $\rangle$

c. ['who']($dis-sit_0$) = s;
RESTRICTIONS: $dis-sit_0 \models \langle$ PERSON, s $\rangle$;

d. ['who does Bill like trace']($dis-sit_0$) = $\lambda s\langle$ LIKE, liker:b, likee:s $\rangle$
RESTRICTIONS: $domain-sit_0 \models \langle$ NAMED,'Bill',b $\rangle \wedge \langle$ PERSON, s $\rangle$;

I treat 'when', 'where', and 'why' as sentential modifiers, whose argument is a SOA, restricted to be factual. Given the rule in (56a-c), we get the derivation for 'why does Bill like Mary' in (56d,e):

(56) a. S[+fin,-marker] $\rightarrow$ ADJ: ADVP, H: S[+fin,-marker]

b. [S]($dis-sit_0$) = Λ-CLOSURE($\langle$ Cont(ADJ), Cont(H) $\rangle$)
RESTRICTIONS: combine the RESTR(ADJ) and RESTR(H).

c. Cont('why') = $\lambda P\langle$ BECAUSE, cause: c, effect: P $\rangle$
RESTRICTIONS: $dis-sit_0 \models P$

d. ['does Bill like Mary']($dis-sit_0$) = $\langle$ LIKE, liker:b, likee:m $\rangle$
RESTRICTIONS: $dis-sit_0 \models \langle$ NAMED,'Bill',b $\rangle \wedge \langle$ NAMED,'Mary' m $\rangle$

e. ['why does Bill like Mary']($dis-sit_0$) = $\lambda c\langle$ BECAUSE, cause: c, effect: $\langle$ LIKE, liker:b, likee:m $\rangle$ $\rangle$
RESTRICTIONS: $dis-sit_0 \models \langle$ LIKE, liker:b, likee:m $\rangle \wedge \langle$ NAMED,'Bill',b $\rangle \wedge \langle$ 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 **time** and **event**, whereas 'where' will have an operator 'IN' with argument roles **location** and **event**.

[15]For simplicity, I am assigning the same domain situation, the discourse situation, to all NP's here; in a more careful treatment, each NP could, in principle, be assigned its own domain situation.

[16]Here I am exploiting the trace-less analysis described by Pollard and Sag chapter 9, p. 450ff.

3.4.5 Basic sentence rules

HPSG analyzes 'that clauses' as consisting of an *unmarked* (i.e. complementiser-less) declarative clause and a marker. Given the discussion concerning (45), 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:

(57) a. S[fin,+DECL,+marked] $\rightarrow$ Marker: that, H: S[fin,+DECL,-marked]

S[fin,that]$(dis-sit_0, descr-sit_0)$ = (descr-sit$_0$! Cont(H))
RESTRICTIONS: Identical with Restr(H)

I analyze 'whether-clauses' analogously: hence, in line with above discussion, 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:

(58) a. S[fin,+INT,+marked] $\rightarrow$ marker: whether, H: S[fin,+DECL,-marked]

S[fin,+INT,+marked]$(dis-sit_0, descr-sit_0)$ = (descr-sit$_0$? Cont(H))
RESTRICTIONS: Identical with Restr(H)

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

(59) a. VP[fin] $\rightarrow$ H: V[fin], C: S[fin,+INT]

VP $(dis-sit_0, ms) = \lambda x\langle$ Cont(H), subj-role:x,
content-role: Cont(S) cog-role: ms $\rangle$;
RESTRICTIONS: Restr(C) conjoined with Restr(H).

b. ['who likes what]$(dis-sit_0, described-sit_0)$ = (described-sit$_0$?$\lambda t, s\langle$ LIKE, liker:t likee: s $\rangle$)
RESTRICTIONS: $dis-sit_0 \models \langle$ INANIMATE, s $\rangle \wedge \langle$ PERSON, t $\rangle$
(an alternative derivation of (53) via rule (52))

c. ['ask who likes what']$(dis-sit_0, described-sit_0, ms) = \lambda x\langle$ ASK, subj-role:x,
content-role: (described-sit$_0$?$\lambda t, s\langle$ LIKE, liker:t likee: s $\rangle$), cog-role: ms $\rangle$
RESTRICTIONS: $dis-sit_0 \models \langle$ INANIMATE, s $\rangle \wedge \langle$ PERSON, t $\rangle$

In line with the general treatment of sentence embedding discussed previously, ms will be constrained via the interrogative analogue of the constraints in (39). However, resolutive predicates are constrained to satisfy additional constraints. I turn now to specifying these.

4 Resolvedness/Factivity presuppositions (interim account)

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 (60) get captured:

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

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:

(61) $\langle P^{prop}_{factive}, P'er : x, content{-}role : p, cog{-}role : ms\rangle \leftrightarrow \exists f$[PROVES(f,p,ms) $\wedge\langle P^{fact}_{factive}, P'er : x, content - role : f, cog - role : ms\rangle$]

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 τ, a proposition $p = (s!\sigma)$ and a mental state ms as follows:

(62) PROVE$(\tau, (s!\sigma), ms)$ iff

a. $\tau \Rightarrow_{ms} \sigma$

b. $s \models \tau$

Here $\Rightarrow_{ms}$ is taken to be a sound notion of consequence available to the mental state ms. 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 particular, though I will assume that $\Rightarrow_{ms}$ is reflexive, that is $\forall\tau[\tau \Rightarrow_{ms} \tau]$. In that case, it follows that:

(63) PROVE$(\tau, (s!\sigma), ms)$ iff 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 might be related differently.

Thus, we directly obtain as a special case the "standard" view of factivity:[17]

(64) $\langle P^{prop}_{factive}$, P'er: x, content-role: $(s!\sigma)\rangle \rightarrow$ **TRUE**$[(s!\sigma)]$

The resolutivity inferences can be formulated similarly:

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

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:

(66) $\langle P^{question}_{resolutive}, P'er : x, content - role : q, cog - role : ms\rangle \leftrightarrow \exists f$[RESOLVES(f,q,ms) $\wedge\langle P^{fact}_{resolutive}, P'er : x, content - role : f, cog - role : ms\rangle$]

[17]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.

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

(67) RESOLVES$(f, (s?\mu), ms)$ iff

a. $s \models \tau$

b. Pot-Resolves(τ, μ)

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

The relation Pot-Resolves motivated in section 2.5, and the operator goal-SOA(ms), roughly the goal currently represented in ms, will be further specified below in section 4.2.

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:[18]

(68) a. The first question/issue was q_0
The second question/issue was q_1
q_0 V q_1
q_0 is resolved
So, q_1 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 became a resolved issue.

This can be captured via the following constraint:[19]

(69) $\langle P^{question}_{conditional-resolutive}, independent - content : q_1, dependent - content : q_2, cog - role : ms\rangle \rightarrow \forall f[RESOLVES(f, q_1, ms) \rightarrow \exists f_1[RESOLVES(f_1, q_2, ms)]]$

Here we have one instance of the use of a notion like resolvedness, which applies to *questions*, rather than a reductive notion pertaining to propositions such as factivity: given the inapplicability of such predicates to declaratives, trying to characterize the lexical properties by means of factivity does not make much sense.

4.1 Characterising potential resolvedness

I assume that *potential resolvedness* discussed previously in 2.5 is a relation entirely determined on the level of *information*, i.e. SOA's and abstracts, so that a proposition $(s_1!\tau_0)$ *potentially resolves* a question $(s_0?\lambda X_1, \ldots, X_n\sigma(X_1, \ldots, X_n))$ iff
Pot-Res$(\tau_0, \lambda X_1 \ldots X_n\sigma(X_1 \ldots X_n))$ regardless of the identity of s_1 and s_0. $Pot - Res$ is what I will now characterize: attempting to capture the observations of section 2.5. These remarks and the methodological remarks in the following paragraph will apply equally to the characterisation of *aboutness* I offer in section 5.2.

The basic tool utilised is the informational partial-ordering $\rightarrow$ among the SOA's: the range of SOA's potentially resolving a given abstract μ will involve subsuming a certain SOA (or SOA's) determined by μ. 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

[18] See his discussion footnote 6, p. 10.
[19] Thanks to Dan Hardt for pointing out to me an error in an earlier formulation.

subsumption between SOA's (so that e.g.
$\langle$ MANY, $\lambda Z\langle$ Q,Z;+ $\rangle$, $\lambda X\langle$ R,X;+ $\rangle$;+ $\rangle$
$\rightarrow \langle$ EXISTS, $\lambda Z\langle$ Q,Z;+ $\rangle$, $\lambda X\langle$ R,X;+ $\rangle$;+ $\rangle$.)

The definition I offer is given in figure 3:

(70)	Given a SOA τ and a SOA-abstract μ, Pot-Resolve(τ,μ) holds iff either $\tau \rightarrow \bigvee$APPL-INST(μ) **Or** $\tau \rightarrow \overline{\bigvee}$APPL-INST$(\mu)$

Figure 3: Potential Resolvedness conditions

Let us apply this definition. In (21) I suggested an empirical characterisation of potential resolvedness for yes/no interrogatives, repeated here as (71):

(71) for a yes/no interrogative 'whether p' the range of *potentially resolving* information is constituted by all information that entails one of the polar options

Thus, applying the definition of the set of application instances of an abstract, (30a), to a 0-ary abstract, a SOA, $\bigvee$APPL-INST$(\mu)$is simply μ, hence $\overline{\bigvee}$APPL-INST(μ) is $\overline{\mu}$. So for yes/no-questions, the relation reduces to the desired:

(72) Pot-Resolve(τ,μ) iff $(\tau \rightarrow \mu) \vee (\tau \rightarrow \overline{\mu})$

Similarly, in (19) I suggested an empirical characterisation of potential resolvedness for wh-interrogatives repeated here as (73):

(73) For a unary wh-interrogative $q(x)$ the range of *potentially resolving* information is constituted by all information that entails instantiations $q(c)$ and quantifications $Quant(N, q(x))$, where $Quant$ is either a monotone increasing quantificational force, or the pure negative existential ('No one'/'Nothing').

For $n \geq 1$: $\bigvee$APPL-INST(μ) is $\exists X_1,\ldots,X_n\sigma(X_1,\ldots,X_n))$, hence
$\overline{\bigvee}$APPL-INST(μ) is $\forall X_1,\ldots,X_n\overline{\sigma(X_1,\ldots,X_n)}$. Thus, for wh-questions, the relation reduces to:

(74) Pot-Resolve$(\tau,\lambda X_1,\ldots,X_n(\sigma(X_1,\ldots,X_n)))$ iff $(\tau \rightarrow \exists X_1,\ldots,X_n\sigma(X_1,\ldots,X_n))$
$\vee\ (\tau \rightarrow \forall X_1,\ldots,X_n\overline{\sigma(X_1,\ldots,X_n)})$

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:

(75) a. $\langle$ R,a;+ $\rangle \wedge \langle$ R,b;+ $\rangle$ **is Pot-Resolve** $\lambda X\langle$ R,X;+ $\rangle$

b. $\langle$ R,a;+ $\rangle$ **is Pot-Resolve** $\lambda X\langle$ R,X;+ $\rangle$

c. $\langle$ SEVERAL, $\lambda Z\langle$ Q,Z;+ $\rangle$, $\lambda X\langle$ R,X;+ $\rangle$;+ $\rangle$ **is Pot-Resolve** $\lambda X\langle$ R,X;+ $\rangle$

d. $\langle$ NO, THING, $\lambda X\langle$ R,X;+ $\rangle$;+ $\rangle$ **is Pot-Resolve** $\lambda X\langle$ R,X;+ $\rangle$

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 neither disjunct in the defining condition above is informationally subsumed.

