

Note: This is a non-final draft of a paper to appear in a special edition of *Discourse Processes*, edited by Anton Benz and Katja Jasinskaja.

The Best Question: Explaining the Projection Behavior of Factives*

May 2015

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Abstract

This paper deals with projection in factive sentences. The paper first challenges standard assumptions by presenting a series of detailed observations about the interpretations of factive sentences in context, showing that what implication projects, if any, is quite variable and that projection is tightly constrained by prosodic and contextual information about the alternatives under consideration. The paper then proposes an account which accommodates the variability of the data and sensitivity to contextual alternatives. The account is formulated within a modified version of Roberts 1996/2012 question-based model of discourse.

1. Introduction

The verbs *believe* and *know* both describe relations that can hold between an individual and a proposition, as in:

- (1) Jane knows that it's raining.
- (2) Jane believes that it's raining.

*The authors thank audiences at the University of Amsterdam, Rutgers University and Yale University for helpful discussion of this work during its development., as well as three anonymous reviewers for this journal. This paper is based upon work financially supported by a collaborative research grant from the National Science Foundation to the authors ('Collaborative Research: Semantics and Pragmatics of Projective Meaning across Languages'; grants BCS-0952571 (OSU), BCS-0952497 (CMU), BCS-0952862 (UTAustin); 2010–2012). This manuscript was completed while Roberts was a Senior Fellow in 2014-15 at the Institute for Advanced Studies at Central European University, Budapest, Hungary, sponsored by Budapesti Közép-Európai Egyetem Alaptvány; the theses promoted herein are the authors' own, and do not necessarily reflect the opinion of the CEU IAS.

A speaker who says (1) asserts that Jane knows that it's raining, and thereby indicates her own belief that it's raining. There is a clear relation between the two facts. Jane can know that it's raining only if it is raining. A speaker could not be in a position to assert that Jane knows that it is raining unless she knows that all of the conditions for Jane to know that it's raining are met; so the speaker must know that it is raining. In contrast, a speaker who says (2) does not commit to its being the case that it is raining. Jane can believe that it is raining even if it is not in fact raining; so the speaker can know that Jane believes this regardless of her own knowledge or beliefs about the weather.

The above observations are easy to explain. This paper is concerned with some more complicated observations, having to do with what happens when sentences like (1) are negated or questioned, or when expressions of possibility are added to them. We restrict our attention here to the negated case, illustrated for *know* in (3) and for *believe* in (4):

(3) Jane doesn't know that it's raining.

(4) Jane doesn't believe that it's raining.

A speaker who says (4) does not commit to its being the case that it is raining. Again, there is a simple explanation: Jane could fail to believe that it is raining whether or not it is in fact raining. But a speaker who says (3) would often be taken to believe that it is raining, just as would a speaker of (1). This is surprising, because if it were not raining, then sentence (3) would certainly be true. So why should utterance of the sentence imply that the complement is true? In this paper, we propose a new answer to this question.

There is already an answer to this question which is rather widely assumed to be correct. The answer goes like this: the lexical entry of *know* requires that the content of its complement be presupposed. Standard accounts of presupposition then predict that sentences containing *know* as main verb imply the truth of the complement, even when the sentences are negated, questioned, and so on. (For accounts of this type see i.a. Karttunen 1974, Heim 1983, 1992, van der Sandt 1992, Schlenker 2008). Verbs which show this behavior are called *factives*. Non-factive verbs like *believe*, which do not trigger the implication that their complement is true, differ from *know* in that they do not require their complements to be presupposed.

Accounts which attribute the implication of truth of the factive complement to a lexical requirement face a serious challenge: this implication is relatively fragile. It can quite easily be over-ridden by contextual factors, and is affected by focus marking in a way that is not explained by standard accounts. We establish these claims in section 3.2. of the paper. We then go on to develop our own account, which draws heavily on the idea that the interpretation of an utterance involves the identification of the set of alternatives amongst which the speaker intends to distinguish by that utterance. We formalize these alternatives as questions. One central contribution of this paper is to distinguish between two different notions of conversationally relevant question: an utterance relative notion, closely tied to formal properties of an uttered sentence or clause, which we call the *Congruent Question* (CQ) for the utterance; and a discourse-segment relative notion, which we call the *Discourse Question* (DQ). As we will show, the factive implication is sometimes a consequence of the structure of the CQ itself (Section 4), and sometimes arises from the process of building relations of relevance between the CQ and the DQ (Section 5). The central feature of our account is its sensitivity to the role of an utterance in an ongoing discourse, and to linguistic cues which constrain the questions (CQ or DQ) which an utterance can be taken to address.

