

Interrogatives: questions, facts and dialogue

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1 Introduction

This paper focuses on the semantics of interrogative sentences and has three main parts.¹ The first critically reviews some basic issues drawing on the recent literature. In the second, I present and motivate the outlines of a theory of questions and a semantics for interrogatives. Both sections are based on work presented in much fuller detail in Ginzburg 1994a. The third section offers a dialogue setting for the theory developed in the second part.

2 Basic issues in the semantics of interrogatives

2.1 Questions and Interrogatives

There is a clear connection between the semantics of interrogatives and the notion of a question. A number of common-noun phrases denote entities of which one can predicate (un)resolvedness, openness and so forth:

- (1) a. The question/issue remains unresolved.
- b. The question/issue is still an open one.

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

- (2) a. The question/issue is who left/whether Bill is happy.
- b. # The question/issue is that Bill is happy.

When we try to explain what underlies inference patterns such as the ones in (3a) and in (3b), we see perhaps more strongly the co-dependence of the two issues— what denotation² to assign to interrogatives and what (semantic) object a question is.

- (3) a. The question is who should be selected for the job. Jill has been investigating this question. Hence, Jill has been investigating who should be selected for the job.
- b. The question was who should be selected for the job. However, since we now know that ... and that ..., it is clear that this question is now resolved.

¹Extensive discussion of the semantics of wh-phrases can be found in Groenendijk and Stokhof 1984, May 1985, Engdahl 1986, Berman 1991, Ginzburg 1992, Chierchia 1993.

²Here 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.

The clichéd statement that *how such issues are to be resolved is determined, to a large extent, by the range of phenomena one’s theory is intended to cover* applies here with special force, since intuitions on what an interrogative should denote are hard to come by. In light of this, a common approach within the work on interrogatives has been to focus on a particular set of phenomena, find a semantic invariant defined by an interrogative use for that set of phenomena, and then identify the interrogative denotation with that invariant. Distinct phenomena have spawned distinct approaches and conflicting opinions on which is *the invariant* that most adequately serves as the denotation. Focus on how elliptical responses get interpreted shows the importance of associating an n-ary relation with an interrogative use, whereas focus on the use of interrogatives in attitude reports inclines one to the importance of associating a particular proposition, the exhaustive answer, with an interrogative use. It is researchers who noted the use of interrogatives to denote apparently *non*-propositional attitudes from whom proposals have originated that the existing ontology needs to be expanded to include a new class of object, a question call it. The most influential proposals to this effect have, in fact, proposed a very specific characterisation of what a question is: namely, that a question is a property of propositions, that property which specifies what it is to be an *exhaustive answer*.

An important point that will emerge in this first section is that all the invariants noted above, as well as a number of ones hitherto unmentioned, are in one way or another, with certain important modifications, necessary for semantic analysis. Hence, in order to get a viable analysis, the denotation(s) one posits needs to be ones from which, in conjunction with the semantic structure provided by other available semantic objects, it is possible to “read off” the requisite invariants.

2.2 Questions and N-ary relations

One of the most obvious ways in which a query use of an interrogative i_0 changes the context is to enable elliptical followups that agree with the interrogative phrase(s) of i_0 :³

- (4) a. Who likes Millie? Jill/A friend of Jill’s.
- b. Why does Jill like Millie? Because they’re cousins.
- c. Are you happy? Yes/Maybe.

A plausible conclusion to draw from this is that each *question* q_0 expressed by an interrogative use is associated with an n-ary relation, say $rel(q_0)$, which is made salient whenever q_0 is. This is what allows a response to a query to be elliptical—the full content of the response is then computed by predicating the elliptical response of $rel(q_0)$:

- (5) a. The question expressed by a use of: ‘Who likes Millie’
is associated with $\lambda x LIKES(x, m)$.

³I restrict myself here to English. In languages with overt case-marking, the elliptical phrase has to concord in case with the relevant interrogative phrase.

Content of response ‘Jill’: $\lambda P P(j)$.

Content of response ‘A friend of Jill’s’: $\lambda P \exists y (friend - of(j, y) \wedge P(j))$.

Full content: $\lambda P P(j)[\lambda x LIKES(x, m)]$.

Full content: $\lambda P \exists y (friend - of(j, y) \wedge P(j))[\lambda x LIKES(x, m)]$

- b. The question expressed by a use of: ‘Does Bill like Mary’

is associated with $LIKES(b, m)$.

Content of response ‘Yes’: $\lambda p TRUE(p)$.

Content of response ‘Maybe’: $\lambda p MAYBE(p)$.

Full content: $\lambda p TRUE(p)[LIKES(b, m)]$.

In fact, stronger conclusions from data such as (4) have been drawn: for instance, one can *identify* q_0 with $rel(q_0)$ (see e.g. Keenan and Hull 1973, Hull 1975, Hausser 1983, Hausser and Zaefferer 1979). In (5), I have strayed from a number of works in this tradition in viewing the *responsive* phrase as the operator, rather than the interrogative:⁴ it suggests that the expected semantic category of the responsives is $\langle rel(q_0), t \rangle$, (i.e. a function that takes elements of type $rel(q)$ to propositions). This has two positive consequences: first and more importantly, quantified answers, as in (4a), are directly accommodated and expected. Second, $rel(q)$ for a y/n interrogative ‘whether p’ is p . This is intuitively appealing since a declarative ‘p’ can be used to make a similar query.

There is an important insight emphasized by this approach, namely that a question and answer pair form a dialogue unit. As we shall see when we come to consider naturally occurring dialogue in section 4, what is required is a more general notion that relates a question to a multiplicity of contributions that pertain to it. In other words, since the discussion of a single question can last over several turns, and elliptical contributions are possible, in principle, arbitrarily far away from the turn in which the question was posed, what will be needed is a notion of context which can express the fact that a particular question is (still) under discussion, and hence its associated relation is (still) salient.

A common argument against identifying questions with n-ary relations dating back to the classical Montagovian era concerns the multiplicity of semantic types that emerge; that is, within a type theory such as that provided by Motague’s IL, any two interrogatives differing in r-ity (e.g. unary/binary/ternary wh-interrogative-sentences) or in the type of argument (e.g. where constituent interrogative is adverbial vs. where constituent interrogative is an argument of a verb.) are distinguished. This contradicts a possible methodological constraint that a given syntactic category should map onto a single semantic type. An empirical problem deriving from this concerns coordination: how to interpret a coordinate structure consisting of conjuncts of distinct semantic type? In light of the subsequent relaxation of type discipline, both problems currently seem less acute. In particular, in a setting where λ -abstracts form a single semantic type, one can offer definitions such as the following for coordination:⁵

⁴Such a strategy, with certain modifications, is adopted in Groenendijk and Stokhof 1984.

⁵This particular definition is taken from Cooper 1993 who proposes that DRS’s in the sense of Kamp 1981 comprise a semantic type consisting of n-ary abstracts.

$$(6) \quad \lambda X_1, \dots, X_n \sigma(X_1, \dots, X_n) \vee / \wedge \lambda Y_1, \dots, Y_m \tau(Y_1, \dots, Y_m) \\ =_{def} \lambda X_1, \dots, X_n, Y_1, \dots, Y_m \sigma(X_1, \dots, X_n) \vee / \wedge \tau(Y_1, \dots, Y_m)$$

Below, I shall propose that $rel(q_0)$ is one of two invariants that serve to individuate a question. In addition to its importance in characterising the context change associated with questions, it turns out that a number of fundamental notions of answerhood are definable on the basis of $rel(q_0)$.

Nonetheless, I do not believe that it is theoretically desirable to *identify* questions with n-ary relations. What is missing is a connection to the world. Let us see why.

2.3 Questions and Propositions

2.3.1 Introduction

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

- (7) 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, it is also satisfied by a class of non-factives). The schema relates V'ing of fact nominals to V'ing of that clauses:

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

In Ginzburg 1994a, analogous schemas are pointed out 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*:

- (9) a. 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.
- b. A certain fact is/has been V'ed (known/discovered/told to me/reported/guessed)
 .
 Which fact? A fact that resolves the question of who left.
 So, it is/has been V'ed (known/discovered/told to me/reported/guessed) who left.

This analogy makes clear the strong connection between facts, questions and propositions: just as truth is a fundamental property of propositions relating them to the facts and the way the *world* actually is, so *resolvedness* is an analogous property of questions.⁶

However, *identifying* a question q_0 with its $rel(q_0)$ does not offer any obvious account of such a connection to the world.

There have been various accounts of questions that have tied them quite closely to propositions. The issue is: how tight is this connection? One approach initially proposed by Åqvist and Hintikka (e.g. Åqvist 1965, Hintikka 1976, 1978) seeks to reduce interrogative meaning to declarative meaning by means of paraphrases of the following type:⁷

- (10) a. John V's who came \leftrightarrow Any person is such that if he came, then John V's that he came.
- b. John V's whether it is raining \leftrightarrow If it is raining, then John V's that it is raining, and if it is not raining, then John V's that it is not raining. (Hintikka 1976)

An alternative approach, due originally to Hamblin 1973 and to Karttunen 1977, while sharing much of the intuition that inspires (10), seeks to establish the connection at a semantic level, thus recognizing an ontological distinctness between questions and propositions.⁸

One of the main reasons that lead to the prominence of the alternative approach, particularly influential within Montague Grammar, is this: Karttunen pointed out the existence of a class of predicates which embed interrogative but not declarative complements:

- (11) a. Jill asked/wondered/investigated who left.
- b. Jill asked/wondered/investigated $\#$ that Bill left.