4.2 Goal content

The final component in our definition of resolvedness concerns *goals*, or as I have formulated it in (66), the goal-SOA specified by a mental situation. Given the purposes of this paper, this will be restricted to a 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 (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:

(76) 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 the goal specified by a question with the SOA that describes its decidedness conditions, its Fact-$\bigwedge$:

(77) a. When goal-content(ms) is described by a question $(s_1?g_0)$, that is: $\exists T, f[\text{ms} \models \langle\langle GOAL*, a, T, f, t; +\rangle\rangle$ $\wedge \exists^* T f = (s_1?g_0)]$, then goal-SOA(ms) = Fact-$_{SIT_0} \bigwedge(g_0)$

b. When goal-content(ms) is described by a proposition $(s_1!g_0)$, that is: $\exists T, f[\text{ms} \models \langle\langle GOAL*, a, T, f, t; +\rangle\rangle$ $\wedge \exists^* T f = (s_1!g_0)]$, then goal-SOA(ms) = 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 1977), that with each interrogative is associated a fixed *desideratum*, which describes the epistemic condition whose fulfillment a querier desires.

Given this, our definition of resolvedness in (66) can be reformulated as in figure 4:

A proposition $(s!\tau)$ 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 $\Rightarrow_{ms}$ to be $\rightarrow$, then *resolvedness* reduces to *decidedness*, in other words Karttunen or Groenendijk and Stokhof truth conditions. Thus, my assumption 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. As an example for this consider the examples (9) and (10). We need to show why the fact, call it τ, in (79a) conveyed by Jill's utterance in both cases resolves the question (79b) in the context described in (79c), but not in (79d). My constraint on resolutive predicates will then ensure that (79e) is true relative to the parameters of context A, but not relative to the parameters of context B.

(78) RESOLVES($\tau, (s?\mu), ms$) holds iff

a. $s \models \tau$

b. Pot-Resolves(τ, σ)
And either:

c. $\tau \Rightarrow_{ms}$ Fact-$\bigwedge(g_0)$, if goal-content(ms) is a question ($s_1?g_0$).
Or:
$\tau \Rightarrow_{ms} g_0$, if if goal-content(ms) is a proposition ($s_1!g_0$).

Figure 4: Resolvedness conditions

(79) a. Jill is in Helsinki; $s \models \langle In, location : \textbf{Helsinki}, event : \langle LOCATED, j\rangle, \rangle$

b. Where is Jill; $(s?\lambda l\langle In, location : l, event : \langle LOCATED, j\rangle, \rangle)$

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 in now outside the Nurmi memorial.

e. Jill knows where she is.

(79a) indicates that the first condition for resolvedness is met. It is also easy to verify that τ Pot-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 (80a), so the goal condition is (80b):

(80) a. Jill knows that she is in Helsinki.

b. ⟨ KNOW, knower:j, content-role: (⟨ In, location: **Helsinki**, event: ⟨ LOCATED,j ⟩, ⟩), cog-role:ms ⟩

Given that τ is a fact and Jill stated it, then assuming a principle such as 'If agent x states a fact, then agent x knows that fact.', the third condition for resolvedness is met.

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

(81) a. Jill knows she is in now outside the Nurmi memorial.

b. ⟨ KNOW, knower:j, content-role: (⟨ In, location: **Nurmi-memorial**, event: ⟨ LOCATED,j ⟩, ⟩), cog-role:ms ⟩

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

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 evaluation metric of how a theory of questions extends to provide an account of 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 an evaluation metric 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:

(82) a. A: Bill is tired.

b. B: Bill?

c. B: I've heard you.

Equally, then, I would claim that a theory of *questions* is not in the business of explaining why responses such as (83b,c) arise:

(83) 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, I believe, is a theory of dialogue structure (see e.g. Hamblin 1970, Carlson 1983, Ginzburg 1994a,1994b.)

The conclusion, then, is that once we find the right dividing line, then we can demand proper characterisation of this class 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 disquotability 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 1977).

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.[20] This criterion is illustrated in (84):

(84) 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.

[20] 'concerning', 'on', 'as–to', and 'regarding' are close synonyms of this sense of 'about'.

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.

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 extremely helpful 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 (84) 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.[21]

Ranges of aboutness for questions arising out of yes/no-interrogative uses and simple[22] uses of unary wh-interrogatives are described in figure 5.[23]

(85) a. Jill: Is Millie leaving tomorrow?

Bill: Possibly/It's unlikely/Yes/No.

b. Bill provided information about whether Millie is leaving tomorrow. (We have no indication whether this information is reliable.)

(86) For a yes/no question q_0 (= 'whether p'), the range of information *about* q_0 includes all propositions 'mod p', where *mod* is a propositional modality.

For unary wh-interrogatives:

(87) a. Jill: Who is coming tonight?

Bill: Millie and Chuck/Several friends of mine./Few people I've heard of.

b. Bill provided information about who was coming that night. (We have no indication whether this information is reliable.)

(88) For a unary wh-question r_0 $(= q(x))$ the range of information *about* r_0 includes includes all instantiations $q(c)$ and quantifications $Quant(N, q(x))$

Figure 5: aboutness ranges of yes/no and unary wh-questions

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,

[21]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.

[22]'simple' in the sense that functional/pair-list/reprise uses are ignored.

[23]The ranges described in this figure should probably be viewed as base cases, since, for instance, if p constitutes information about q_0, it would appear that (p, if r) does too:

(i) A: Will Mary come? B: She probably will, if it isn't raining.

I owe this point to David Milward.

the truth conditions his analysis would supply for 'provides information about' can be paraphrased as follows:[24]

(89) B provides information about who ran (whether J ran) $\leftrightarrow$ There is some (consistent) proposition p such that B provided p and B's being correct in his information provision would necessarily result in his providing information that *a* 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 (85) and (87).

Groenendijk and Stokhof 1990 define a notion of answerhood, 'partial answerhood', which captures a certain aspect of 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 wit 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 = 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 a certain kind of 'quantified answer' can be accommodated:

(90) a. The (set of) leavers consisted of several men (and no one else).

b. The (set of) leavers consisted of every man (and no one else).

c. The (set of) leavers consisted of few men (and no one else). (That is, either noone left or the ones who left were men and few.)

Hamblin's 1973 semantics is, apparently, motivated by his earlier work on modelling dialogue: 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 1982, Higginbotham and 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 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 6:[25]

[24] In the afore-mentioned paper, the case Boër considers is actually an analysis of 'about' that will work for the complex predicate 'speculates about'.

[25] I could have offered a more precise analogue of Pot-Res, to wit About(τ, μ) holds iff

$\tau \rightarrow \bigvee \text{APPL-INST}(\mu) \vee \overline{\bigvee} \text{APPL-INST}(\mu)$

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

(i) $\langle MIGHT, \sigma \rangle \rightarrow \sigma \vee \overline{\sigma}$

Although I believe that there are good arguments for positing (i), given 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.

(91)	Given a SOA τ and a SOA-abstract μ, About(τ,μ) holds iff whenever $s \models \tau$, it is the case that $s \models \bigvee \text{APPL-INST}(\mu) \vee \overline{\bigvee} \text{APPL-INST}(\mu)$	

Figure 6: Aboutness conditions

Note that here we make strong use of partiality: whereas on a traditional model-theoretic conception this defining condition is vacuous, given that in the SOA algebra $\sigma \vee \overline{\sigma} \neq 1$, the condition is restrictive. On the one hand, then, ⟨ LEAVE, leaver:j;+ ⟩ will *not* be about λX⟨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

(92) About(τ,σ) holds iff whenever $s \models \tau \rightarrow s \models \sigma \vee \overline{\sigma}$

We want to show that modal information e.g. that 'possibly/probably/unlikely p' is about 'whether p'. I confine myself here to show 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 1985; 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 σ'. 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.[26] The intuition is simple: any information expressing the possibility that σ is a conceivable option, as $MIGHT(\sigma)$ should allow one to conclude, should also allow one to conclude that either things are as described by σ or they're not. (Though of course this should *not* allow one to conclude that either things are as described by τ or they're not, for arbitrary τ.)

Define:

(93) a. $s \models \langle MIGHT, \sigma\rangle \leftrightarrow \exists\tau[s \models \sigma \vee \tau \wedge s \not\models [\sigma \wedge \tau] \wedge s \not\models \overline{\sigma}]$

b. Paraphrase: There is no proof that σ isn't the case and σ *is* among the current alternatives.

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

(94) a. μ = ⟨⟨ AT-MOST-3, λZ⟨ Q,Z;+ ⟩, λX⟨ R,X;+ ⟩;+ ⟩ **About** λX⟨ R,X;+ ⟩ (Intuitively: 'at most one person left.' subsumes the disjunction 'There exists some person that left or no one left.')

b. μ = ⟨ R,a;+ ⟩ ∨ ⟨ R,b;- ⟩ **About** λX⟨ R,X;+ ⟩ (Intuitively: 'John left or Mary didn't leave.' subsumes 'John left or someone other than Mary left or no one left.')

[26] For further motivation and details see Ginzburg (in preparation).

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.[27] 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:

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

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

In (95a) I provide a constraint that describes the force of this query operator: any discourse situation in which a query is posed involves a querier a, a responder b, a situation s and an abstract μ in such a way that the querier desires from the responder a response whose content provides information *about* the question $(s?\mu)$.[28] 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.[29], [30]

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-$\bigwedge$(g), the responder knows that if the question *asked* transparently reflects the querier's goal, then that goal is indeed FACT-$\bigwedge$(g). Hence, the implicature that not only the response should satisfy (96a),in fact it should satisfy (96b):[31]

(96) a. $\langle ABOUT, CONT(r), \mu\rangle$

[27] That is, assuming perfect communication on the linguistic front, an oft unattainable ideal. For current purposes, we hold on to this idealisation.

[28] Recall that the fragment described above assumed that matrix interrogatives have abstracts as their contents.

[29] See Cooper 1993 for a situation semantics formulation of PTQ along these lines.

[30] 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. 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 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 *Pot-Resolves* and *ABOUT* in the requisite way.

[31] 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.

b. $\langle CONT(r) \rightarrow FACT - \bigwedge(\mu)\rangle$

This, however, is a defeasable expectation.

Taking the *querier's* perspective forces us to take into account her goals and belief/knowledge. Adopting the perspective on goals described in 4.2, 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 question q, rather than some other question, forces on her the pretense of being someone that expects to be provided with information about q, and it is indeed somewhat hard to defease this expectation:

(97) 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.

On the other hand, 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":

(98) a. A: When is the train leaving?

b. B: Follow this porter, he'll put you on it.

Thus, I offer the following as an approximation to the force the speaker intends it to have, to be denoted as QUE$^{speaker-intended}$, relative to a goal content and beliefs of mental state ms_0:

(99) a. Speaker's intended construal of Query:

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

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 ms_0

Hence the SOA-content of a desired response, call it a *goal-fulfilling* response, say σ, will, according to this view, satisfy:

(100) a. $\langle ABOUT, \sigma, \mu\rangle$

b. $\langle \sigma \Rightarrow_{ms} goal - SOA(ms)\rangle$

There are some obvious immediate 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, (100) imposes no *factuality* requirement, which resolvedness does carry, and second, the relation $ABOUT$ is more inclusive than $Pot - Resolves$. Hence we can accommodate *false* answers as goal-fulfilling, [32] as well as explain why non-resolving answers can arise and be entirely felicitous, exemplified by data such as (18) repeated here:

(101) 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.

[32] I thank an anonymous reviewer for emphasising to me the need to demonstrate this.