2. Projection

Example (3) above illustrates what is known in the linguistic literature as *projection*. In cases of projection, an utterance of a sentence containing negation (or some other entailment canceling operator) has a special feature: an implication associated with material which is in the syntactic scope of the operator is nonetheless understood as a commitment of the speaker.¹ As we will make clear, a given sentence can sometimes have a projection reading and sometimes a non-projection reading. Examples (5)-(7) illustrate utterances which are most likely to be given a projection reading, where what projects is the content of the complement:

- (5) [The speaker has just run into Lara who is out with a child, obviously her daughter]
I didn't know that you have a daughter.
- (6) [The speaker to her daughter, who has not yet got out of bed]
Are you aware that you have school today?
- (7) [The speaker to her husband, as they are wondering why their daughter is out of bed early on a Saturday]
Perhaps she's forgotten that her ballet class is canceled this week.

The utterance in (5) is a way for the speaker to acknowledge that the addressee has a daughter; the speaker of (6) is reminding the addressee that she has school today; and the speaker of (7) is most naturally understood as assuming that the ballet lesson is canceled, and speculating that her daughter has forgotten that. In each case, the speaker is understood to be committed to the truth of the factive complement.

Each of these examples can be analyzed as an atomic sentence with a factive verb that falls under the scope of an entailment canceling operator. Example (5) is the negation of *I knew that you have a daughter*; example (6) is the question form of *You are aware that you have school today*; and example (7) embeds the sentence *She's forgotten that her ballet class is canceled this week* under the modal adverb *perhaps*. From the perspective of compositional semantics, the projection readings of these utterances are surprising, because typically the implications of an atomic sentence do not survive when the sentence is embedded in these ways. For example, the sentence in (8)a. implies (the content of) (8)b.; but none of the sentences in (9) have this implication.

- (8) a. Jane ate a sandwich.
b. Jane ate something.
- (9) a. Jane didn't eat a sandwich.

¹ We use the term *projection* in a way which differs from the original use of the term, for example by Langendoen & Savin 1971. For those authors, and in much of the subsequent literature, projection concerned the processes whereby the lexically encoded presuppositions of an atomic sentence S are inherited by sentences that embed S. In the more recent literature, it has become commonplace to use the term *projection* as a descriptive label for any cases of implications which "survive" embedding under entailment canceling operators. This is the way in which we use it here.

- b. Did Jane eat a sandwich?
- c. Perhaps Jane ate a sandwich.

This is why there is something special to explain about the factive implication. But, as noted, whatever explanation is given must take into account the fact that embedded factive sentences have projection readings sometimes, but not always, as we will illustrate in what follows.

3. Projection and Factives: the standard view, and some puzzles for that view

3.1 Approaches to projection in factive sentences

As noted above, the standard view maintains that the contents of the complements of factive verbs project because factive verbs conventionally mark that content as presupposed, and projection follows from presuppositionality. According to a large and widely accepted class of accounts, conventionally presupposed content is required to be entailed by (or to have an antecedent in) the context relative to which the presuppositional utterance is evaluated (see Heim 1983, 1992, van der Sandt 1992).² Projection occurs when a contextual requirement of an embedded clause must be satisfied by the global context. Non-projection occurs when the contextual requirement of an embedded clause can be satisfied by a local context.

A range of alternative, pragmatic accounts have been proposed in e.g. Abrusán 2011, Atlas 2005, Boër & Lycan 1976, Chierchia & McConnell-Ginet 2000, Kadmon 2001, Karttunen & Peters 1979, Kempson 1975, Levinson 1983, Simons 2001, 2004, Stalnaker 1974, Wilson 1975. All of these have argued that projection of the content of factive complements is due to general pragmatic considerations. These accounts typically take as their starting point the truth conditions of atomic factive sentences. While our account is closer in spirit to these than to conventionalist accounts, we see these accounts as similar to conventionalist accounts in one respect. Both types of account assume that the projectivity of complement clauses of factive verbs should be explained at the sentence level, based on semantic features of the sentence. In contrast, on our account, projection is explained at the discourse level. Our account is closer in spirit to that of Abusch 2002, 2009, who takes the presuppositionality of factives to arise from the alternative set which these verbs trigger. However, Abusch takes the relevant alternative sets to be conventionally determined, so falls into the conventionalist camp with respect to the source of presupposition and hence of projection.

The conventionalist account predicts that what projects in utterances of factive sentences is immune to particular features of the utterance, including intonation.³ In the remainder of this section, we show that this prediction is not borne out. Our observations highlight the sensitivity of projection in factive sentences to markers of information structure and hence prepare the ground for the presentation of our largely information-structural account of factive projection.

3.2. Puzzles for the standard view

² Tonhauser et al. 2013 cast doubt on the claim that factive complements are subject to this contextual constraint, on the basis of judgments from speakers of English and Paraguayan Guaraní.