Moreover, even if one attempts to provide a semantics for some such predicates by means of lexical decomposition, Karttunen's claim is that there is no obvious way to lexically decompose predicates such as those in (12) in a similar way:⁹

- (12) a. Who wins the race depends upon who enters it.
- b. When Mary will arrive will be influenced by who drives the bus.

⁶Lappin 1982 identifies the meaning of a query use of an interrogative with the conditions under which it is answered where the fulfillment (answering) conditions of the query are the interrogative counterpart of the truth conditions of an assertive use of a declarative.

⁷Stenius 1967 proposes an alternative reductionist account in which questions are analyzed into an interrogative operator and a truth-conditional "sentence radical" to which the operator applies.

⁸For additional discussion of Hamblin 1973 and Karttunen 1977, and for an alternative approach to the semantics of interrogatives see Higginbotham (this volume).

⁹However, see Boër 1978 and Hand 1988 for a semantics for 'depend wh' which share important assumptions with Hintikka interrogative semantics.

This argument had a compelling force during the early days of Montague Grammar where adherence to surface compositionality was stressed. For those to whom the argument might appear somewhat esoteric (‘how often does ‘depend on’ appear in a corpus?’), there is an interesting correlate to Karttunen’s argument within dialogue which is worth pointing out: a sufficient condition for a query use of a question q_1 to be felicitously responded to with a question q_2 is that q_1 *depend on* q_2 (cf. Carlson 1983):

(13) a. A: Who murdered John?

B: Who was in town yesterday?

b. Who murdered John depends on who was in town yesterday.

Predicates such as ‘depend’, then, play an important role in structuring dialogue. For more discussion and a generalization of this see section 4.

2.3.2 Hamblin semantics

Hamblin’s view is, apparently, inspired by his earlier work on modelling dialogue (Hamblin 1970): ‘Pragmatically speaking a question sets up a choice situation between a set of propositions, namely those propositions that count as answers to it.’ (Hamblin 1973, p. 254) On this view, each question defines a set of alternative propositions, call it *Answer – Set*(q), each element of which constitutes a valid option for a response. Hamblin chooses to identify a question with its Answer-Set (this is not his terminology.). Hamblin posits the following:

(14) a. Answer-Set(‘Who likes Bill’) = $\lambda p[\exists y(p = LIKES(y, bill))]$ = { LIKES(j,b), LIKES(m,b), LIKES(c,b), ... }

b. Answer-Set(‘Who likes whom’) = $\lambda p[\exists y\exists x(p = LIKES(x, y))]$ = { LIKES(j,b), LIKES(m,b), LIKES(c,b), ... }

c. Answer-Set(‘Does Bill like Mary’) = $\lambda p[(p = LIKES(b, m)) \vee (p = \neg LIKES(b, m))]$ = { LIKES(b,m), \neg LIKES(b,m) }

Actually, Hamblin proposes to ‘type raise’ declarative denotations to (singleton) sets of propositions. One can then offer the following algebraical perspective within a lattice of propositional elements: questions are the “non-singular” entities, the “plural propositions”. Such a view has been developed further in Belnap 1982 and especially in Lahiri 1991:

(15) $Q' =_{def} \{p : \exists p' [p' \in Power - set(Answer - Set(q)) \setminus \emptyset \wedge p = \bigwedge p']\}$ (Lahiri p. 159)

Therefore, the individual members of the Answer-Set(q) can be construed as the potential partial answers. More on this aspect of Hamblin’s theory in section 3.4.2.

Hamblin’s approach is particularly important, historically, in recognizing the need for an independent ontological notion of question. Moreover, construing questions as entities

that, in some sense, determine answerhood options is an important, if not unproblematic insight.

On the critical side of things, it is worth noting that the particular composition Hamblin chooses for his Answer-Sets is open to question. It arises by stipulation rather than via a uniform mapping that covers the *wh*-questions and the *y/n*'s questions. Indeed, if one is to construe Answer-Set(*q*) as characterising the responsehood options associated with a query involving *q*, it is clearly inadequate.

For instance, there is a class of propositions that a competent speaker of English recognizes as “intimately related” to a particular question, call it q_0 , quite independently of their truth or specificity relative to current purposes. This class consists of those propositions characterisable as providing information *about* q_0 .¹⁰

Ranges of aboutness for questions arising out of yes/no-interrogative uses and simple¹¹ uses of unary *wh*-interrogatives are exemplified in (16), (17).¹²

(16) 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.)

(17) 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.)

For convenience, let us notate the class of propositions that are *about* q_0 as Aboutness-Set(q_0). Comparison with the answerhood options offered by Hamblin suggests that, in this respect, Hamblin's view of questions is not adequate empirically.

2.3.3 Karttunen

To see how the Hamblin view relates to Karttunen's account, it is useful to fix the epistemic setting, since it is within such a setting that the analysis is more persuasive. We have as given a set of entities with which we are familiar to a large extent. In other words, the “essential” properties of these entities are known to us, and with each entity we have, say, associated a name that rigidly designates it. At some point t , we get interested in

¹⁰‘concerning’, ‘on’, ‘as-to’, and ‘regarding’ are close synonyms of this sense of ‘about’.

¹¹‘simple’ in the sense that functional/pair-list/echo uses are ignored.

¹²The ranges described here should probably be viewed as base cases, since, for instance, if p constitutes information about q_0 , it would appear that $(p, \text{if } r)$ does too:

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

I owe this point to David Milward.

the makeup of a particular property P . It is quite natural in such a setting to view our wonderment about the question *who P's* in, as I shall dub it, *alternativist* terms: is it a_1 who P's, is it a_1 and a_2 who P, etc. More concretely, the desired *end* result of an inquiry or conversation on the topic of who P's will frequently be a proposition dubbed the exhaustive answer:

- (18) a. $\text{Exh-Answer}(q) = \bigwedge \{p \mid \text{True}(p) \wedge p \in \text{Answer-Set}(q)\}$
 b. $\text{Exh-Ans}(\text{'Who likes Bill'}) = \text{conjunction of all true instantiations of Likes}(x,b).$
 c. $\text{Exh-Ans}(\text{'Whether Mary likes Bill'}) = \text{Likes}(m,b)$ if true, otherwise $\neg \text{Likes}(m,b).$

That is, we will be happy to assent to the inference that if we know or have been told who P's, and a_1 P's, then we know that a_1 P's.

Karttunen chooses the exhaustive answer as the invariant with respect to which questions are to be identified. More specifically, Karttunen identifies a question with a property of propositions, the property of being the exhaustive answer.

- (19) a. $I = \text{'who walks'}$
 b. Karttunen denotation of I at $\langle w \rangle$: $\lambda p[TRUE(p) \wedge \exists y(p = WALKS \langle w \rangle (y))]$

Thus, whereas Hamblin sees a question as indicating to us what the options for responding are, what Karttunen is offering is, in terms of the schemas in (9a, 9b), a very specific analysis of a question's resolvedness conditions.

Given this, one natural question to ask about Karttunen's approach is whether in an epistemic setting different from the one sketched above, this analysis of the resolvedness conditions holds up. Belnap 1982 is dubious about the analysis on the grounds that a question might have more than one resolving answer, for instance:

- (20) What is an example of a prime number.

In section 3.4 I take up this issue in some detail, concluding ultimately that resolvedness conditions are best characterised in agent-relative rather than semantic terms.

An additional issue is this: Karttunen provides an argument for assuming that our ontology needs to contain *questions* as the content of *some* interrogative uses. However, for methodological reasons (type hygiene), he actually assumes that *all* interrogative uses denote questions. Thus, in order to relate the interrogative and declarative complements of resolute predicates Karttunen proposes, for instance, the following meaning postulate for 'know':

- (21) $\text{know}(x,Q) \leftrightarrow \forall p(\text{if } Q(p), \text{ then } \text{know}(x,p))$ and if $\neg \exists p Q(p)$, then $\text{know}(x, \wedge \neg \exists q Q(q))$ (Karttunen 1977, footnote 11, page 18)

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

Table 1: Resolutive and Question predicates

We can convert our intuition that not all interrogative complements denote questions into data: Resolutive and factive predicates do not embed question-denoting nominals in a purely referential way, though question predicates do.¹³

This is an intrinsic problem for a Karttunenian strategy for interrogative semantics whereby all interrogative embedding predicates are treated uniformly as having *questions* in their extension.

- Substitutivity:

- (22) a. Jill asked/investigated an interesting question. The question was who left yesterday. Hence: Jill asked/reflected over who left yesterday.
b. Jill discovered/revealed an interesting question. The question was who left yesterday. It does *not follow* that: Jill discovered/revealed who left yesterday.

- Existential generalisation:

- (23) a. Jill asked/investigated 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. Jill discovered/knows who left yesterday. It does not follow that: there is a question/issue that Jill discovered/knows.

2.3.4 Groenendijk and Stokhof

Groenendijk and Stokhof's approach is one which recognizes the existence of (at least) two kinds of interrogative complements and the need to offer a systematic connection between the two. Groenendijk and Stokhof follow Karttunen in providing questions as semantic entities distinct from propositions. Indeed in explicating what a question is, their approach is close in spirit although quite distinct in execution. In order to gain a systematic

¹³The term 'pure referentiality' and tests associated with it are taken from Quine 1953, especially p. 139-145. See Ginzburg 1994a, section 7.2 for assumptions on of how such tests are to be construed in attempts at establishing the ontological correctness of a denotation type.

correspondence between questions and propositions Groenendijk and Stokhof appeal to the Montague Grammar (MG) distinction between the *intension* and the *extension* of an expression.