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

The question expressed here is, say:

(102) $(s?\lambda x\langle DURING, time : \textbf{tonight}, event : \langle COME, comer : x\rangle, \rangle)$

Whereas, the goal could be described as in (103a), the goal-SOA will be something along the lines of (103b):

(103) a. Jill wants to confirm that her past antics won't embarrass her tonight.

b. goal-SOA: $\gamma = \langle DURING, time : \textbf{tonight}, event : EMBARASS, embarassing-event : \textbf{last} - \textbf{party}, embarassee : \textbf{j}; -\rangle; \rangle$

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

(104) a. σ = ⟨ FEW, *restrictor*: λz⟨ PERSON, z ⟩ ∧ ⟨ IN, location: **last-party**, event: ⟨ SAW, see'er:z, seen: **j** ⟩;⟩, *nuclear*: λx⟨ DURING, time: **tonight**, event: ⟨ COME, comer: x ⟩; ⟩; ⟩

Assume that a conditional such as (105) is represented in Jill's ms, an instance presumably of some, more general social convention:

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

b. $\langle \rightarrow, \sigma, \gamma\rangle$

In that case, σ satisfies the requirements in (100). However, (101) follows since *it is not the case* that

(106) Pot-Resolves(σ, μ)

and therefore *resolving* information has not been conveyed. Why is it the case, nonetheless, that (107) holds?

(107) Bill's response indicated to some extent who was coming that night.

An explanation for this will emerge in the following section.

6 The QVE

6.1 Introduction

I have hitherto restricted attention to two notions concerning questions, *aboutness* and *resolvedness*. I now turn to a phenomenon that brings out the connection between the two, namely *partial* resolvedness. Intuitively, information I_0 partially resolves a question q iff it is *about* q and in addition is also factual and subsumes *at least some* of the information that is required to resolve q.

One class of phenomena that bring out the need for such a notion, I argue, are the readings triggered by adverbial modification of interrogative clauses, related to which is the quantificational variability effect (QVE) discussed extensively in the work of Berman 1990,1991, 1994, Lahiri 1991 and Groenendijk and Stokhof 1993.

Berman 1990,1991 argues that sentences such as those in (108a-b) exemplify a fundamental bifurcation among interrogative clauses (the 'quantificational variability effect' (QVE)). His claim is that whereas in (1a) the adverb can only be interpreted as quantifying over cases/events/situations (henceforth the *cases* reading), (1b) displays an additional reading, (the *qv* reading), paraphrasable as (108c):

(108) a. Jill to some extent/for the most part wonders which students cheat on the exam.

b. Jill to some extent/ for the most part knows which students cheat on the exam.

c. For some/most students x that cheated on the exam, Jill knows that x cheated on the exam.

Subsequent accounts of the QVE, Lahiri 1991 and Groenendijk and Stokhof 1993, differ from Berman and from each other in a number of important ways. However, all three accounts are united in assuming

- **Quantificational Variability (QV)**: (108c) is a correct paraphrase/entailment of the qv reading;
- **Question/Answer predicate bifurcation (QAPB)**: there is a class of interrogative-clause embedding predicates that do not display qv readings. This includes 'question predicates' such as 'wonder', 'ask', 'investigate', and 'discuss'.

In this section, I argue that both assumptions are false. I start by considering the truth conditions of sentences like (108b) involving adverbial modification of resolutive predicates. I show how the notion of *partial resolvedness* provides the basis for an account that avoids the inadequacies introduced by assuming QV, and allows the requisite pragmatic relativisation to be captured. Following that, I consider QAPB: my claim is that once one moves away from a view of qv readings as involving quantificational variability, one notices that question predicates also trigger the cases/qv ambiguity. In fact, I suggest that the qv reading is independent of the nature of the embedded complement and arises equally with declaratives and NP's. Finally, I sketch an account of the phenomenon, one that ties qv readings to adverbial modification of the embedding *predicate*.

6.2 Truth conditions

The first issue I consider is whether the paraphrase Berman proposes for this reading, which his account is designed to provide, and which both Groenendijk and Stokhof and Lahiri in their distinct ways also provide, is, in fact, correct. On the quantificational variability approach, what the adverb in examples such as (109) is affecting is quantification over the role associated with the wh-phrase.[33]

(109) a. Bill for the most part knows who came to the party.

b. Bill remembers to some extent which students failed the exam.

Thus, on this approach these sentences are assumed to involve the following logical forms respectively:

(110) a. For most x, x a human that came to the party Bill knows that x came to the party.

b. For some students x that failed the exam, Bill remembers that x failed the exam.

My claim is simply this: the paraphrases typified in (110) are *incorrect*; rather, I suggest that the effect of the adverbial modification is to require information so disquoted to be resolving to the extent specified by the adverb.

To see this consider first example (111):

[33]This description reflects, in broad terms, the intuition underlying both Berman's and Groenendijk and Stokhof's DRT and DMG accounts. However, although a similar effect is achieved by Lahiri's account, the underlying intuition is quite different. In fact, the notion of Q-extent resolvedness proposed here can be viewed as contextually parametrising his notion of an answer being Q-extent exhaustive.

(111) Celia: All I know is that some rather unruly linguists showed up, though I don't know who.

(111) would appear to license the following inferences:

(112) a. Celia could tell me (only) to some extent/ to a limited extent who showed up last night.

b. Celia knew (only) to some extent/to a limited extent who showed up last night.

c. For some x who showed up last night Celia told me/knew that x showed up last night.

Nonetheless, given the context of (111), it is clear that the *de re* nature of the paraphrase in (111c) is not warranted.[34]

Second, consider the following scenario: Jill is about to step out of a taxi in Helsinki.

(113) a. Driver: Do you know where you are?

b. Jill: South West Helsinki.

In many contexts, i.e. unless Jill's purpose is to locate a specific destination, Jill's response in (113b) licenses the statement in (114):

(114) Jill knows for the most part where she is.

Once again, a paraphrase of (114) analogous to (108c) is clearly incorrect:

(115) For most places x where Jill is, Jill knows that she is in x.

Third, consider (20) repeated here as (116).

(116) a. Jill: If there's a likelihood that Millie will come, I'll bake a cake. Could you tell me: is Millie coming tomorrow?

Bill: She's not overworked, so I'd say she might come.

b. Bill's response indicated to a certain extent whether Millie would be coming tomorrow.

[34] Berman 1994 reacting to an earlier version of this paper suggests an alternative explanation of this case, namely that '...[this] is a use of many adverbial quantificational expressions that is logically independent of the individual quantifying analysis I [Berman -J.G.] have analysed.' (Berman 1994 p.32) As evidence for this, Berman offers the following (Berman 1994's (62)):

(i) For the most part, Celia knows only to some extent who showed up last night.

This, Berman claims, is evidence that 'the same sentence may without contradiction contain adverbials with conflicting quantificational forces'. Berman explains that 'he understands this as asserting that for most people who showed up Celia has only limited knowledge of who they are. But on Ginzburg's account, this sentence should assert that Celia's knowledge simulatenously resolved the question of who showed up both to a majority degree and to a minority degree, which appears to be contradictory.' (Berman 1994, p. 32.)

The informants that I have consulted *do* find the sentence distinctly odd and hard to evaluate. Putting these dialectal differences to one side, nonetheless, it seems that there is no reason to reach Berman's conclusion that a contradictory reading is predicted by the current proposal. Extent adverbials do have an illocutionary use paraphrasable as

(ii) 'To Q-extent p' $\leftrightarrow$ I am to Q-extent willing to commit myself to claiming that p.

One can predict that (i) has a sensible reading paraphrasable as (iii). (iv) offers one possible context consistent with this reading which seems also consistent with the reading Berman intuits:

(iii) I am to a large extent willing to commit myself to the claim that Celia knows only to some extent who showed up last night.

(iv) It is more or less true to say that Celia knows only to some extent who showed up last night, but not entirely accurate. She does know that Bill and Mary showed up and she can give you a long lecture about who they are.

The analysis I offer for qv readings with declaratives will suggest a source for such readings. Furthermore, let us observe that Berman's analysis actually predicts that (i) should have the reading in (v), or perhaps (vi):

(v) For most x that showed up to the party, Celia knows only to some extent that x showed up last night.

(vi) For some x that showed up to the party, Celia knows for the most part that x showed up last night.

However, neither (v) nor (vi) do not seem to exhibit such readings, which seem, in fact, to be quite distinct from the reading Berman intuits.

If non-resolving information about y/n-questions also licenses adverbially modified interrogative disquotation, there does not seem to be any obvious way to relate this to the quantification over individuals view of the QVE. Note that this problem does not, in principle, apply to Lahiri's view of the problem, though in practice it does, given the Karttunenean interrogative semantics he adopts.

Let us, for the moment, restrict ourselves to providing a reading that captures the truth conditions and does not run into the problems pointed out above for the qv reading.

In general, a partial ordering $\Rightarrow$ which is transitive and reflexive, satisfies:

(117) $\tau \Rightarrow \sigma$ if and only if for any ψ if $\sigma \Rightarrow \psi$, then $\tau \Rightarrow \psi$

In this light, I define $\Rightarrow^{Q-extent}$ intended to capture the notion of 'contains Q-extent of the information':

(118) $\tau \Rightarrow^{Q-extent} \sigma$ iff *For Q-extent* ψ such that $\sigma \Rightarrow \psi$, it holds that $\tau \Rightarrow \psi$.

I formalise the notion of *to Q-extent resolving* information, as follows:

(119) RESOLVES$^{Q-extent}(\tau, (s?\mu), ms)$ holds iff $\exists\chi$ such that:

a. $s \models \tau$

b. About(τ, μ)

c. $(s!\chi)$ is a (g,ms) resolving answer.

d. *For Q many* ψ such that $\chi \Rightarrow_{ms} \psi$, it is also the case that $\tau \Rightarrow_{ms} \psi$.

My suggestion is that adverbs can modify the resolutive entailment carried by predicates such as *know* so that we have the following inference schema:

(120) A certain fact has been discovered.
Which fact? A fact that to Q-extent resolves q.
So, it's been V'ed to Q-extent q.

Given the approach I have taken to resolutive predicates hitherto, this suggests the following constraint is in operation:

(121) $\langle P^{Q-extent}_{question}, P'er : x, content-role : q, cog-role : ms\rangle \leftrightarrow$
$\exists f[RESOLVES^{Q-extent}(f, q, ms) \wedge \langle P_{fact}, P'er : xcontent-role : f, cog-role : ms\rangle]$

Things are somewhat subtler than this, as we shall subsequently see. Nonetheless, a number of consequences follow directly. First, it is easy to see why the qv inference need not hold. Celia knowing to some extent who showed up involves the existence of a fact τ that Celia *knows*. This fact needs to satisfy, for some resolving fact χ that:

For some μ such that $\chi \Rightarrow_{ms} \mu$, it is also the case that $\tau \Rightarrow_{ms} \mu$

As long as τ is about the question $(s?\lambda x\langle SHOW-UP, x\rangle)$, then given the existential quantificational force, nothing *forces* τ to be an application-instance of $\lambda x\langle SHOW-UP, x\rangle)$, by the definition of *aboutness*, and hence the inference is blocked.

Now reconsider (113a). Assume a goal plausible for this context, say that Jill be able to find her way from where she alights. Then, as is easily verifiable, the reading the above definition generates is one paraphrasable as follows:

(122) Jill knowing that she is South West Helsinki constitutes most of the information needed for her to be able to find her way once she alights.

Let us now move to consider adverbial modification of embedded interrogatives in a more general perspective, starting with the putative qv reading asymmetry.

6.3 Which predicates manifest qv readings?

Berman 1990,1991 assumes that the relevant distinction among embedding predicates is factivity: factive predicates do and non-factive predicates do not display the qv reading. The proper characterisation of the class of predicates that (putatively) do not display qv readings is a matter of some controversy among the three accounts, though there is broad agreement that it should include 'predicates of questions' such as *wonder, ask, investigate,* and *discuss.*. I will henceforth dub the complement of this class, those predicates that do exhibit qv readings, the class of "answer predicates".

The first issue of data raised here concerns which adverbs actually exhibit a *qv* as distinct from *cases* reading. Here I follow Lahiri, who argues carefully and in detail, that adverbs of frequency show no QVE effect: there is no question/answer bifurcation for these adverbs, no reading distinct from the cases reading. It is only adverbs of quantity that bring out an additional reading:[35] Thus, (123a) (Lahiri's (218)) should be paraphrased as (123b) (Lahiri's (224)) not (123c) (Lahiri's (219)):

(123) a. John usually knows who does well on the exam.

b. For most exams, John knows more or less who does well on the exam.

c. Most x, x does well on the exam, John knows that x does well on the exam.

I now attempt to demonstrate that question predicates such as *wonder, investigate, discuss* and *ask* also exhibit a qv reading. Some care is required here: it is clear that such predicates do not display a reading such as that paraphrased in (110a). This is hardly surprising given my claim that also answer predicates do not actually exhibit such a reading. In addition, all these predicates are not, in the terms described above, resolutive predicates: hence the interrogative complement is not being used to describe a factual resolution of the denoted question; in addition, the predicates are not *applicable* to declaratives for such a reading to be available in principle.[36]

Nonetheless, my claim is that such predicates certainly do allow for readings distinct from the cases reading, readings which for both question and answer predicates can be paraphrased as follows:

(124) a. Jill adverb V q = Jill had adverb-many Nom(V) of q.

b. Jill for the most part/hardly/to some extent knows q = Jill had almost complete/very partial/partial knowledge of q.

c. Jill for the most part/hardly/to some extent discussed q = Jill had almost complete/very partial/partial discussion of q.

Consider first (125):

(125) a. This issue, who to hire for the position, is highly complex. We have managed sofar to discuss it only to a very limited extent/partially.

b. A limited/partial discussion of who to hire for the job ensued.

It seems clear that (125a) has a qv reading, paraphrasable as in (125b). Consider now (126):[37]

[35] This was also noted, independently in Srivastav 1991 and Ginzburg 1992a.

[36] Berman 1991 is aware of this point, as his discussion on p. 84 makes clear. However his discussion does not entirely address the problem: he suggests that even though question predicates do not have declarative complements, it is *prima facie* surprising that e.g. 'The principal mostly wonders which students cheat on the exam' has no reading wherein 'for most students x such that x cheated on the final exam, the principal stands in the wondering relation to the proposition that x is a student and x cheated on the final exam.' Given that 'wonder' and other question predicates are inapplicable to propositional denoting expressions in general, this would make the proposed paraphrase ill-formed.

[37] This example was suggested to me by Elisabet Engdahl.

(126) a. There have been many issues for us to investigate, far far too many for us to do a thorough job. We have to some extent investigated who committed the crime, we have fully investigated who was at the scene of the crime, but only to a limited extent when the suspects were in town.

b. Partial investigation of the first issue, complete investigation of the second issue, limited investigation of the third issue.

(126a) has a reading paraphrasable as in (126b), one quite distinct from the cases-reading. A similar reading can be found for the predicate 'depend':

(127) Who comes here in the morning depends to some extent on how many terminals are free. (There is a partial dependency of the resolution of the question who comes here to the resolution of the question how many terminals are free.)

With 'wonder', it is somewhat less easy to get such readings: wondering involves, roughly, a desire to get an unresolved question resolved. Partial wonderment would thus appear to involve either a partial desire or a partially resolved question or both:

(128) a. I was really perplexed by his attack. Of course, your explanation of his behaviour seems reasonable, but I still wonder to some extent at least why anyone would adopt such an attitude. That is, I still have a partial desire for an explanation that could resolve that issue.)

b. To some extent I do wonder if there's any point in pursuing this project anymore. (That is, to a certain extent I realize why we should pursue the project, but I also have doubts.)

With 'ask', given its reportive function, some work is required to construct convincing examples of non-cases readings:

(129) a. I'm not sure if there is any point in my raising this question, how you deal with these ECP counterexamples, since the previous speaker was to a large extent asking this same question.

b. I hope you realize that what he's doing is to some extent asking you how much you'll pay up.

The conclusion these data point to is that adverbs of extent can trigger qv readings for question predicates. The basic criterion for availability of such a reading seems to be: to what extent can the argument of the predicate be "partially consumed". Partial knowledge or recollection are more easily conceivable than partial wonderment or asking.

6.4 QV readings for non-interrogative complements

We will now see that qv readings also arise with non-interrogative complements of these same predicates. (130a,b) contrast sharply with (131a,b): the former demonstrate that adverbs of extent can modify both the (semi) factivity of an embedded declarative as well as the resolvedness of an embedded interrogative. In other words, in both cases what has been *established* is a *weaker* fact than the one potentially described by the complement. On the other hand, with a full factive like 'amaze', both the factivity and the resolutivity are maintained.

(130) a. The scientist has to some extent established which person committed the crime. The scientist has established a fact that goes some way towards resolving the question of which person committed the crime.)

b. The scientist has to some extent established that unpasteurised milk causes botulism in rats. (The scientist has discovered a fact that goes some way towards proving the claim that unpasteurised milk causes botulism in rats.)

(131) a. It to some extent amazed/disgusted Jill who chose to show up to the party. (Jill was somewhat amazed/disgusted by a fact that resolves the question of who chose to show up to the party.)

b. It to some extent amazed/disgusted Jill that unpasteurised milk causes botulism in rats. (Jill was somewhat amazed/disgusted by the fact that (proves the claim that) unpasteurised milk causes botulism in rats.)

I correlate the split with whether a similar split arises with fact nominals:

(132) a. This fact to some extent amazes Jill.

b. Jill has to some extent managed to establish [this fact]$_1$. (What Jill has actually established is a "weaker" fact than fact$_1$.)

More generally, my claim is that partial answer/evidence readings arise for precisely those predicates which manifest a "weaker" fact reading in (133a):

(133) a. Bill to some extent knows/discovered/revealed [this fact]$_1$. (What Jill actually knows/discovered/revealed is a "weaker" fact than fact$_1$.)

b. Bill to some extent knows/discovered/revealed who showed up. (What Bill knows/discovered/revealed is a fact from which one can partially conclude a fact resolving the question who showed up.)

c. Bill to some extent knows/discovered/revealed that Mary showed up. (What Bill knows/discovered/revealed is information from which one can partially conclude that Mary showed up.)

These data, combined with the data presented in the previous section, suggest two sources for qv readings. The first: such readings result from V modification. In particular, this would pave the way for an account for resolutivity/factivity projection properties, which are uniform for a given predicate. Thus, 'be-amazed' or 'disgust' are holes both for factivity and resolutivity when extent-modified, whereas 'establish' or 'reveal' filter them away. In the following section, where I explore the need for an account that captures resolutivity and factivity in terms of *coercion*, the possibility of a unified treatment will emerge: the basic idea will be that declaratives/interrogatives embedded by factives/resolutives denote *facts*. Partial answer/evidence readings will then be analysed in terms of attitude verb modification:

(134) $\langle$ V-to-Q-extent, A, $\sigma\rangle \leftrightarrow \langle$ V, $\tau\rangle$, where $\tau \rightarrow^{Q-extent} \sigma$

Given this, the possibility for an account of a related reading, one in which the asserter to Q-extent commits herself to a statement emerges directly (cf. footnote 34):

(135) a. To some extent/for the most part, Bill knows who was there.

b. To some extent/for the most part, Bill knows that Mary was there.

c. $\langle$ ASSERT-to-Q-extent, A, $(s!\sigma)\rangle \leftrightarrow \langle$ ASSERT $(s!\tau)\rangle$, where $\tau \rightarrow^{Q-extent} \sigma$

7 Ontology

7.1 Introduction

The strategy I have developed sofar can be labelled Karttunean, as far as one important aspect goes: predicates embedding interrogatives have been treated *uniformly* as denoting relations whose complement denotes *a question*.[38] The fact that certain of these predicates can also embed 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. (66)).

Karttunen's strategy was, to a large extent, unprecedented and also abandoned by many subsequent works, all of which adopted a propositionally reductive strategy of some sort to deal with the resolutives. Thus, the approach developed by Hintikka reduces interrogative meaning to declarative meaning. Groenendijk and Stokhof, by contrast, do not eschew positing the existence of relations that take questions as their arguments. Relations of this kind include 'wonder' and ' ask', which in their system is the *intension* of an interrogative sentence. However, relations such as those denoted by interrogative complement embedding *know, tell etc* are not treated as relations that take questions, rather the argument in this case is taken to be a proposition, which in their system is the *extension* of an interrogative sentence.

Here I will argue that a careful consideration of the entities that interrogative and declarative predicates are applicable to, as demonstrated by a series of inference patterns that test whether an argument role is *purely referential*, in Quine's sense, in question/proposition entities, demonstrate that *neither* strategy is tenable. The evidence I present indicates that resolutive interrogative complements denote neither questions nor propositions but rather a family of entities which include the class of *facts*. Conversely, it also turns out that precisely those declarative embedding predicates whose arguments are *required* to be propositions, by just about anyone's criteria for what constitutes a proposition, namely being a truth or falsity bearer, are inapplicable to interrogative content.

These considerations will *inter alia* motivate the need for an ontology that distinguishes facts and (true) propositions. One such ontology is that provided by situation theory, certain of whose features prove theoretically useful, certain others of which perhaps less so. Given that interrogatives do, of course, have a question-denoting use, and declaratives a proposition-denoting use, the strategy I will pursue will be based on the notion of *coercion*. Roughly, I will assume that an interrogative I can be coerced to denote a fact, one that in that context resolves the question denoted by I, whereas a declarative d can be coerced to denote a fact, one which proves the truth of the proposition denoted by d.

Finally, I will show how the revised semantics for resolutive/factive predicates can be exploited to provide a unified account of adverbial modification effects discussed above.

The account offered here bears a number of obvious debts, in particular to Austin 1950, 1954 and to Vendler 1967, 1972: Austin 1954, while defending the theory of truth presented in Austin 1950, argues at some length against conflating facts with true propositions. This is a position that Vendler 1967 motivates further, whereas Vendler 1972 assembles a variety of evidence that partitions the declarative complement predicates into two main categories. He uses this data to argue for a pervasive ambiguity among these complements, between fact-embedding and proposition-embedding predicates.

7.2 Purely Referential question predicates

An important presupposition of mine below will be the following criterion. Assume we have a predicate expression P which takes as its surface arguments a class of expressions E, the referents of which can be described, say, as $\ulcorner$ q $\urcorner$. Take as given $e \in E$, a context c where P denotes $D(P)$, and e denotes $D(e)$. Then, a necessary and sufficient condition for positing that $D(e)$ is in the extension of $D(P)$, and more generally that the referents of E should be posited as members of the positive or negative extension of $D(P)$, is that the occurrence of e in $\ulcorner$ Pe $\urcorner$ is *purely referential (PR)* in the sense due to Quine.[39] Two tests for this are *substitutivity* and *existential generalisation*:

[38] Here and elsewhere I use 'denote' as shorthand for 'its content on a particular use is'; in particular, no associations whatever should be made between this usage and ones that pertain to the Fregean distinction between sense and denotation.

[39] See e.g. Quine 1953, p. 139-145 for discussion.