The extension of an interrogative is identified with the exhaustive answer. Hence, the intension is that function that maps a world to the proposition that constitutes the exhaustive answer in that world. Within a possible worlds semantics the picture that emerges is this: the extension at w is a set of worlds, those worlds that determine the extension of the queried property equivalently. The intension of the interrogative is the partition of the set of possible worlds induced by this equivalence relation:

(24) a. whether Millie likes Bill.

Extension at i : $\lambda j(\text{like}(m, b)(j) = \text{like}(m, b)(i))$ (All worlds j that agree with respect to the truth value of ‘like(m,b)’ at i .)

Intension: $\lambda i \lambda j(\text{like}(m, b)(j) = \text{like}(m, b)(i))$

b. who likes Bill. Assumed paraphrasable as: ‘for all x whether x likes b ’.

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

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

Two comments on these definitions. First, Groenendijk and Stokhof offer a single schema covering *y/n* and *wh*-interrogatives, a constituent of which is indeed $rel(q_0)$. Second, the notion of exhaustiveness that Groenendijk and Stokhof assume is *stronger* than that implemented by Karttunen. Whereas Karttunen sees the end result of an inquiry into a question *who P*’s as the acquisition of knowledge of the *positive* extension of P , Groenendijk and Stokhof build in the assumption that it involves knowledge of the negative extension as well. In other words, that ‘Jill knows who left’ is assumed to entail that ‘Jill knows *whether* a_1 left’, for all a_1 .

Groenendijk and Stokhof then distinguish between two types of interrogative embedding relations. On the one hand, there are relations that take questions as their arguments. Technically, these relations will take the intension of an interrogative as their argument. Relations of this kind include ‘wonder’ and ‘ask’. 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 the extension of an interrogative which, like the *intension* of a declarative, is taken to be a proposition. I will argue in section 3.2 that the ontological distinction between resolute/factive predicates and question predicates is of a different nature.

2.4 Recap: what is a question

I have surveyed a number of different approaches to the semantics of interrogatives and to the related issue of what is a question. As I mentioned in the introduction, a general approach has been to find a semantic invariant needed to analyze an interrogative use for a particular class of phenomena and then identify the interrogative denotation with that invariant. I have mentioned the following as fundamental invariants associated with a question q_0 :

- $\text{Rel}(q_0)$: each question is associated with an n -ary relation. This is needed for the semantics of elliptical responses.
- $\text{Aboutness-Set}(q_0)$: each question is associated with a class of propositions, those characterisable as providing information $\text{About}(q_0)$ —those a competent speaker of English recognizes as “intimately related” to any given question, call it q_0 , quite independently of their truth or specificity relative to current purposes. The accounts discussed above do not offer a fully adequate account of this invariant.
- $\text{Exh-answer}(q_0)$: each question is associated with the proposition which, for a particular epistemic setting described above, provides an account of when the question is resolved. Resolvedness conditions are required for the semantics of resolute predicates.

The issue to consider is, then, does one or another of these invariants deserve priority as defining *the essence* of what a question is for semantic purposes? I have already suggested that identifying q_0 with $\text{Rel}(q_0)$ is undesirable, primarily because it does not offer any obvious account of how questions are related to facts and the way the *world* actually is, as manifested by a relation of resolvedness.

What about identifying q_0 with $\text{Exh-answer}(q_0)$, or rather, with an intensional construct that determines $\text{Exh-answer}(q_0)$? In section 3.4, I will suggest that this turns out to be undesirable once one takes a wider perspective, both in terms of the different circumstances in which questions are used and by considering questions other than ‘who-questions’. Strengthening Belnap’s complaints about the *non-uniqueness* of resolving information, I will demonstrate that whether a particular item of information *resolves* a given question is in part determined by agent-relative rather than by semantic factors. Hence, it is undesirable to reduce the *semantic* identity criteria of a question to its resolvedness conditions.

In the absence of an essential property that *defines* questionhood, the approach I shall ultimately propose will be one that remains agnostic as to what a question is, while at the same time explaining how to characterize its basic properties. In such an approach a question, just like other propositional entities, will be treated on a par with other individuals.

3 Towards a theory of questions

3.1 Introduction

This section is structured as follows: first I motivate the adoption of a somewhat different ontological setting for interrogative and declarative semantics. I then consider the issue of whether a question should be reductively characterised in terms of its “resolvedness conditions” and reach a negative conclusion. I then show how questions and propositions emerge as “derived elements” from a basic situation theoretic ontology consisting of situations, facts, and n-ary lambda abstracts. Finally, this ontology is used to provide a semantics for interrogatives.

3.2 Ontological Considerations

The initial issue I will pursue is an ontological one. I will suggest that a bifurcation of the kind identified by Groenendijk and Stokhof for interrogatives also arises with declaratives. This evidence points to the need for a modification of some basic ontological assumptions about propositional attitude predicates, along lines originally proposed by Vendler 1972.¹⁴ The overall diagnosis will be the existence of (at the very least) a 3-way split among interrogative and declarative embedding predicates. Certain predicates (*ask*, *wonder*) take questions as their arguments, certain predicates (*believe*, *claim*) take propositions as their arguments, whereas resolutive/factive predicates (*know*, *discover*) take neither questions nor propositions as their arguments, but rather a family of entities which include the class of *facts*. In particular, the evidence suggests that precisely those declarative embedding predicates whose arguments are *required* to be propositions on just about anyone’s criteria for what constitutes a proposition, namely being a truth or falsity bearer, are *inapplicable* to interrogative content. This is a fact that goes unexplained on any approach, such as Groenendijk and Stokhof’s, in which interrogatives possess a propositional denotation.

Resolutives	Factives	QI	TF
report	reveal	ask	claim
tell	know	wonder	believe
announce	forget	investigate	assume
guess	determine	discuss	assert
predict	discover	ponder	allege
state	remember	about	deny
	show		prove

Table 2: Resolutive, Factive, Question, TF predicates

The data we saw in (22,23), which shows that questions are not genuine arguments of resolutive/factives, is perhaps not particularly surprising for any semantic approach, such

¹⁴Philosophical motivation for distinguishing facts and true propositions is offered by Austin 1950, 1954.

as Hintikka’s or Groenendijk and Stokhof’s, which analyze interrogatives embedded by resolutive/factives as denoting propositions. However, unexpected for the latter type of approach is that a set of data analogous to the one above can be produced with respect to proposition-denoting nominals, ones that denote entities of which one can predicate truth or falsity. In this case, factive predicates do not embed proposition-denoting nominals purely referentially, though TF predicates do.

- Substitutivity:

- (25) a. The Fed’s forecast was that gold reserves will be depleted by the year 2000.
 b. Bill believes/accepts the Fed’s forecast. Hence, Bill believes/accepts that gold reserves will be depleted by the year 2000.
 c. 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.

- Existential generalisation:

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

The main contrast revealed here is highlighted in (27):

- (27) a. Jill believed a certain hypothesis. Hence, Jill believed that that hypothesis is true.
 b. Jill discovered a certain hypothesis. It does not follow that Jill discovered that that hypothesis is true.

In fact, this data constitutes the tip of an empirical iceberg that motivates us to discard the label *propositional attitudes* as a catch-all term for the ‘that-clause’ embedders, given the presupposition the 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 for TF preds and, moreover, for assuming both that:

- **Non-prop-int**: interrogatives *do not* have a denotation that propositional.
and, that
- **Non-prop-decl**: declaratives *do* have a denotation that is non-propositional.

The contrast exemplified above in (25-27) can be formulated more generally in terms of the following inference schema:¹⁵

¹⁵This schema is inspired by observations of Vendler 1972, chapter 5.

- (28) $\frac{[V \text{ the } N']}{[V \text{ that the } N' \text{ is true}]}$

T-Pred

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:¹⁶

- (29) a. # Basil supposes/ assumes which pitcher will do what tomorrow.
 b. # Bill claimed/argued who came yesterday.

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

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

This is one indication that a pragmatic explanation of such facts,¹⁷ for instance based on a principle such as *do not fill the cognitive argument of a TF predicate with material already present in the common ground*, cannot be made to work.

Although the data considered sofar might suggest that factives affect their NP arguments in some mysterious way, data such as the following indicates that when the common-noun phrase denotes entities which refer to or describe facts, events or other states of affairs that obtain, pure referentiality *is* evinced:

- Substitutivity:

- (31) 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.

¹⁶These facts are , apparently stable across a wide range of languages, including English, Hebrew, Japanese, Greek, and Turkish.

¹⁷Boër 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).

- 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)
- (32) 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.

3.3 Interim Conclusion

The data presented in the previous section leads us in the following ontological direction: we need an ontology in which questions, propositions, and facts are distinguished in order to capture the difference between the entities distinct classes of predicates embed *purely referentially* and those to which they are *inapplicable*. Clearly, it will not be satisfactory to posit such an ontology in a wholesale, unstructured fashion. Rather what we desire is to establish how these distinct entities relate to each other and to provide (some of) the basic structure for a semantic universe. One strategy for constructing such a universe will be provided in section 3.5, after I discuss the issue of questions and resolvedness conditions.

Given such an ontology, we will be able to move more directly to the semantic front. What we have seen is that interrogatives are required to denote both questions and facts, and equally that declaratives are required to denote both propositions and facts. The explanation common to both cases which I will adopt, is that such expressions can be *coerced* to denote facts.

3.4 Questions and resolvedness conditions

Recall that in section 2.3 I described an epistemic setting which is particularly well suited for the view of questions developed by Karttunen, and Groenendijk and Stokhof. This is a setting where the entities are ones with which we are to a large extent familiar. In such a case it is at least plausible to model our wonderment about a question *who P's*, for some locally salient property *P*, in alternative lines: is it a_1 who *P's*, is it a_1 and a_2 who *P*, etc. Equally, that question's resolvedness conditions are captured fairly well by the exhaustive answer.

However, the epistemic setting described above is far from prototypical. A somewhat extreme case is when the domain of interest is completely unfamiliar. Consider, for example, the following sentence

- (33) What is the word for 'relaxation' in Chukotian?

uttered by someone who doesn't know what language family Chukotian belongs to, let alone possible word forms in the language. Clearly, I can ask or understand this question with little or no reference to or acquaintance with *any* singular proposition which instantiates an answer. For such a context, our wonderment about that question does not seem to be plausibly modelled in alternativist terms. In other words, any even *prima facie* psychologically conceivable notion of the update of an epistemic state will not involve the constituents of the Answer-Set.¹⁸

To see how a change in epistemic setting can actually affect truth conditions, consider the following case: a scientist and an EC politician visit an institute located in a country on the far periphery of observable academic activity. Both people are taken to visit a local research institute where the scientist gives a number of lectures. After the last lecture, each asks (34a). It is clear that neither of them will be satisfied with (34b), to which they would be entitled to react with (34c):

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

Note that in this case (34b) is, on anyone's account, an *exhaustive* answer since, if true, it fixes the extension of the predicate 'has been attending these talks'.¹⁹ Nonetheless, neither queriers' wonderment about the question is at all satisfied by the exhaustive answer. But notice that the epistemic setting here is a crucial parameter. If a local researcher, familiar with the lecture attendees, but who had not herself attended the lectures, happened to hear the dialogue in (34), she would, typically, react by saying (34d).

What the visitors would really have welcomed would be responses of the type provided in (35a,b), which could then be reported as (35c):

- (35) 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 had been attending the talks and she told me.

¹⁸Note that these considerations apply equally to Hamblin's approach.

¹⁹Indeed, to remove a possible objection about the role of proper names in this example, one could change the example to one where the director responds deictically by pointing at the crowd: 'this person and that person and that one and that one ...'.

Is the contrasting behaviour between the two foreigners and the local observer one that can be addressed, say, by positing a kind/individual ambiguity associated with ‘who’? Apparently not, as a careful examination of (35) shows. Notice that permuting the responses results in inappropriateness. Supplied with the information in (35b), the EC politician would react in terms similar to (34c). Equally, supplying the scientist with the information in (35a) would in all likelihood not satisfy him enough to assert (35c). (For that matter, neither responses would, in all likelihood, be satisfactory for the local observer.)

These examples emphasize that a number of agent-relative factors come in to play in the *truth conditions* of interrogatives embedded by resolute predicates such as ‘tell’, ‘know’, or ‘discover’, in other words in fixing what information counts as information that resolves a given question. Rather than one, exhaustive answer, there exist a multiplicity of non-mutually entailing items of information that *potentially* resolve a given question. It is only within a particular kind of context that extension-fixing exhaustive answers are particularly favoured.

3.4.1 Resolving when and where

In the previous section I argued that the simple picture of what a question is provided by alternativist views of questions is hard to maintain for who-questions. Here, rather briefly, I would like to indicate that when we extend our attention to other types of question, the situation is, if anything, worse for the alternativist.

The examples in (36) illustrate how information ranging from relatively coarse quantificational statements (36b,c) to the ultra-precise (36d,e) can constitute resolving information disquotable as (36f):

- (36) a. A: When is the train leaving
- b. [B is a guard at the station.] B: Very soon. Run before you miss it.
- c. B: Within the next hour: you better stay in the station.
- d. B: At 13:10.
- e. [A is about to measure the speed of light:] B: according to our caesium clock at 13:10.88254.
- f. B indicated to A when the train is leaving.

Examples (37) and (38) illustrate, respectively, how a particular proposition serves as resolving information in the one context, but no longer does so in another context:

- (37) 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.

(38) a. [Context: (Based on a scene from Jim Jarmusch’s ‘Night on Earth’) Jill about to step out of taxi in Helsinki.]

Driver: Do you know where you are?

Jill: Helsinki.

b. Driver: Oh dear. Jill doesn’t (really) know where she is.

What is the difference between the two contexts? The difference seems to lie in the different causal roles associated with the information Jill possesses. In the former case the information has no role beyond confirming for Jill that she has arrived at the right destination; in the latter case the information cannot be used by Jill to locate the destination she needs. Concretely, assuming Jill’s inferential capabilities remain constant across the two contexts, the difference lies in the lower bound, henceforth the *goal*, which the potentially resolving information must be able to entail.

3.4.2 Partial Resolutives

The overly restricted view of resolvedness I am considering also manifests itself in connection with the issue of what constitutes partial resolvedness. Within an alternative epistemic setting, it is natural to view partial resolvedness concerning *who* P ’s as consisting of information about one or more individuals a_1, \dots, a_n that indicates that they P . However, I suggest such a notion is *not* an adequate, weaker substitute with which to explicate questions.

Berman 1990, 1991 suggests that such partial exhaustive readings arise systematically in interrogatives embedded by resolutives modified by adverbs of quantification. Berman claims that in addition to a reading in which the adverb can be interpreted as quantifying over cases/events/situations, (39a) displays an additional reading, (the *quantificational variability* (*qv*) reading), paraphrasable as (39b):²⁰

(39) a. Jill to some extent/mostly/usually knows which students cheat on the exam.

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

Berman offers an account for such readings by combining a Hintikka-based approach to interrogatives with a DRT approach to adverbs.

Lahiri 1991 argues that *qv* readings arise only with adverbs of extent and proposes an account of such readings as involving quantification over the *atomic* elements of a Hamblin semantics Answer-Set:

²⁰For discussion of this and other aspects of the quantificational variability effect (QVE), see Berman 1990, 1991, Lahiri 1991, Groenendijk and Stokhof 1993, and Ginzburg 1994a, 1995.

- (40) a. John mostly/partly knows who did well on yesterdays's exam.
- b. Most/Some atomic factual answers to 'who did well on the exam' are atomic factual answers such that John knows them.

Let us once more change the epistemic setting to one that includes unfamiliar individuals. The inference from (41a) to (41b) is licensed even on *de dicto* readings of (41a), in which case the inference to (41c) is unjustified:

- (41) a. Celia knows that some rather unruly linguists showed up (though she doesn't know who).
- b. Celia knows to some extent who showed up last night.
- c. For some person x that showed up last night, Celia knows that x showed up last night.

Similarly, unexpected on the Hamblin view where no partial information about y/n interrogatives is accommodated, is (42a) licensing a qv reading as in (42b) or (42c):

- (42) a. Jill: Is Millie coming tomorrow? Bill: It's possible, (given that she's booked her flight.)
- b. This information indicates to some extent whether Millie will be coming tomorrow.
- c. Bill gave Jill some idea of whether Millie would be coming tomorrow.

In fact, given the strong connection suggested in the schemas in (7), (8) 3.2 between resolute interrogatives and factive declaratives, we are not surprised to find that similar readings arise with declaratives:

- (43) 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.)

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.)

3.4.3 Resolvedness: interim conclusions

The data we have seen in the previous three subsections can be summarised as follows: the notion of *resolvedness* is agent-relative.^{21,22} A given question defines a class of informational items which can each *potentially* be resolving. Whether a given member of this class, p , is actually resolving *for a given agent* depends on two additional factors: a goal g_0 , which determines what p needs to entail, and a knowledge state, ms_0 , which determines the resources relative to which p has g_0 as a consequence.

An empirical characterisation of the class of potentially resolving information is not entirely straightforward because of the de-contextualisation involved. I assume the following:²³

- (44) a. An informational item τ *potentially resolves* q if either:
- b. τ POSITIVELY-RESOLVES q (for 'whether p ': any information that entails p ; for a wh-question: any information that entails that the extension of the queried predicate is non-empty.)
 - c. τ NEGATIVELY-RESOLVES q (for 'whether p ': any information that entails $\neg p$; for a wh-question: any information that entails that the extension of the queried predicate is empty ('who came? No one came'.))

Why resolvedness has the parameters that it does becomes more obvious when considered in terms of dialogue. The explication it will receive in section 4 is as an agent-relative view of when the question has been discussed enough for current purposes to be considered "closed".

3.5 Characterising Questions and Propositions

3.5.1 Basic Strategy

How to characterize questions then? The strategy I adopt here in common with past work in situation theory (e.g. Barwise 1989, Barwise and Cooper 1991, Barwise and Etchemendy

²¹Hintikka 1976, 1983, Boër 1978, and Boër and Lycan 1985 represent approaches, which although they do not countenance an independent notion of question, can be construed as providing notions of resolvedness which are parametrized. Boër and Lycan's 1985 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.

²²Groenendijk and Stokhof do show how to relativize their notion of answerhood to individual epistemic states. What this allows is for a refinement of the partition of the set of possible worlds defined by an interrogative intension.