(136) ⌈ Pe ⌉
⌈ e is f ⌉
————
⌈ Pf ⌉

substitutivity

(137) ⌈ Pe ⌉
————————
Then, ⌈ there exists a q such that Pq ⌉

existential generalisation

Both tests are not entirely unproblematic. Existential generalisation becomes more and more controversial the further one strays from the domain of concrete entities. Substitutivity, especially in attitude contexts, depends on maintaining a single perspective. Nonetheless, these caveats notwithstanding, I believe that the contrasts these tests bring out in the following sections will be sharp enough to enable us to draw some reasonably firm conclusions.

By these criteria, for instance, 'eat' has the denotata of such expressions as 'the pie' in its positive and negative extensions which consist of ⌈ concrete objects ⌉ (assuming for the moment such a class can be characterized somehow.):

(138) Jill ate the pie. The pie is the thing Bill baked yesterday. Hence, Jill ate the thing Bill baked yesterday.

Bill ate a pie. Hence, there is some concrete object that Bill ate.

I start with evidence that shows the existence of predicates that are PR with question individuals, and also predicates which fail these tests. I refer to the former as question interrogative predicates (QI), to the latter as resolutive interrogative predicates (RI). Table 1 provides a sample list of predicates from both categories.

RESOLUTIVES		**QI**
discover	report	ask
find out	tell	wonder
forget	announce	weigh–in–self's–mind
guess	state	investigate
predict	reveal	discuss, talk about
know	remember	over
determine	show	about

Table 1: Resolutive and Question predicates

Various common-noun phrases denote entities of which one can predicate unresolvedness, openness and so forth:

(139) a. The question/problem/issue remains unresolved.

b. The question/problem/issue is still an open one.

Interrogative but not declarative sentences can be used to designate such entities:

(140) a. The question/problem/issue is who left/whether Bill is happy/the cause of Bill's happiness.

b. # The question/problem/issue is that Bill is happy.

QI predicates are PR in question-entities, whereas resolutive predicates fail such tests:[40]

- Substitutivity:

(141) a. Jill asked/reflected over an interesting question. The question was who left yesterday. Hence: Jill asked/reflected over who left yesterday.

b. Bill investigated/discussed that issue. The issue was whether Jill would arrive. Hence: Bill investigated/discussed whether Jill would arrive.

c. Jill discovered/revealed an interesting question. The question was who left yesterday. It does *not follow* that: Jill discovered/revealed who left yesterday. (It does follow that Jill reported/was aware of *what the question is.*)

d. Bill reported/was aware of the issue. The issue was whether Jill would arrive. It does *not follow* that: Bill reported/was aware of whether Jill would arrive. (It does follow that Bill reported/was aware of *what the issue is.*)

- Existential generalisation:

(142) a. Jill asked/reflected over who left yesterday. Hence, there is a question/issue that Jill asked/reflected over yesterday. Which question? The question was who left yesterday.

b. Bill investigated/discussed whether Jill would arrive. Hence there is a question/issue that Bill investigated/discussed. Which question? The issue was whether Jill would arrive.

c. Jill discovered/knows who left yesterday. It does not follow that: there is a question/issue that Jill discovered/knows.

This data illustrates that resolutive predicates do not embed question denoting expressions PR. Note that this is not influenced by syntactic form since the same facts apply to so called 'concealed questions':

(143) a. Jill asked/reflected over/discovered an interesting question. The question was the source of Bill's wealth. Hence: Jill asked/reflected over the source of Bill's wealth.

It does not follow that: Jill discovered the source of Bill's wealth.

b. Jill asked/reflected over/discovered the source of Bill's wealth. Hence, there is a question/issue that Jill asked/reflected over yesterday. Which question? The source of Bill's wealth.

It does not follow that: there is a question/issue that Jill discovered.

In fact, the only reading which resolutive predicates can obtain with question nominals is, as we have noted in (141c,d), a concealed question one paraphrasable as 'V what the question/issue is', just as with other entities such as times or names which are clearly *not* potential arguments of these predicates.

Such data, then, constitute a serious problem for the Karttunean *strategy* for embedded interrogatives. Let us ignore some, as it were, *tactical* problems related to the strictly typed Montogovian system in which Karttunen's system is formulated: due to this, it is not straightforward to extend

[40]'wonder' does not subcategorize for NP arguments, hence it is inapplicable to these particular tests. 'wonder about' is applicable to and passes these tests and is, apparently, reasonably synonymous to 'wonder'. In fact, 'V about' passes these tests for resolutive predicates as well. However, as for instance Boër 1978 notes, in such cases 'V about' manifests significantly distinct behaviour from 'V'. For instance, 'Bill managed to make a guess about who showed up to the party' does not imply that Bill's guess was correct, in contrast to 'Bill managed to guess who showed up to the party'. Both contrasts follows directly once we assume that it is 'about', a predicate that is purely referential in question entities, that is predicating of the questions in these cases.

the system to offer a semantics for question nominal uses.[41] Nonetheless, within a different setting, one of two approaches can be expected. Either assume the existence of a single relation underlying the interrogative and the NP complement verbs, or at the very worst, use an equivalence of the following kind to relate interrogative, V_Q and question nominal relations, V_{NP}:

(144) $\forall Q(question(q) \rightarrow [V_{NP}(x,q) \leftrightarrow V_Q(x,q)])$

However, both approaches fly in the face of the data we observed above. The conclusion that this points to: resolutive predicates do not have *questions* in their extension.

7.3 Purely referential proposition predicates

A set of data similar in many respects to the one we observed in the previous section with respect to questions can be produced with respect to propositions.

Various common-noun phrases denote entities of which one can predicate truth or falsity:

(145) theory, claim, report, forecast, allegation, prediction, charges, hypothesis, conjecture.

Declarative but not interrogative sentences can be used to designate such entities:

(146) The theory/claim/belief is that Bill is happy.

The theory/claim/belief is who left/whether Bill is happy/the cause of Bill's happiness.

On the one hand, there exist a class of predicates which pass PR tests for such nominals, whereas there exist a class of predicates, primarily factives, which fail these tests. I refer to the former class as **TF** (for truth/falsity) predicates. Table 2 provides a sample list of predicates from both categories.

TF	FACTIVES
claim	discover
allege	find out
assert	forget
believe	reveal
assume	remember
accept	know
deny	regret

Table 2: Resolutive and Propositional predicates

- Substitutivity:

  (147) The Fed's forecast was that gold reserves will be depleted by the year 2000.
  Bill believes/accepts the Fed's forecast. Hence, Bill believes/accepts that gold reserves will be depleted by the year 2000.
  Bill discovered/was aware of the Fed's forecast. It does *not follow* that: Bill discovered/was aware that gold reserves will be depleted by the year 2000. (*It does follow* that Bill discovered/was aware of what the Fed's forecast is.)

- Existential generalisation:

  (148) a. Bill believes that gold reserves will be depleted by the year 2000. Hence, there is a claim/hypothesis/prediction that Bill believes.

[41] See Chierchia 1982 for a post-Montagovian system adequate for such a job.

b. Bill discovered/knows that gold reserves will be depleted by the year 2000. *It does not follow* that there is a claim/hypothesis that Bill discovered/knows.

I believe that the contrasts in (147) are fairly uncontroversial; (148), on the other hand, is an obvious target for dissent even by those tolerant of some ontological pluralism. Nonetheless, even for those who accept only (147), it reveals a clear contrast exemplified in (149) (I use an indefinite NP here since that excludes the possibility of a concealed question interpretation):

(149) a. Jill believed a certain hypothesis.

b. Jill discovered a certain hypothesis.

whereas in (149a) the fact that 'hypothesis' is an entity that has propositional content is crucial for the felicity of the predication, in (149b) this fact is completely orthogonal; whereas in (149a) once we know what the hypothesis concerns, we learn something about what Jill's believes, we learn no such thing about what Jill has discovered in (149b). (149b) means something like 'There was some hypothesis which lay around undetected; at some point Jill did manage to detect it, however.' The very same reading would arise if we would substitute 'America' for 'a certain hypothesis'. This is very strange behaviour indeed if **discover** takes propositions as its arguments.

In fact, this data constitutes the tip of an empirical iceberg that motivates discarding the label *propositional attitudes* as a catchall term for the 'that-clause' embedders, given the presupposition that label carries that *all* such predicates take propositions as their arguments. There are many explanatory benefits for reserving this term and the presupposition it embodies to TF preds and, moreover, for assuming both that:

- **Non-prop-int**: interrogatives *do not* have a propositional denotation.

  and, that

- **Non-prop-decl**: declaratives *do* have a non-propositional denotation.

Let us take these assumptions in turn. Consider the following fact: TF predicates but not other declarative embedding predicates obey the following inference pattern, noticed by Vendler (Vendler 1972, chapter 5.):

(150) $$\frac{\lceil \text{V the N'} \rceil}{\lceil \text{V that the N' is true} \rceil}$$

T-Pred

(151) a. Bill believes/accepts Mary's theory/ the Fed's forecast/the recently published report.

Hence, Bill believes/accepts that Mary's theory/the Fed's forecast/the recently published report is true.

(152) a. Jill discovered/revealed Bill's hypothesis/claim/conjecture.

It does not follow that: Jill discovered/revealed that Bill's hypothesis/claim/conjecture is true.

T-pred characterizes TF predicates as imposing an appropriateness condition on their arguments, namely that they be truth/falsity predicable. T-pred coupled with *Non-prop-int* allows for an ontology in which the following fact about TF predicates can be captured. TF predicates are inapplicable to interrogative content:[42]

[42]These facts are stable, apparently, across a wide range of languages, including English, Hebrew, Japanese (Yo Matsumoto-p.c.), and Turkish (Guven Guzeldere-p.c.).

(153) a. # Bill believes/ hopes who came yesterday.[43]

b. # Basil supposes/ assumes which pitcher will do what tomorrow.

c. # Bill claimed/argued who came yesterday.

Notice that these facts remain unchanged if one adds as an assumption that the requisite belief, desire, claim etc is true:

(154) Bill knows who left: Jerry, Mike and Marabella. So, # he believes/assumes who left.

Similar facts hold for concealed questions:

(155) # Jack believed/doubted/assumed Bill's weight./my phone number.

Now if interrogatives never denote propositions, whereas TF predicates require precisely such entities as their arguments, then, as long as we have a "well motivated" ontology for what interrogatives do denote, the inapplicability facts above fall out immediately. Moreover, TF predicates are inapplicable to other construction-types which can be argued to denote facts, for instance POSS-gerunds:[44]

(156) a. # Bill believed/alleged /assumed/doubted/claimed Jill's having discovered a new ontological distinction.

b. # Bill believed/alleged/assumed/doubted/claimed Jill's finding the treasure much before anyone else did.

Such an account of (153, 155) is neither more nor less explanatory, as far as I can tell, than an explanation of the infelicity of (157) based on a common sense ontology which distinguishes abstract from concrete entities, and assumes 'eat' imposes the appropriateness condition on its **eatee** argument that it be concrete:

(157) # Bill ate the square root of 3.

Can we evade these *semantic* conclusions by means of some pragmatic explanation? I believe not. Stalnaker 1974, 1978 and Lewis 1979 have persuasively argued for the utility of a notion of presupposition as conversationally accepted information. However, assuming such a notion of presupposition, means that serious problems will be encountered by any attempt to invoke presuppositions whose function is the enforcing of 'epistemic weakness' or 'conversational controversiality' to the arguments of TF predicates. In other words, it is problematic to assume that the inapplicability of TF predicates to the veridical entities made available by resolved questions, fact nominals, POSS-gerunds etc derive from a prohibition of the following kind: *do not fill the cognitive argument of a TF predicate with material present in the conversational record.*[45]

Data such as the following would appear to fly in the face of such a prohibition:

[43] In certain environments *believe* does have a factive, "emotive" use where it comes to mean something like 'be reconciled with':

(i) She can't BELIEVE that line-call.

This use enables *believe* to predicate of wh-questions:

(ii)You won't BELIEVE who showed up last night.

or NP's:

(iii) You won't BELIEVE that fact.

Note that this use seems to require stressing the verb. Moreover, as David Milward has pointed out to me, unambiguously propositional negation does not license such predications:

(iv) # It is not the case that you will believe who showed up last night.

This suggests that it is modification at the level of the verb that is involved here. Hence, whatever the precise nature of the phenomenon, we need not suspect that, via some process of presupposition projection, the "normal" sense of *believe* is applicable to questions or facts.

[44] See Vendler 1967 and Bennett 1988, chapters 1,2 for such arguments.

[45] Boër 1978 seems to advocate such a solution: 'it is the inherent factivity of 'who' clauses which makes them bad company for most non-factive verbs of propositional attitude. Usually, the pragmatic point of using a non-factive verb of propositional attitude is to leave open the question of truth value of the proposition which is the object of that attitude, and this point is frustrated by the semantics of 'who' clauses...' (Boër 1978, p.333).

(158) a. Bill is usually so wrong headed, but for once he actually believes something we all accept without batting an eyelid, namely that the sun will rise tomorrow.

b. Now that she's been shown the evidence, and let me assure you it conclusively establishes his guilt, Jill won't deny that Bill could have committed the crime.

(159) a. For a long time there had been allegations that Dave was seeing a certain actress. It's turned out that the allegations are well founded. Thus, even though we all know they're true, John, staunchly loyal, doesn't accept the allegations.

b. Bill's claim was that Mary was ill. I discovered that, in fact, Mary was ill. After that, everyone accepted the claim.

Any adjusting of the condition to hold not of the conversational record, but of the agent whose mental state is reported is confounded by examples such as the following:

(160) Jill believes that John was on MDA last night, in fact she knows it.

(161) # Bill knows that, but he doesn't believe it. (*believe* can only be understood here in the sense of 'be reconciled with'.)

Thus, building into *believe* or other TF predicates a requirement that its complement is *not known* will result in contradiction.

7.4 Purely referential fact-embedders

Let us turn to the second assumption appealed to above, namely that declaratives also have a non-propositional denotation. Following argumentation of a similar kind to the one employed in the previous subsection to resolutive predicates and questions, it seems that such an assumption is required in order to explain why factives fail the PR tests above with TF nominals.

Of course, we can only adopt such an assumption if we have a viable alternative. And I believe such an alternative exists: my claim is that the requisite semantic category is one that includes the class of *facts*. Both the factives as well as the non-factive resolutive predicates show PR behaviour with fact nominals:

Certain common-noun phrases, like those in (162) denote entities which refer or describe facts, events, or other states of affairs that obtain:

(162) truth-about, outcome, result, important fact about, earthquake, King's coronation

We note first that truth or falsity cannot be predicated of the entities referred or described by such expressions:

(163) # The truth about that event/the outcome of the competition/this fact/that earthquake is true/false.

- Substitutivity:

  (164) a. Jill is aware of/reported/revealed that fact. That fact is that Bill has been working hard to destroy the company. Hence, Jill is aware/reported/revealed that Bill has been working hard to destroy the company.

  b. Jill guessed/could have predicted/discovered these basic truths about Bill. One of these is that Bill never finishes writing up. Hence, Jill guessed/could have predicted/discovered that Bill never finishes writing up.

  c. Jill regrets/remembers well a particularly gruesome outcome of Bill's pronouncement. That particularly gruesome outcome of Bill's pronouncement was that everyone was required to sign the pledge. Hence, Jill regrets/remembers well that everyone was required to sign the pledge.

- Existential generalisation: (for declaratives: valid only for factives)

(165) a. Jill discovered/revealed that Bill has been working hard to destroy the company. Hence, there is some fact that Jill discovered/revealed.

b. Jill discovered/told us who Bill has chosen for the job. Hence, there is some fact that Jill discovered/told us.

This data provides us with a way out from the impasse one might think we had reached having concluded that both interrogatives and declaratives need not denote questions and propositions. The explanation common to both phenomena, I suggest, is that such expressions can be *coerced*, coerced to denote facts. I follow a variety of recent work surveyed in Pustejovsky 199? that appeals to a notion of coercion described as follows:

> Type coercion: a semantic operation that converts an argument to the type which is expected by a function, where it would otherwise result in a type error. (Pustejovsky 199? p. 7)

Pustejovsky exemplifies a system in which the reading paraphrasable as (166b) can be provided for a sentence such as (166a):

(166) a. John began a novel.

b. John began reading a novel. (Pustejovsky's example (18))

In the system described by Pustejovsky, each expression is (potentially) assigned an argument structure, an event structure defining the event type of the expression and a qualia structure. In (166a) the verb 'begin' expects a second argument of type *event*, one of whose participants is the filler of its first argument. The NP 'the novel' does not satisfy this type, so the verb coerces the NP into an event denotation, in this case an event structure of sort *READ(event:e, agent:x, Novel:y)*, which , the NP has available from its head CN's own qualia structure, which is in this case 'novel'.

The setting Pustejovsky envisages is a typed λ-calculus. However, in common with e.g. Pollard and Sag 1991, one can also envisage such an operation based on appropriateness within a type-free setting such as the one we operate in here. At present I cannot appeal to the existence of a framework that serves to underpin such a view, therefore I will restrict myself to a *specification* of the coercion in the interrogative/declarative cases that are of concern to us here.

The system that will emerge as a result will involve a 4-way split:

- Factives: take as arguments the coerced factive denotation both for declaratives and for interrogatives.

- Non-factive resolutives: these take the coerced factive interrogative denotation. On the other hand, there is evidence that they can also take propositional arguments, hence no need to assume coercion in the declarative case:

(167) a. Bill has told me that story many times in the past. That story, obviously untrue, was, essentially, that Mary would never agree to Jill's terms. Hence, Bill has told me that Mary would never agree to Jill's terms.

b. Bill predicted, falsely as it turns out, that Mary would never agree to Jill's terms.

- QI: as far as interrogatives go, they take questions as arguments. On the other hand, they are inapplicable to declarative content, presumably since their arguments are required to have "unresolvedness" predicable of them.

(168) a. # Xiaokang asked/wondered/investigated/weighed-in-his-mind that Jill likes Bongo drumming.

b. # It is open/unresolved that Jill likes Bongo drumming.

- TF: as far as declaratives go, they take propositions as arguments. They are, as we noted above, inapplicable to interrogative content.

I mention one further ontological constraint that I believe emerges from the data: whatever the precise appropriateness condition imposed on fact arguments, the emergent class of entities must be a superset of the set of actually holding facts. The reason for this is presupposition projection:

(169) a. Did you, in fact, discover that Javed was a Kylie fan? [Does not entail that Javed was actually a Kylie fan.]

b. If Martha buys a blue dress and Susan does too, then Martha will regret having bought a dress identical in colour to Susan's. [Does not entail that Martha did buy a dress of identical colour to Susan's.] (Based on an example of Soames 1989).

Within a situation theoretic ontology, factuality is a property of a strict subset of the class of SOA's, since each SOA is posited to have a dual and only coherent situations[46] are assumed to exist. This means that whether predications are felicitous does not become an (entirely) empirical issue. I, therefore, avoid the problem posed by Ramsey for Russell's 1918 semantics for perception verbs.[47]

7.5 Excursus on hybrid coordination

The 4-way bifurcation posited above raises one question with respect to coordination, namely the status of hybrid question/proposition entities exemplified by (170):

(170) Jill know who left and/or that Mary had been disappointed.

Examples such as (170) are among the motivations for Groenendijk and Stokhof's approach in which the extension of an interrogative is assumed to be of the same semantic type as the *intension* of a declarative, namely propositional.

If we assume that both declaratives and interrogatives embedded by a predicate that is both resolutive and factive denote *facts*, then for such cases, compounding is treatable using the normal SOA-algebra $\vee$ and $\wedge$. In fact, whether such hybrids would be of any semantic use is called into question by examples such as the following: if the hybrid is a proposition, it is surprising that (171b) where this object is predicated by 'believe' a predicate of propositions, is bad, whereas if the hybrid is a question, the analogous case with 'ask', a predicate of questions, is surprising:[48]

[46] Ones that satisfy $s \models \sigma$ implies $s \not\models \overline{\sigma}$.

[47] In a number of works (e.g. Russell 1918), Russell propounded a theory which distinguishes the logical form of declarative sentences embedded by *believe* or *wish* from those embedded by *perceive* or *know*. Those sentences embedded by *believe* or *wish* would, roughly speaking, contribute an entity consisting of (or individuated by) the denotata of the constituents of the sentences. Thus, in

(i) Othello believed that Desdemona loved Cassio.

the embedded sentence contributes something like a triple consisting of the objects **Desdemona**, **Cassio** and the relation *love*. In contrast, a sentence embedded by *perceive* would contribute a *fact*, construed in strictly realist terms by Russell as an object on a par with chairs and tables. Thus, in

(ii) Othello perceived that Desdemona wasn't breathing.

the embedded sentence contributes *the fact that Desdemona wasn't breathing.*. Were Desdemona to be breathing, *the fact that Desdemona wasn't breathing.* would *not* exist. And herein lies a problem for Russell's account, as Ramsey pointed out. Sentences like

(iii) Bill believed he knew that Mary was 6 feet tall.

cannot be assigned logical forms if Mary is, in fact, not 6 feet tall. Since then the postulated object of Bill's knowledge, *the fact that Mary is 6 feet tall*, does not exist and cannot, therefore, be a constituent of a proposition.

[48] Conditionals are a somewhat different case since they clearly do form hybrids, of genus question:

(i) Bill asked who would come if Jill left.

(ii) # Bill believed who would come if Jill left.

These hybrids, nonetheless, can be handled not as question/proposition compounding but simply as SOA/SOA-abstract compounding of the kind discussed in section 3.

(171) a. # Bill asked who left and/or that Mary had been disappointed.

b. # Jill believed who left and/or that Mary had been disappointed.

Of course, one could appeal to a syntactic analysis based on subcategorisation to explain these facts: in a framework for coordination along the lines of Sag et al. 1985, where hybrid compounds are allowed in via some kind of "disjunctive" feature only a predicate that subcategorises for *both* interrogatives and declaratives will also subcategorise for the hybrid.

The one case that poses some problems and might benefit from proposition/question hybrids concerns resolutives that are not factives. Predicates such as 'tell' or 'guess'. In such cases, my account, assumes that an interrogative is coerced to denote a fact, but the evidence is that the declarative argument is propositional.

This assumption, that such predicates are applicable to both states-of-affairs and propositions, raises an interesting issue with respect to mixed compound complements, containing one junct that is proposition-denoting, the other state-of-affairs-denoting (interrogative, gerund or CQ use of NP). I have suggested that a declarative embedded by *report* is a (truth-bearing) proposition, whereas the interrogative, the gerund and the concealed-question denote a (factual) state-of-affairs. This should mean that a mixed compound in such a case is infelicitous, but of course the examples in (172) are quite felicitous:

(172) a. Jill reported to us who Bill likes and that Mary is ill.

b. Jill reported to us Dave's current marital status and that Mary is ill.

c. Jill reported to us Dave's having betrayed Judy and that Mary is ill.

One might view this as a *prima facie* counterexample to the current account and its postulated semantic type distinction between states-of-affairs and propositions since, apparently, expressions denoting the two putatively distinct entities can be conjoined. Things are not so simple, however. Notice that truth cannot be predicated of the compound, as we might expect were it to denote a proposition. Thus, the adverb in the examples (173) cannot modify the truth of the embedded clause, it can only serve to indicate that there was some infelicity in making the report in the given circumstances etc:

(173) a. Jill incorrectly/?falsely reported who Bill likes and that Mary is ill.

b. Jill incorrectly/?falsely reported to us Dave's current marital status and that Mary is ill.

c. Jill incorrectly/?falsely reported to us Dave's having betrayed Judy and that Mary is ill.