(i) Assume I/Q is a partition of the set of possible worlds I determined by the question Q . An information set J is a non-empty subset of I . Then, the set of answers compatible with J is: $\{X \in Q | X \cap J \neq \emptyset\}$ (See Groenendijk and Stokhof 1984, p. 222.)

Nonetheless, Groenendijk and Stokhof view such a relativisation as an explanatory tool for the pragmatics of query/response interaction and do not try to build it into the semantics of embedded interrogatives. Moreover, such a relativisation does not deal with fluctuations of *the goal* associated with an (embedded) question.

²³Based on data in Ginzburg 1994a. See also Belnap 1982 p.196 for apparently similar intuitions.

1990, Westerståhl 1990, Fernando 1991, Aczel and Lunnon 1992) and in property theory (e.g. Bealer 1982, 1989, Chierchia and Turner 1988, Chierchia 1994), is to characterize semantic objects such as properties, propositions, and in this case questions, in a way that treats their identity conditions very much on a par with “ordinary” individuals. Such entities are taken as basic but arrive on the scene with certain structural constraints that relates them to the other entities.²⁴

On this strategy, then, we will find certain parameters with which to individuate questions from each other which can be used in conjunction with the semantic structure provided by other available semantic objects to define a number of the invariants discussed above as requisite invariants, some of which will be parametrized by agent specific parameters. This is quite analogous to associating certain individuating parameters with a human entity, say, her finger-prints, height, weight, profession and date of birth, and using these in conjunction with certain structural social facts to characterize her current properties. There is no temptation to identify the human with her \langle finger-prints, height, weight, profession, date of birth \rangle , though the State occasionally chooses to do so.

3.5.2 Basic Ontology

The basic ontology we start out with consists of a non-empty collection of: objects Sit_0 called situations, objects SOA_0 called SOA’s,²⁵ and a set of n-ary SOA-abstracts.²⁶

Here situations are partial, actual entities, with uses that include: explicating such objects as states or events, denotations of naked infinitive clauses (see e.g. Barwise and Perry 1983), and explicating domain restriction in quantification (Gawron and Peters 1990, Ginzburg 1992, Cooper 1993).

SOA’s here perform a function of describing possible ways the actual situations might be; hence play a similar role to possible worlds in possible worlds semantics, with two obvious differences. SOA’s are structured and they are either “atomic” (the *basic* ones), or built up from the basic ones by algebraic operations.

A *basic* SOA is an “atomic possibility” denoted $\langle R, f; i \rangle$, where R is a relation, f is a mapping assigning entities to the argument roles of the R , and i is a *polarity*, i.e. $i \in \{+, -\}$. Basic SOA’s come in pairs corresponding to whether the objects assigned to the argument roles stand in the relation R or do not. These are denoted, respectively, as follows:

- (45) a. $\sigma = \langle R, r_1 : a_1, r_2 : a_2, \dots, r_n : a_n; + \rangle$
b. $\bar{\sigma} = \langle R, r_1 : a_1, r_2 : a_2, \dots, r_n : a_n; - \rangle$

²⁴As per Chierchia 1994: ‘it doesn’t matter what propositions are to the extent that they have enough logical structure to support a comprehensive semantic program and plausible view of mental attitudes.’ (Chierchia 1994, p. 147.)

²⁵Also referred to as *infons* in the literature.

²⁶I will proceed informally here. For a careful development of such a universe *sans* questions see Barwise and Etchemendy 1990, Barwise and Cooper 1991, Cooper and Poesio 1994.

In the case that a *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

$$(46) \quad s_0 \models \sigma_0$$

The structure that has typically been proposed for this ontology includes at least the following:

- The SOA's form a Heyting algebra under a partial order ' \rightarrow ' ('informational subsumption'). This means that we get a structure that is closed under arbitrary meets (\wedge) and joins (\vee).
- The situations and SOA's together form a SOA-algebra:
 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 SOA's, then $s \models \wedge \Sigma$ iff $s \models \sigma$ for each $\sigma \in \Sigma$.
 4. If Σ is any finite set of SOA's, then $s \models \vee \Sigma$ iff $s \models \sigma$ for some $\sigma \in \Sigma$.
- An operation of application is defined which satisfies an analogue of β -reduction:

$$(47) \quad \begin{aligned} \text{a. } & \lambda x \langle \mathbf{LIKE}, \mathbf{liker:jill}, \mathbf{likee:x}; + \rangle [x \mapsto \mathbf{mike}] = \\ & \langle \mathbf{LIKE}, \mathbf{liker:jill}, \mathbf{likee:mike}; + \rangle \\ \text{b. } & \lambda x, y \langle \mathbf{HOT}, \mathbf{location:x}, \mathbf{time:y}; + \rangle [x \mapsto \mathbf{HCRC}, y \mapsto \mathbf{3am}] = \\ & \langle \mathbf{HOT}, \mathbf{location:HCRC}, \mathbf{time:3am}; + \rangle \end{aligned}$$

3.5.3 Propositions

Given these “basic” entities of the ontology, we can now introduce propositions and questions. In situation theory, a *proposition* is constructed as a relational entity $p = (s!\tau)$ in terms of a situation s and a SOA τ . In other words, we assume as a basic identity criterion that in order for two propositions p_1, p_2 to be identical, their “defining components” have to be identical: $p_1 =_{def} (s_1!\tau_1) = p_2 =_{def} (s_2!\tau_2)$ iff $s_1 = s_2$ and $\tau_1 = \tau_2$.

The sense in which a proposition is constructed from a situation and a SOA is that the basic properties of the proposition are fixed by the situation/SOA pair that individuate it.

$$(48) \quad p = (s!\tau) \text{ is TRUE iff } \tau \text{ is a } \textit{fact} \text{ of } s: \text{ denoted as: } s \models \tau$$

Thus, the proposition $(s!\langle \mathbf{WALK}, j; + \rangle)$ is TRUE iff $s \models \langle \mathbf{WALK}, j; + \rangle$. That is, intuitively, if j 's walking is a fact of s .

For many semantic applications, what is needed is a more relativised notion. Factivity, for instance, concerns itself not with absolute truth, but with information that has already

been established for an agent or set of agents. Hence, we have the following notion of *provability* relativised to an agent's mental situation ms . This holds between a SOA σ and a proposition $p = (s!\tau)$ (' σ proves p ') iff σ is a fact from which the truth of p (or equivalently: the facticity of τ) can be deduced relative to the *notion of consequence* provided by ms .

$$(49) \quad \text{PROVE}(\tau, (s!\sigma), ms) \text{ iff}$$

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

$$\text{b. } s \models \tau$$

Here \Rightarrow_{ms} is taken to be a sound notion of consequence available to the mental state ms of an agent a .²⁷

3.5.4 Questions

A question will be an entity $(s?\mu)$, constructed from a situation s and an n -ary abstract $\mu = \lambda X_1, \dots, X_n \sigma(X_1, \dots, X_n) (n \geq 0)$. This latter is, of course, $\text{Rel}(q_0)$ discussed previously in section 2.2, whereas s is the parameter that provides the connection to the world. For instance, the rules I will posit in 3.6 will associate:

$$(50) \text{ a. a use of 'Did Bill leave' with the question } (s?\langle LEFT, b; + \rangle),$$

$$\text{b. a use of 'who left' with the question } (s?\lambda x \langle LEFT, x \rangle)$$

I have noted before that relations definable *semantically* by a question should include the notions of *aboutness*, the exhaustive answer, and the facts that *potentially* resolve the question. Indeed, I say that $q = (s?\mu)$ is constructed from s and μ because:

1. μ constitutes an “underspecified” informational item from which the class of informational items, SOA's, that are *about* q can be characterized (recall that intuitions concerning *aboutness* are independent of truth or specificity; they pertain solely to “subject matter”)
2. Those SOA's which are facts of s and informationally subsume a level determined by μ constitute the class of SOA's that *potentially* resolve q .

(For formal definitions for aboutness, potential-resolvedness and an analogue of the exhaustive answer see Ginzburg 1994a.)

I have emphasised above that the notion of *resolvedness* relevant for natural language semantics is in part agent-relative. Where the agent-relativity comes in is in determining the degree of the specificity of the information ('the goal') and the informational means relative to which this specificity must be attained. Hence, we have the following definition which is stated relative to an agent's mental situation that supplies a *goal* g and a *notion of consequence*:

²⁷See e.g. Barwise 1986 for one such situation theoretic notion of \Rightarrow . For more recent developments see Barwise 1993. Of course, in the current paper nothing hinges on the particular notion of \Rightarrow chosen.

(51) A fact τ RESOLVES ($s?\mu$) relative to a mental situation ms iff

1. Semantic condition: τ is a fact of s that potentially resolves μ
2. Agent relativisation: $\tau \Rightarrow_{ms} \text{Goal-content}(ms)$ (Intuitively: τ entails the goal represented in the mental situation ms relative to the inferential capabilities encoded in ms .)

3.6 Meanings for interrogatives

Given the emphases of this current paper, I will provide a minimal discussion of wh-phrase meaning, limiting myself to a sketch of how meanings for a number of rather simple interrogative sentences can be compositionally constructed. More specifically, I limit myself here to a discussion of individual uses of wh-phrases, though some discussion of echo uses will be provided in section 4.4.

3.6.1 Meaning in Situation Semantics

In situation semantics an *utterance* is reified as a situation, one that supports the various contextual facts needed to obtain a content from a meaning. A meaning for an expression will be an n-ary abstract in which the contextual parameters are abstracted away subject to certain *restrictions*, facts that must hold in any utterance (situation) of that expression.²⁸ For example: a simplified, tenseless meaning for an assertoric use of (52a) is given in (52b):

(52) a. Bill likes me

- b. $\lambda b, a, s \langle \text{ASSERT}, a, (s! \langle \text{LIKE}, b, a; + \rangle) \rangle$
 RESTRICTIONS: $u \models \langle \text{NAMED}, \text{'Bill'}, b; + \rangle$.
 $u \models \langle \text{SPEAKER}, a; + \rangle$ $u \models \langle \text{DESCRIBING}, a, s; + \rangle$

For its full effect to go through, the utterance situation needs to provide values for a speaker a , the situation described s , and a referent b for the NP ‘Bill’. We shall see in section 4.4 how, given this view of meanings and utterances, we can attempt to characterize what possible clarification-questions an utterance of this sentence can give rise to.

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

- (53) a. $[\text{'a'}](x_1, \dots, x_n) = B$.
 RESTRICTIONS: $C(x_1, \dots, x_n, \dots, y_1, \dots, y_m, B)$

Here x_1, \dots, x_n are contextual parameters introduced by this grammar rule, usually including the utterance notated as *utt-sit*. y_1, \dots, y_m 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:

²⁸For an introduction to a current version of situation semantics see Gawron and Peters 1990, Cooper and Poesio 1994

- (54) a. $S \rightarrow NP, VP$
 b. $[S](utt - sit) = \langle \text{Cont}(VP), \text{Cont}(NP) \rangle$;
 RESTRICTIONS: combine the RESTRICTIONS(NP) with the RESTRICTIONS(VP).

with the following simplified example of a derivation:

- (55) a. $['\text{You walk}'](utt - sit) = \langle \text{WALK}, s \rangle$.
 RESTRICTIONS: $utt - sit \models \langle \text{ADDRESSED-WITH 'You', } s \rangle$.
 b. $['\text{walk}'](utt - sit) = \text{WALK}$.
 RESTRICTIONS: (none).

'You' $(utt - sit) = s$.
 RESTRICTIONS: $utt - sit \models \langle \text{ADDRESSED-WITH, 'You', } s \rangle$.

Following up on this, we can provide rules for that/whether clauses using HPSG-like syntax. 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:

- (56) a. $S[\text{fin}, +\text{DECL}, +\text{marked}] \rightarrow \text{Marker: that, H: } S[\text{fin}, +\text{DECL}, -\text{marked}]$
 b. $[S[\text{fin}, \text{that}]](utt - sit, descr - sit_0) = (descr - sit_0 ! \text{Cont}(H))$
 RESTRICTIONS: Identical with RESTRICTIONS(H)

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

- (57) a. $S[\text{fin}, +\text{INT}, +\text{marked}] \rightarrow \text{marker: whether, H: } S[\text{fin}, +\text{DECL}, -\text{marked}]$
 b. $[S[\text{fin}, +\text{INT}, +\text{marked}]](utt - sit, descr - sit_0) = (descr - sit_0 ? \text{Cont}(H))$
 RESTRICTIONS: Identical with RESTRICTIONS(H)

3.6.2 Constructing Question meanings

Let us now bring wh-phrases into the picture. The simplified 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 *closed* in with wider scope than nominal quantifiers.²⁹ This is described by the following modification to (54):

²⁹Motivation 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 a 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 and a fragment that includes functional and echo uses. A restricted and somewhat modified version which also includes a semantics for attitude reports is presented in Ginzburg 1994a.

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

b. $[S](\text{utt} - \text{sit}_0, \text{descr} - \text{sit}_0) = (\text{descr} - \text{sit}_0 ? \Lambda\text{-CLOSURE}(\langle \text{Cont}(H), \text{Cont}(C) \rangle))$
 RESTRICTIONS: combine the RESTRICTIONS(C) with the RESTRICTIONS(H)

Here the question-situation is provided by context. $\Lambda\text{-CLOSURE}$ is an operator that abstracts over the variables introduced by each wh-phrase that gets closed at that sentential level to form an abstract. We appeal here to the existence of a notion of simultaneous abstraction (as in e.g. Aczel and Lunnon 1992):

(59) $\Lambda\text{-CLOSURE}(\langle Q, \dots r_1 : x_1, \dots, r_n : x_n \rangle) =_{\text{def}} \lambda x_1, \dots, x_n \langle Q, \dots r_1 : x_1, \dots, r_n : x_n \rangle$

Given the lexical entries for ‘who’ and ‘what’ in (60a,b) and the rule in (58), this will yield the following derivation for ‘who likes what’:

(60) a. $[\text{‘who’}](\text{utt} - \text{sit}_0) = t$;
 RESTRICTIONS: $\text{dis} - \text{sit}_0 \models \langle \text{PERSON}, t \rangle$;
 b. $[\text{‘what’}](\text{utt} - \text{sit}_0) = v$;
 RESTRICTIONS: $\text{dis} - \text{sit}_0 \models \langle \text{INANIMATE}, v \rangle$
 c. $[\text{‘likes what’}](\text{utt} - \text{sit}_0) = \lambda x \langle \text{LIKE}, \text{liker}:x, \text{likee}:v \rangle$
 RESTRICTIONS: $\text{dis} - \text{sit}_0 \models \langle \text{INANIMATE}, v \rangle$
 d. $[\text{‘who likes what’}](\text{utt} - \text{sit}_0, s) = \lambda t, v \langle \text{LIKE}, \text{liker}:t \text{ likee}:v \rangle$
 RESTRICTIONS: $\text{dis} - \text{sit}_0 \models \langle \text{INANIMATE}, v \rangle \wedge \langle \text{PERSON}, t \rangle$

I treat ‘when’, ‘where’, and ‘why’ as sentential modifiers, whose argument is a SOA, restricted to be factual. Given the rule in (61a-c), we get the derivation for ‘why does Bill like Mary’ in (61d,e):

(61) a. $S[+\text{fin}, -\text{marker}] \rightarrow \text{ADJ: ADVP}, H: S[+\text{fin}, -\text{marker}]$
 b. $[S](\text{utt} - \text{sit}_0) = \Lambda\text{-CLOSURE}(\langle \text{Cont}(\text{ADJ}), \text{Cont}(H) \rangle)$
 RESTRICTIONS: combine the RESTR(ADJ) and RESTR(H).
 c. $\text{Cont}(\text{‘why’}) = \lambda P \langle \text{BECAUSE}, \text{cause}:c, \text{effect}:P \rangle$
 RESTRICTIONS: $\text{utt} - \text{sit}_0 \models P$
 d. $[\text{‘does Bill like Mary’}](\text{utt} - \text{sit}_0) = \langle \text{LIKE}, \text{liker}:b, \text{likee}:m \rangle$
 RESTRICTIONS: $\text{utt} - \text{sit}_0 \models \langle \text{NAMED}, \text{‘Bill’}, b \rangle \wedge \langle \text{NAMED}, \text{‘Mary’}, m \rangle$
 e. $[\text{‘why does Bill like Mary’}](\text{utt} - \text{sit}_0, s) = (s ? \lambda c \langle \text{BECAUSE}, \text{cause}:c, \text{effect}: \langle \text{LIKE}, \text{liker}:b, \text{likee}:m \rangle \rangle)$
 RESTRICTIONS: $\text{utt} - \text{sit}_0 \models \langle \text{LIKE}, \text{liker}:b, \text{likee}:m \rangle \wedge \langle \text{NAMED}, \text{‘Bill’}, b \rangle \wedge \langle \text{NAMED}, \text{‘Mary’}, m \rangle$

‘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**.

3.7 Factives and resolitives

The need for a coercive analysis of declaratives and interrogatives embedded by factives and resolitives respectively was motivated in section 3.2.

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 resolitives and factives and ensure that the requisite inference patterns are satisfied.

In light of this we define the following sets of facts:

- (62) a. $f \in \text{RESOLVING-FACTS}[q, ms]$ iff $\text{RESOLVES}(f, q, ms)$
 b. $f \in \text{PROVE-FACTS}[p, ms]$ iff $\text{PROVES}(f, p, ms)$

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 this SOA, to wit $\bigvee(\text{RESOLVING-FACTS}[\text{CONT}(S[+\text{Int}]), ms])$, we achieve the effect of:

- (63) $\lceil \bigvee S[+\text{Int}] \rceil$ denotes $\lambda x \exists f \langle \text{CONT}(V), x, f, ms \rangle$ where
 $f \in \text{RESOLVING-FACTS}[\text{CONT}(S[+\text{Int}]), ms]$ (The VP denotes the property that holds of an x for whom there exists a fact f that resolving the embedded question relative to ms and such that x stands in the relation denoted by V to f and ms .)

How do we know the set $\text{RESOLVING-FACTS}[\text{CONT}(S[+\text{Int}]), ms]$ is non-empty? 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.

Similar reasoning can be applied to the propositional case with factives.

Given this, we postulate the following rules:

- (64) a. An interrogative I can be coerced to denote $\bigvee(\text{RESOLVING-FACTS}[\text{CONT}(I), ms])$
 b. A declarative D can be coerced to denote $\bigvee(\text{PROVE-FACTS}[\text{CONT}(D), ms])$

These rules are not overly complicated. What might be less obvious is *why* such an ontology arises. Let us then change perspective and adopt the perspective of dialogue to see how *inter alia* resolvedness emerges as a dynamic “control principle” that relates questions and facts.