Fuerthermore, the embedded declarative is not forced to be true, as would follow on an account wherein there existed a factive homonym of *report*:

(174) Jill reported who Bill likes and that Mary is ill. As it turns out Mary is *not* ill.

Thus, the problematic nature of such compounds is independent of the bifurcation postulated here for propositional entities and will not go away by postulating an ambiguity for the embedding predicate. I do not offer a solution to this problem here, only point in the direction of the aforementioned Chierchia 1982 account as a direction worth pursuing.

7.6 A coercion based account of resolutive interrogative and factive declarative content

The coercion process we require is intended to achieve two effects. On the one hand, it is supposed to enable both an interrogative I and a declarative D to denote facts. On the other hand, the two coercions are required to provide facts with slightly different pedigrees: the interrogative coercion needs to yield a fact that in that context resolves the question denoted by I, whereas the declarative coercion should yield a fact that proves the truth of the proposition denoted by D. In this way, we achieve both the right content-type for resolutives and factives and ensure that the requisite inference patterns are satisfied.

In detail: assume as given a question q. On the basis of the relation RESOLVES developed in section 4.2, we can define the following set of SOA's:

(175) $f \in$ RESOLVING-FACTS$[q, ms]$ iff RESOLVES(f, q, ms)

Here ms is a parameter for the the mental situation that has to be contextually supplied whenever an attitude predicate embeds a content.

The coercion semantics we are after is intended to get the following effect for a resolutive predicate V:

(176) $\ulcorner$ V, S[+Int] $\urcorner$ denotes $\lambda x\langle$ CONT(V), x, f,ms $\rangle$ where
$f \in$ RESOLVING-FACTS[CONT(S[+Int]),ms]

Two questions arise: first, how do we know R-F is non-empty? csecond, if R-F is non-empty, which f do we choose? The answer to the first question is clear: the coercion process will be well-defined if and only if the question is resolved. In other words, it is a presupposition of the coercion that the question is resolved. Thus, going along the coercion route, allows for the resolvedness presupposition to emerge without further stipulation.

To the second issue. We recall the background SOA-algebra: this ensures that for any set of SOA's, there exists a join, a SOA that represents the weakest information specified by that set. If we choose that, to wit $\bigvee$(RESOLVING-FACTS[CONT(S[+Int]),ms]), we achieve the effect of:

(177) $\ulcorner$ V, S[+Int] $\urcorner$ denotes $\lambda x \exists f\langle$ CONT(V), x, f,ms $\rangle$ where
$f \in$ RESOLVING-FACTS[CONT(S[+Int]),ms]

Similar reasoning can be applied to the propositional case with factives. For a proposition $p = (s!\sigma)$, we define the following set of SOA's:

(178) $f \in$ PROVE-FACTS$[p, ms]$ iff PROVES(f, p, ms)

Here the desired effect of the coercion is:

(179) $\ulcorner$ V, S[+DECL] $\urcorner$ denotes $\lambda x\langle$ CONT(V), x, σ,ms $\rangle$ where [CONT(S[+DECL])] = $(s!\sigma)$

This will emerge from a schema analogous to the interrogative one, to wit:

(180) $\ulcorner$ V, S[+DECL] $\urcorner$ denotes $\lambda x\langle$ CONT(V), x, f,ms $\rangle$ where
$f \in$ PROVE-FACTS[CONT(S[+DECL]),ms]

just in case the denoted proposition is true, and we choose f to be $\bigvee$(PROVE-FACTS[CONT(S[+DECL]),ms], which is σ, if [CONT(S[+DECL]) = $(s!\sigma)$. Thus, once again, the factivity presupposition emerges as a presupposition required for the well-definedness of the coercion process.

More generally, if I is an expression-type which denotes questions, and D an expression type that denotes propositions, these can each be coerced to have facts as their contents as follows:

(181) a. I can be coerced to denote $\bigvee$(RESOLVING-FACTS[CONT(I),ms])

b. D can be coerced to denote $\bigvee$(PROVE-FACTS[CONT(D),ms])

(182) provides a simplified derivation for 'discover who likes what':

(182) a. VP[fin] $\rightarrow$ H: V[fin], C: S[fin,+INT]

b. ['who likes what]$(dis-sit_0, described-sit_0)$ = (described-sit$_0$?$\lambda t, s\langle$ LIKE, liker:t likee: s $\rangle$)

c. ['discover who likes what']$(dis-sit_0, described-sit_0, ms) = \lambda x\langle$ DISCOVER, subj-role:x, content-role: f, cog-role: ms $\rangle$
RESTRICTIONS: $dis-sit_0 \models \langle$ =, f, $\bigvee$[RESOLVING-FACTS(described-sit$_0$?$\lambda t, s\langle$ LIKE, liker:t likee: s $\rangle$, ms)], $\rangle$

7.7 Excursus: Coercion and NP's

As stated, the rule in (181) will overgenerate, since, for instance, we do not want a question-denoting NP such as 'the question' or a proposition-denoting NP such as 'the hypothesis' to coerce in this way, as examples (141) and (147) taught us:

(183) Jill discovered a question; The question was who left; *It does not follow* that Jill discovered a fact that resolves the question of who left.

a. Jill discovered a hypothesis; The hypothesis was that Bill left; *It does not follow* that Jill discovered a fact that proves the claim that Bill left.

Nonetheless, stating the coercion simply as an operation on contents of interrogatives and declaratives is too restricted, since, for instance, it will not capture the fact that concealed question uses have both a question denoting use and a fact denoting use:

(184) Jill investigated/discovered the source of Bill's wealth.

Resolving the tension between (183) and (184), is unfortunately outwith the scope of this paper, not least because it involves providing a treatment of concealed question uses of NP's. I suggest that the contrast arises for something like the following reason: assume that 'discover' expects its argument to be fact-denoting. NP's can coerce in a variety of ways.[49] One such coercion ('existential coercion') is of the type evinced in (183), which can be paraphrased as 'the fact that x existed':

(185) a. Jill told me of/reported/knows/revealed a certain question.
(= Jill told me of/reported/knows/revealed the fact that a certain question exists.)

b. Jill told me of/reported/knows/revealed a certain friend of his.
(= Jill told me of/reported/knows/revealed the fact that a certain friend of his exists.)

One other possible coercion for an NP, if it is definite, is the concealed question use, where it denotes a question paraphrasable as 'who/what is the NP'. This in turn can undergo question-to-fact coercion as described in (181). The contrast between (183) and (184) can then be explained as follows: since the NP in (183) is specified as being able to coerce to a *fact* according to the schema underlying (185), the predication in (183) is successful using that coercion. On the other hand, for an NP such as the one in (184) existential coercion is impossible for some reason. Concealed question coercion is, however, applicable. This outputs a question content. This is still not appropriate for 'discover'. Hence question-to-fact coercion takes place. Hence, a reading as in (184).

I provide now one application of the coercion analysis: a unified account of the qv reading for interrogative and declarative complements of factive/resolutive predicates.

7.8 QV readings for resolutive interrogatives and factive declaratives

Recall that in section 6.4 I suggested that the partial evidence/answer reading for declaratives and interrogatives occurs when similar behaviour is evinced with fact nominals:

(186) Jill has to some extent managed to establish this fact. (What Jill has actually established is a "weaker" fact than the fact demonstrated.)

How to obtain such readings? The account proceeds as follows: I treat the adverb of extent as a verb modifier. The modified verb triggers coercion: question-to-fact in the interrogative case, proposition-to-fact in the declarative case, no coercion needed in the fact nominal case. The meanings involved are as follows:

[49] See Pustejovsky 199? for examples.

(187) a. ['to some extent discover who likes what']$(dis{-}sit_0, described{-}sit_0, ms) = \lambda x\langle$ DISCOVER-TO-SOME-EXTENT, subj-role:x,
content-role: f, cog-role: ms $\rangle$
RESTRICTIONS: $dis - sit_0 \models \langle$ =, f, $\bigvee$[RESOLVING-FACTS(described-sit$_0?\lambda t, s\langle$ LIKE, liker:t likee: s $\rangle$, ms)], $\rangle$

b. ['to some extent discover that Bill likes Jill']$(dis - sit_0, described - sit_0, ms) = \lambda x\langle$ DISCOVER-TO-SOME-EXTENT, subj-role:x,
content-role: f, cog-role: ms $\rangle$
RESTRICTIONS: $dis - sit_0 \models \langle$ =, f, $\bigvee$[PROVE-FACTS(described-sit$_0!\langle$ LIKE, liker:b likee: j $\rangle$, ms)], $\rangle$

Finally, I impose the following constraint, assumed to hold for predicates such as those in (133):

(188) $\langle$ V-TO-Q-EXTENT subj-role:x,
content-role: f, cog-role: ms $\rangle \rightarrow \exists f_1\langle$ V, subj-role:x,
content-role: f, cog-role: ms $\rangle$, where f_1 is a SOA that satisfies the following: $f_1 \Rightarrow_{ms}^{Q-extent}$ f.

Recall that $\Rightarrow_{ms}^{Q-extent}$ is the notion of Q-extent information containment defined in (118).

In particular, it is straightforward to verify that if $f_1 \Rightarrow_{ms}^{-Q-extent} f$, where f resolves a question q, then f_1 to Q-extent resolves q, in the sense of our definition (119). Hence, we can capture the requisite truth conditions.

7.9 Summary of resolutive predicate account

Let me summarize what the revised account of interrogative and declarative complementation proposed in this section amounts to.

I have proposed that a question is not an appropriate argument for the relation denoted by an resolutive predicate, whereas a proposition is not appropriate for a factive predicate. Whenever an resolutive (factive) predicates of an interrogative that denotes a question q (a declarative that denotes a proposition p), that complement is *coerced* to denote a SOA which, unless projection phenomena intervene, resolves the question (proves the proposition). A relation denoted by a QI predicate *is*, by contrast applicable to a question, similarly for a TF predicate and a proposition. In fact, the latter carry an appropriateness restriction that their argument be an entity of which truth or falsity is predicable. Such an account directly

1. Captures the resolutive (factive) entailments that I suggested RI (factive) predicates satisfy (examples (1- 3).

2. Derives the resolutive (factive) presuppositions as a condition on the well-definedness of the coercion process.

3. Blocks substitutivity and existential generalisation with question-denoting (proposition-denoting) arguments for resolutive (factive) predicates, while allows them to hold for QI (TF) predicates.

4. Accounts for the uniform behaviour of adverbially modified predicates that are both resolutive and factive with interrogative, declarative and fact-nominal arguments.

5. Offers a simple account for the cross-linguistically valid generalisation that TF predicates are inapplicable to interrogative meaning.

8 Appendix

8.1 Meaning in Situation Semantics

The view of meaning developed in situation semantics draws on an important insight of David Kaplan's (Kaplan 1977), namely that the world plays two roles with respect to (declarative sentential) *meaning*: it determines *what the content is* and also *whether the content fits the facts.* Whereas Kaplan, and Montague antecedently, simply boxed together the content-determining aspects into an n-tuple or *index*, Barwise and Perry proposed that such content-determining aspects be grounded in various parts of the world or *situations* just like the truth-determining aspects in possible world semantics. The coherence of the world and its parts is supposed to explain why sentences such as the following although expressing contingent truths can never be used to make false assertions:

(189) a. I am speaking now.

b. Jill is called Jill.

c. [to addressee] You're the addressee.