4 Dialogue Dynamics

4.1 Introduction

Various phenomena relating to questions warrant adopting a dynamic perspective, where by *dynamic* I mean an approach wherein the meaning of a linguistic form is explicated in terms of the effect its use has on existing commonly shared “resources”. Posing a question changes a context in such a way as to (a) significantly restrict the space of felicitous follow-up assertions or queries, (b) to license an elliptical form which (overtly) conveys only the *focus* component of the response. Nonetheless, whereas the setting for most dynamic theories of meaning has, since Stalnaker 1978’s pioneering paper on assertion and presupposition, been monological *discourse*, it is clear that the natural setting for question use is a conversational setting consisting of at least two speakers, i.e. *dialogue*.

In fact, since dialogue is the basic form of conversational interaction, a strong case can be made that this should be the appropriate setting for semantic theory in general, requiring both a more *individualistic* and a more *structured* view of context. At a given point, *distinct* individuals can have *distinct* semantic options; context has *components* only some of which a given conversational contribution need interact with. (See Ginzburg 1994b,c for detailed argumentation to this effect.)

Here my aims will be relatively restricted. The first aim is to sketch a framework, one which conservatively extends the Stalnakerian view, in which it is seen how the semantic entities motivated in the previous section, questions, propositions, and facts, both are manipulated in and structure language use. In particular, I am concerned to explain how such “pragmatically conditioned” presuppositions as *resolvedness* emerge, but also how the fact that a particular question is *under discussion* influences topic choice and licenses ellipsis. Second, I will offer notions of querying and assertion that capture the interactive nature of these acts in dialogue. For instance, B1-B3 are all felicitous follow-up moves by B either to the query in (65a) or the assertion in (65b):

- (65) a. A: Does Bill know Mary?
b. A: Bill knows Mary.
c. B1: yeah.
d. B2: I don’t think so.
e. B3: Mary?

Thus, within a dialogue perspective, it is not only queries that elicit responses; rather any move after which the turn is surrendered to another participant will require us to offer a characterisation of the available follow-up moves. My third aim derives from the existence of one class of such followups common to all utterances, namely those whose primary function is to indicate comprehension or the need for clarification. Most formal semantic models have hitherto abstracted away from issues pertaining to communication, such as the

fact that one participant's utterances are not automatically and identically comprehended by the other participants. The consequence of this has been that many actually occurring dialogue contributions cannot be analysed. I will show how the conception of question developed here allows us to offer an analysis of such utterances and take an initial step towards integrating semantics and communication. More generally, the aim is to show that, given the notion of question we have available to us and given the notion of context we develop, many responses whose post-query felicitousness has previously been relegated to "pragmatics" can now be provided with a more principled semantic account.

4.2 Structuring the common ground

How to talk about a dialogue participant (DP)? I propose the following schematic partition. On the one hand, we need a way of talking about some *quasi*-shared object, each DP's version of the common ground, relative to which conventionalized interaction will be assumed to take place. This is because I adopt the assumption, built into the notion of a *dialogue game*, (e.g. Hamblin 1970, Carlson 1983, Houghton and Isard 1986), that interaction in conversation can be characterised in terms of a limited number of primitive move types which set up a restricted set of options or, perhaps obligations (Traum and Allen 1994). I will call this component the *DP's gameboard* (cf. Hamblin's 1970 notion of 'individual commitment slate').

Separate from this will be the *non-publicized* aspects of each participant's individual mental state. I will call this the DP's *unpublicized mental situation* (UNPUB-MS(DP)). Typically, such things as goals and general inferential capabilities will be represented here. We saw in section 3.4 that the notion of *resolvedness* is agent-relative, and hence within the current terms we would say it is relative to the UNPUB-MS(DP).

Thus, a participant in a dialogue is modelled as a set of triples, each triple of the form $\langle GB, ms, t \rangle$ ('a gameboard configuration *GB*, with a mental situation *ms* at time *t*'). A gameboard is a situation which represents a DP's view of certain attributes of the dialogue situation. Which attributes?

Stalnaker limited himself to the contextual change brought about by assertion, and hence the sole contextual resource that he was concerned with was the set of assumptions the conversational participants hold commonly at *t*. For reasons already discussed in section 3.2, rather than identify this as a set of true propositions, I will propose this resource should be the set of commonly accepted FACTS. Once we bring querying into the picture, what other attributes should the gameboard be specified for?

Our starting point is the observation that conversation is structured: at any given point, what speakers can talk about and how is constrained by the history of the conversation. More particularly, and with certain caveats to be discussed below, more recent moves have more influence on what can be said and how than moves that occurred further back in the past.

How does structure emerge? I recognize here two basic sources, both of which have figured in the conversation analysis tradition. The first is *the latest-move* made. I will assume, then, that as soon as illocutionary information is *accepted*, it serves as the value of

a contextual attribute which I dub *LATEST-MOVE*. Once we allow this context attribute, we can offer an initial repertory of *reactions* to queries and assertions, a task I shall come to shortly.

The second source of structure derives, not surprisingly, from questions: both the formal semantic (see above) and the Conversation Analysis literature (Sacks and Schegloff 1973, Levinson 1983) have long emphasized that a question and answer pair form a single discourse unit.

What we can see clearly from the examination of actual dialogue, for instance the one in figure 1 taken from the London-Lund corpus, is that the discussion of a single question can last over many conversational turns and be separated by other questions that have been introduced in the meantime. In particular, “answer ellipses” can occur arbitrarily far away from the questions they relate to. Thus, the discussion of the question raised in (1) by B in dialogue 1 is finally concluded 14 turns later in (15) by the ellipse ‘a half generation then’, taken to mean ‘father of *a* is a half generation younger than the father of *B*’:

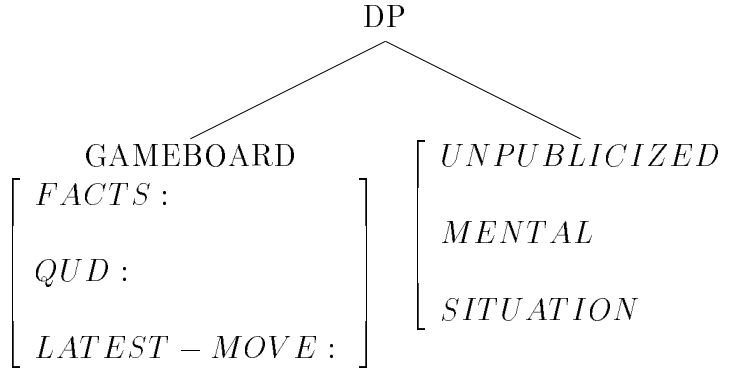
B(1): after all your father's a generation younger than my father isn't he, basically
a(2): well I should think so
B(3): cos your father's now SEVENTY is he
a(4): seventy two or (simultaneous with next turn:) seventy three B(5): SEVENTY TWO.
yes. well father would have been seventy eight I suppose. if he had been alive still
C(6): good lord
a(7): that all
?(8): goodness
C(9): my father would have been a hundred and twenty seven
B(10): no, not seventy eight, eighty eight
a(11): (coughs)
B(12): yes. (simultaneous with next turn:) no. yes
a(13): as bad as Charlotte's
B(14): no, not seventy eight. yes, eighty eight. no, I'm sorry, sixteen years, yes eighty eight,
that sort of thing
C(15): a half generation then

Figure 1: Dialogue 1: Extract from (London Lund, S.1.13, p. 333)

In order to keep track of the class of questions that are (potentially) under discussion at a given point, I assume that the gameboard, in addition to FACTS and LATEST-MOVE, must also provide as value for an attribute QUD (Question Under Discussion), a partially ordered set of questions. The maximal element of QUD corresponds to the current topic of discussion.³⁰

Summarizing for the moment: we have the following view of a participant in a dialogue:

³⁰As will become clear below, the partial ordering is to an important extent semantically driven; when semantics does not determine which question has precedence, however, the DP's will need to negotiate the ordering amongst each other.



The gameboard representing each DP's version of the common ground is structured as follows:

- **FACTS:** set of commonly agreed upon facts;
- **QUD** ('questions under discussion') : partially ordered set that specifies the currently discussable questions. If q is topmost in QUD, it is permissible to provide any information specific to q .
- **LATEST-MOVE:** content of *latest move* made: it is permissible to make whatever moves are available as reactions to the latest move.

4.3 Querying and Assertion

Let us now move to consider how querying and assertion are viewed within this perspective. What principles govern the manipulation of questions and propositions until they finally lead to an incrementation in the set of commonly accepted facts? I make two simplifying assumptions, the first of which will be dropped in section 4.4: first, perfect communication obtains between the participants, and second, each participant performs at most one move per turn (a query or an assertion). That is, a turn containing two separate queries or a query followed by an assertion is not accommodated. Such possibilities are the rule rather than the exception in actual dialogue. They do, I believe, strengthen the need for certain aspects of the setup described here, namely the ordering in QUD and the potential for mismatch among the participants.

For querying we identify the following three as definitive issues:

1. How does a particular question get adopted as *the question to be discussed*?
2. What class of utterances is available as replies specific to a question q ?
3. Until when does a question's discussion continue?