More generally, the view of meaning that emerges is the following: a meaning maps a certain collection of situations and entities that form the initial circumstances–those situations exploited in fixing the content of a given use of the expressions–to a certain collection of situations and entities that form the resulting circumstances of the utterance (including facts about objects that have become salient, situations described, requests made, queries posed etc.)

(190) a. You told Jill that I called.

Thus, for instance, in order to fix the content of (190), the context has to contain facts such as those in (189). So all that information is available to be extracted even though none of it is part of what is being conveyed directly. Hence, we can provide a schematic, tenseless description of the meaning of (190) as follows:

(191) a. ['You told Jill that I called']($discourse - sit_0$) = $\langle$ TELL, **tell-er:t tell-ee:j** prop ent: !(s_{report}, $\langle$ CALL, caller:s $\rangle$) $\rangle$,
WHERE $discourse - sit_0 \models \langle$ UTTERING, expression: 'You told me that I called', utter-er:s $\rangle$
$discourse - sit_0 \models \langle$ ADDRESSED, expression: 'You told me that I called', person-addressed:t $\rangle$
$naming - sit_0 \models \langle$ NAMED, name: 'Jill' named-person:j $\rangle$

Thus, the content of a use of 'You told Jill that I called' will be a descriptive SOA $\sigma(t, j, s, s_{report})$ of the schema $\langle$ TELL, **tell-er:t tell-ee:j** prop ent: !(s_{report}, $\langle$ CALL, caller:s $\rangle$) $\rangle$. This content has four parameters that are not fixed *a priori* of use, t, j, s, s_{report}: The initial circumstances for an utterance of this sentence are specified to fix 't' to the addressee of the use of the sentence, 's' to the speaker, 'j' to some person who, assuming for concreteness a causal theory of proper names, is named 'Jill' relative to some naming situation, and s_{report} to the situation involving the addressee's act of telling.

In general a meaning will be a description for an abstract as follows:

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

Metaphorically, 'B' provides the skeleton and 'C' the flesh, which combined make up the description. Here the x_1 are contextual parameters introduced by this grammar rule, and y_j are contextual parameters (possibly) introduced by the constituents.

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

(193) a. S $\rightarrow$ NP,VP

b. [S]($dis-sit_0$)= $\langle$ Cont(VP), Cont(NP) $\rangle$);
RESTRICTIONS: combine the Restr(NP) with the Restr(VP).

with the following simplified example of a derivation:

(194) a. ['You walk']($dis-sit_0$) = $\langle$ WALK, s $\rangle$.
RESTRICTIONS: $dis-sit_0 \models \langle$ ADDRESSED-WITH 'You', s $\rangle$.

b. ['walk']($dis-sit_0$) = WALK.
RESTRICTIONS: (none).

'You' ($dis-sit_0$) = s.
RESTRICTIONS: $dis-sit_0 \models \langle$ ADDRESSED-WITH, 'You', s $\rangle$.

8.2 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 uses of wh-phrases, is provided in the former work.

8.2.1 Nominal quantifier phrases

I stick here with a fairly simple Generalised Quantifier analysis of quantificational expressions. Thus, a meaning description for a quantificational expression specifies a variable, a Quantif(icational)-Force, and a Restr(ictive)-Term. I 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:

(195) ['Each man']($dis-sit_0, domain-sit_0, scope-of-use_0$) = y; Quant-Force: EACH, Restr-Term:MAN;
RESTRICTIONS: t: $dis-sit_0 \models \langle$ SCOPING-POINT, 'each man', AT: $scope-of-use_0$ $\rangle$

The generalised closure function will be 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 is scoped as specified by the SCOPING-POINT facts, where the narrowest scoping NP is specified to terminate at A_0:

(196) QUANT-CLOSURE(A_0, σ) = $\exists Skel-Cont(a_1), \ldots \exists Skel-Cont(a_{i-1})$
$\langle QUANT-FORCE(a_i), RESTR-TERM(a_i), \lambda Skel-Cont(a_i) \exists Skel-Cont(a_{i+1}), \ldots, \exists Skel-Cont(a_{i+j_i})$
$\langle QUANT-FORCE(a_n), RESTR-TERM(a_n), \lambda Skel-Cont(a_n) \exists Skel-Cont(a_{n+1}), \ldots, \exists Skel-Cont(a_{n+j_n})\ \sigma \rangle \ldots \rangle$ where $a_1, \ldots, a_{n+j_n}$ is the longest sequence of NP sub-utterances of A_0 such that for any i $\langle$SCOPING-POINT, a_i, AT: a_{i+1} … $\langle$SCOPING-POINT, a_{n+j_n}, AT: A_0 $\rangle$

For example:

(197) ['Every man squints.']($dis-sit_0$) = $\langle$ EVERY, MAN, λx$\langle$ λt$\langle$ SQUINT, squint-er: t $\rangle$, t:x $\rangle$ $\rangle$
RESTRICTIONS: $dis-sit_0 \models \langle$ SCOPING-POINT, 'every man', 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:

(198) a. Every woman likes some person.

b. ⟨ SCOPING-POINT, 'every woman', AT: 'Every woman likes some person' ⟩ ⟨ SCOPING-POINT, 'some person', AT: 'Every woman' ⟩ (OBJ has wide scope)

c. ⟨ SCOPING-POINT, 'every woman', AT: 'some person' ⟩ ⟨ SCOPING-POINT, 'some person' AT: 'Every woman likes some person' ⟩ (SUBJ has wide scope)

d. ⟨ SCOPING-POINT, 'every woman', AT: 'every woman likes some person' ⟩ ⟨ SCOPING-POINT, 'some person', AT: 'likes some person' ⟩ (OBJ has scope at VP)

8.2.2 Independent uses of wh-phrases

I start with a slight amendation of the meaning descriptions for wh-phrases, exemplified here for 'who':

(199) ['Who']$(dis-sit_0, domain-sit_0, absorption-point_0)$ = t;
RESTRICTIONS: $dis-sit_0 \models$ ⟨ Λ-SCOPING-POINT,'who', AT: $absorption-point_0$ ⟩;
$domain-sit_0 \models$ ⟨ PERSON, t ⟩;

The condition $dis-sit_0 \models$ ⟨ Λ-SCOPING-POINT,'who', AT: $absorption-point_0$ ⟩, 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 occuring in quantificational uses of indefinites. Their respective contributions to meaning will be different because of the different closure operators that apply to them.

The role of the domain-situation here is to provide the universe from which answers originate. More precisely, it provides possible instantiators for the unresolved role and a domain for quantifiers over that role. Any use of this phrase requires fixing this parameter, failure to do so results, as usual, in failure to get to the (intended) content.

The choice of which level to be closured 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 closured 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 interrogatory sentence and be leftmost, this ensures that solely one wh-phrase in a given sentence will be specified for QUE.[50]

(200) a. S[fin,+INT][1] → H: (V[fin], TO-BIND | QUE([2])),
C: NP[nom,INHER | QUE([2])])
[INHER | QUE] < X

[50] I owe this particular proposal for capturing the syntactic scopal restriction to Ivan Sag.

b. [S]($dis{-}sit_0, descr{-}sit_0$) = (descr-sit$_0$?Λ-CLOSURE(QUANT-CLOSURE(⟨ Skel-Cont(VP), Skel-Cont(NP) ⟩)))
RESTRICTIONS: combine the Restr-Cont(NP) with the Restr-Cont(VP); $dis - sit_0 \models$ ⟨ Λ-SCOPING-POINT, [2], AT: [1] ⟩

Two points require comment to understand the workings of the rule: the first point concerns Λ-closure. This is a function entirely analogous to QUANT-CLOSURE in its workings. Given a SOA with some free variables σ and a use of an expression A_0, it returns an abstract, the product of λ-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:

(201) Λ-CLOSURE(A_0, σ) = $\lambda Skel - Cont(a_1), \ldots, Skel - Cont(a_n)\sigma$, where $a_1, \ldots, a_n$ is the longest sequence of NP sub-utterances of A_0 such that for any i, ⟨ Λ-SCOPING-POINT, a_i, AT: A_0 ⟩

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. The rule for interpreting dislocated structures can now be stated without any additional explanations, since it is entirely analogous:

(202) a. S[fin,+INT] [3] → (H,S[fin, INHER—SLASH([1]), TO-BIND—SLASH([1]), TO-BIND | QUE([2])]), (F,[1](INHER | QUE([2]))
[INHER-QUE] < X

b. [S]($dis - sit_0, descr - sit_0$) = (descr-sit$_0$?Λ-CLOSURE(Skel-Cont(H)))
RESTRICTIONS: combine the Restr-Cont(H) with the Restr-Cont(F); $dis - sit_0 \models$ ⟨ Λ-SCOPING-POINT, [2], AT: [3] ⟩

To illustrate how this works, 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. The 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 uses.

Consider the sentence:

(203) 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. Schematically:

(204) a. λx⟨ ASK, asker:x, λy,z⟨ LIKES, liker-er: y, likee:z ⟩; ⟩

b. λ x,z⟨ ASK, asker:x, λy⟨ LIKES, liker:y, likee:z ⟩; ⟩

In what follows, for perspicuity, I omit the descriptive conditions on the interrogative phrases. The first reading arises if the embedded interrogative has the following meaning description, whose derivation we saw in a previous section:

(205) [who likes whom]($dis - sit_0, descr - sit_0$) = (descr-sit$_0$?λs,t⟨ LIKE, liker:s, likee: t ⟩);
RESTRICTIONS: $dis - sit_0 \models$ ⟨ Λ-SCOPING-POINT, 'who', AT: 'Who likes whom' ⟩; $dis - sit_0 \models$ ⟨ Λ-SCOPING-POINT, 'whom', AT: 'Who likes whom' ⟩

The crucial factor is the Λ-Scoping-Point specification for 'whom':

(206) $dis - sit_0 \models \langle$ Λ-SCOPING-POINT, 'whom', AT: 'Who likes whom' $\rangle$

This forces the λ-abstraction of t at the embedded level.

The second possible meaning this sentence can have will arise if 'whom' is specified with the following restriction:

(207) $dis - sit_0 \models \langle$ Λ-SCOPING-POINT,
'whom', AT: 'Who asked who likes whom' $\rangle$

The embedded meaning then arises as follows:

(208) a. [who likes whom]$(dis - sit_0, descr - sit_0) = (descr - sit_0?\lambda s\langle$ LIKE, liker:s,
likee: t $\rangle)$
RESTRICTIONS: $dis - sit_0 \models \langle$ Λ-SCOPING-POINT, 'whom', AT: 'Who asked who likes whom' $\rangle$

The embedded sentence rule will then yield:

(209) a. ['asked who likes whom']$(dis - sit_0, ms)$ λx$\langle$ ASK, asker:x,
content-role: $(descr - sit_0?\lambda s\langle$ LIKE, liker:s,
likee: t $\rangle)$, cog-role:ms $\rangle$
RESTRICTIONS: $dis - sit_0 \models \langle$ Λ-SCOPING-POINT, 'whom', AT: 'Who asked who likes whom' $\rangle$

and given that the matrix subject has the following specification for this meaning:

(210) a. [who]$(dis - sit_0, domain - sit_0) =$ v,
RESTRICTIONS: $dis - sit_0 \models \langle$ Λ-SCOPING-POINT, 'who', AT: 'Who asked who likes whom' $\rangle$

The full, resulting meaning will be:

(211) a. ['Who asked who likes whom']$(dis - sit_0, descr - sit_1) =$ (descr-sit$_1$?λv,t$\langle$ ASK, asker:v,
content-role: $(descr - sit_0?\lambda s\langle$ LIKE, liker:s,
likee: t $\rangle)$, cog-role:ms $\rangle)$

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