The importance of the first issue becomes clear as soon as one reflects on the fact that the development of a dialogue depends on both participants. That is, one needs to make allowances for the fact that the person who responds to the query might not wish to adopt the question posed by the querier, although an initial rejection of discussion does not mean that the original question gets erased from the context. This is illustrated in the (constructed) dialogue in (66), where on her final turn the responder exploits the presence of the original question in her context in providing an elliptical answer specific to that question:

- (66) (14a) A: Hey, guess who showed up to lunch.
 (14b) B: I don't want to.
 (14c) A: Why not?
 (14d) B: Don't want to.
 (14e) A: Please.
 (14f) B: Oh ok. Millie.

This motivates the following basic protocol for querying: if DP_1 poses the question q he adds q as topmost element in (his own) QUD. Assume all has gone well on the communication side of things, as we shall for the moment. Then, DP_2 will register in her LATEST-MOVE that:

- (67) LATEST-MOVE: DP_1 QUERY q

Now DP_2 has two options: she can either

- **Accept q for discussion:** update QUD so that q becomes topmost and provide a q -specific utterance.
- **Reject q for discussion:** in this case DP_2 also adds q to her QUD, but rather than make q *the* question to be discussed, she asserts her unwillingness to discuss q . This involves making the question pertaining to this, viz. ‘whether DP_2 will discuss q ’ as topmost in her QUD. DP_2 can now utter a rejection phrase (‘I don’t want to talk about that’, ‘Never mind q ’ etc.)

Given a question $q = (s?\mu)$, a q -specific utterance will be one that either:

1. Conveys information ABOUT q .
2. Conveys a question q_1 on which q depends.³¹

³¹Here, inspired by Karttunen 1977, I define the relation of dependence between two questions as follows: q_1 DEPENDS-ON q_2 iff q_1 is *resolved* by a fact τ only if q_2 is also resolved by τ . The insight behind this option is drawn from Carlson 1983, p. 101.

Here, then, the notion of *q-specific utterance* allows in either (potential) partially resolving answers or questions the resolution of which is a necessary condition for the resolution of *q*. In the latter case, the question offered as a reply will typically become the question under discussion:

- (68) a. A: Who killed Bill?
 B: Who was in town at the time?
 A: Do you think that Mary was?
 B: Probably.
 A: And Jill?
 B: Yes. Which one of them had a motive?

Now regardless of which option DP₂ adopted, we face issue #3 above: how long does a question remain under discussion? The basic principle that seems to be at work here is the following:

- (69) **QUD DOWNDATING:** Assume *q* is currently maximal in QUD, and that *ψ* is a fact that either
 (a) *resolves q relative to UNPUB-MS(DP)* Or,
 (b) indicates that *no information about q* can be provided.
 Then, adding *ψ* to FACTS licenses
 (1) removing *q* from QUD, and
 (2) if (a) applies, adding the fact *φ* to FACTS, where *φ* is **the fact that ψ RESOLVES *q* relative to UNPUB-MS(DP)**

The QUD downdate principle suggests a construal of the notion of *resolvedness* that I have been hinting at above, namely that it is an agent-relative view of when the question has been discussed sufficiently for current purposes to be considered “closed”. Equally, (69) provides a source for the emergence of resolvedness presuppositions to which we appealed in our coercive analysis of interrogative complements embedded by resolute predicates. We can summarize the emergence of these presuppositions as in (70):

- (70) I wondered about *q*, so I asked *q*. She told me that ... and that ... etc. This was true. The question *q* is now resolved, so now I know *q*.

Let us return to explicating a query sequence. If DP₂ accepts *q* for discussion, then as stated above, discussion of *q* will proceed in accordance with the QUD downdate principle above. Otherwise, DP₁ has the option of accepting DP₂’s rejection, in which case *q* will be removed from QUD in accordance with the downdate principle, or DP₁ can discuss DP₂’s rejection and try to convince her that *q* should be discussed and so on. If he succeeds, then

‘whether DP₂ will discuss *q*’ gets eliminated from both DP’s QUD’s, *q* is now topmost and will be discussed afterall.

[flow diagram]

Let us now turn our attention to assertion. Here two issues arise:

1. How to provide an account of an assertion sequence that allows, in addition to acceptance and rejection, also the option of *discussion*?
2. When and how can an asserter assume his assertion is *part of the common ground*?

Consider a sequence in which DP₁ makes an assertion *that p*. If FACTS is to serve as some sort of common ground repository, DP₁ cannot, with an important caveat to which I shall come later, update FACTS *before* receiving acceptance from DP₂. What does he do in the meantime? I suggest that what he does is update his QUD with the question *whether p* as its topmost element.

What options does DP₂ have now? Her LATEST-MOVE now contains the information:

(71) LATEST-MOVE: DP₁ asserts that *p*.

DP₂ now has two possible classes of reactions:

- **Accept *p*:** in this case, DP₂ *adds* to her FACTS attribute *the fact that p*. At this point, she can either explicitly utter an acceptance phrase (‘I see’, ‘uh huh’, head nod); Or move on: DP₂’s QUD at this point is a (not necessarily proper) subset of what it was before DP₁’s assertion. So DP₂ can introduce a new question for discussion, either by assertion or by querying.
- **Discuss *whether p*:** in this case DP₂ adds as the topmost element in *her* QUD the question *whether p* and produces an utterance specific to the question.

This perspective on assertion leads to the expectation of three possible routes for the conversation: If DP₂ explicitly chooses *not* to accept the assertion that *p*, a discussion of *whether p* will ensue which, by the QUD downdate principle, should continue until either the question is resolved or one DP indicates she can/will not provide more information concerning that question.

Alternatively, if DP₂ *explicitly* accepts DP₁’s assertion, then since the acceptance constitutes information that resolves the question *whether p*, currently topmost in his QUD, then DP₁ can utilise the QUD *downdating* principle: *whether p* gets removed from QUD and the resolving information, in this case *the fact that p* gets added to FACTS. So, at this point *the fact that p* is in FACTS on both gameboards.

Quite frequently, nonetheless, an assertoric move is unlikely to provoke controversy or response from other DP’s, whether someone is giving a lecture, engaged in instruction, or, there is a certain “meta-linguistic” interaction that I shall come to shortly. We therefore need to allow an option which introduces a potential for mismatch among the participants,

for a DP to accomodate into FACTS the fact that the topmost question in QUD is *positively resolved* even if DP₂ has not accepted this move.³²

(72) **ACCOMMODATE QUESTION:**

if q is topmost in QUD, it is permissible to add the fact *that there exists a fact positively resolving q* to FACTS. Optionally, remove q from QUD.

The relation POSITIVELY-RESOLVES was defined in (44). Since it is the case that for a question of the form *whether p* , all and only facts proving *that p* stand in this relation to the question, it follows that if DP₁ receives neither explicit acceptance nor discussion, he is entitled to update FACTS with *the fact that p* , the point of his original assertion.

4.4 Questions and Meta-linguistic Interaction

Finally, I want to show how within the framework described above the potential for moves indicating successful comprehension or the need for clarification can be explained as a consequence that an utterance of a particular linguistic form with a particular meaning has occurred.

(73) a. A: Bill left last night.

b. B: Bill, mmh.

c. Bill?

d. He left when?

Recall that within the situation semantics described above a meaning is an n-ary abstract where the variables abstracted over correspond to the contextual parameters. An utterance is reified as a situation, one that supports the various contextual facts needed to obtain a content from a meaning.

Given this and the notion of question described in the previous section, it follows that an utterance u and a meaning μ of a sentence S , serve to define a question $q(u, S) = (u?\mu)$. This question can be paraphrased approximately as: *what values are assigned to the contextual parameters of μ*

The analogy to the view of assertion presented above is strikingly clear. Rather than assume that information *about the content* of the utterance that requires fixing by the context is necessarily available to the addressee (in other words can be automatically added in as part of the gameboard), we allow for the option of discussing any of these contextual parameters.

How do we revise our original dialogue move rules to take these issues into consideration? The moves previously described will now be altered by composing any move that

³²Ginzburg 1994c offers independent motivation for this rule from considerations pertaining to sluicing.

involves producing an utterance u of sentence S with a potential discussion sequence of $q(u, S)$.

The basic idea is this: once an utterance has been posed, if the stimulus of an utterance u of a sentence S is good enough for the addressee to recognize what sentence has been uttered, she is expected to act as follows:

(74) If DP_2 believes that S was uttered, she updates QUD with $q(u, S)$

u will be *grounded* if and only if there is a fact that the addressee knows and which resolves the question $q(u, S)$ relative to her UNPUB-MS.³³ In this perspective, grounding involves the utterer and addressee coming to be satisfied that the addressee knows an answer to the meaning question, specific enough for current purposes. In such a case, just as with an assertion, the addressee has the option of explicitly accepting the utterance, as in (73b).

Otherwise, DP_2 has the option of following up DP_1 's utterance of S with any clarification question on which $q(u, S)$ *depends*.

Let us consider an example: why does (75a) license (75b) as a clarification?

(75) a. Bill left.

b. WHO?

On an analysis of the content of echo queries as in Ginzburg 1992, 1994a, (75b) gets a reading with content (76b):

(76) a. $(u?\lambda b, a, s\langle ASSERT, a, (s!\langle LEAVE, b \rangle)))$

b. $(u?\lambda x\langle ASSERT, a, (s!\langle LEAVE, x \rangle)))$ ('who does A assert that left')

Given that the meaning question defined by (75a) is (76a) (ignoring the associated restrictions here for simplicity), (76b) is a $q(u, \text{'Bill left'})$ -specific utterance. (76a) is a question that depends on (76b) and hence (76b) is licensed.

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³³The term 'grounded' is from Clark and Schaefer 1989.

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