³ Conventionalists can account for failure of projection in complex sentences through a mechanism called *local accommodation*. A discussion of how our account relates to the use of this strategy is outside the scope of this paper.

triggered implication projects instead. The theorist interested in maintaining the standard view might be inclined to see the example as showing an interaction between two distinct mechanisms: the lexically triggered projection mechanism, and the interpretation of focus. Our approach is to posit that projection is a by-product of the construction of focal alternatives. On this approach, interaction with focus marking is predicted to be inevitable.

3.2.2 Sensitivity to implicit questions and overt interrogatives

The context of utterance can easily indicate that an utterance of an embedded factive sentence should be given a non-projection reading. (See also Chierchia & McConnell-Ginet 2000, Kadmon 2001, Simons 2001, Beaver 2010). Consider the following examples:

- (12) [Interlocutors are aware that their friend Bill is trying to discover the whereabouts of his grown daughter Sally]
If Bill discovers that Sally is in New York, he'll be relieved.
(Variant on example due to Chierchia & McConnell-Ginet 2000, p.354 (40))
- (13) ...I haven't tried this with wombats though, and if anyone discovers that the method is also wombat-proof, I'd really like to know. (Beaver 2010, (32))
- (14) Mr. Wynn asked if PennDot's review letters were a reaction to a submission Home Depot made with these changes on it, which generated these review comments. Mr. Furnacola believes that there is written verification from PennDot requesting the change. Mr. Wynn is not aware that PennDot has ever dictated access on a Township roadway, since it is not in their jurisdiction. (Beaver 2010, (42))

In these examples, the context makes it implausible that the speaker would commit to the factive complement being true. In (12), it is common ground that the speaker does not know where Sally is, and is just speculating about what will happen if it turns out that Sally is in New York. In (13), the writer makes clear that he doesn't know whether the method works with wombats, not having tried it. Example (14) is a little more obscure, but the style of writing tells us that this is a formal report of a legalistic interaction. The target sentence containing the factive verb *aware* is understood as a report of a first person statement of the form *I am not aware that...*, and the writer has no more information about the case than the people on whom she is reporting.

A further observation about these examples is that the utterance containing the factive occurs in a discourse in which the content of the complement is up for discussion. Example (12) occurs in a conversation where there is a salient implicit question: *Where is Sally?* Similarly, the first conjunct in example (13) serves to raise the question: *Does the method work with wombats?* In (14), it is apparent that an effort is being made to establish certain facts: in particular, to establish whether or not PennDot has ever dictated access on a Township roadway. Mr. Wynn's awareness, or lack of it, is of interest only as it provides evidence as to the answer to this question.

These examples suggest that some cases of non-projection are to be explained in terms of coherence of the interpretation with contextual information about speaker beliefs and conversational goals.

3.3. Two Hypotheses

The account we propose takes as its starting point the idea that every sentence, when uttered, provides some clues as to the alternatives amongst which the utterance is intended to differentiate.

For reasons we clarify shortly, we call these alternatives the *Congruent Question* (CQ) for the utterance. Here is our first hypothesis about projection:

Projection Hypothesis 1: Projection of the content of the complement of an attitude verb occurs if the Congruent Question for the utterance entails this content.⁵

In section 4, we lay out the notion of the CQ and its relation to projection. The CQ, however, will not do all the work needed. We will see in section 5 that there is a second notion of conversational question which we must invoke, that of the *Discourse Question* (DQ). The DQ provides the topic of a segment of discourse and imposes relevance constraints on conversational contributions. In some cases, projection arises from the need to construct a relevance relation between the CQ and the DQ. For these cases, we will explore the following projection hypothesis:

Projection Hypothesis 2: Projection of the content of the complement of an attitude verb occurs if the best explanation for relevance of the CQ to the DQ requires attribution of acceptance of that content to the speaker.

These hypotheses pertain to the complements of attitude verbs generally, not specifically to factive verbs. In section 5.2. we will make clear why we do this: we take the principles to apply equally to verbs traditionally considered nonfactive.

4. Congruent questions and projection

4.1. The basic framework

The elements of the framework we propose will be familiar to readers acquainted with the linguistic literature on focus and questions, although we introduce here some new distinctions. For readers from other domains, we introduce the basic notions without too much technical detail to facilitate understanding of our proposal.

The central notion in our account is that of focus, which we construe as a feature of linguistic constituents. We take the focus feature to be part of the structural description of a sentence, along with constituent structure. Following Selkirk 1984, we assume that in every sentence, some constituent bears focus, and also that an entire sentence may be focused. Focused constituents are, roughly, those which are marked as carrying the new information in a sentence. If the entire sentence is in focus, then all of the information is marked as new.

Different languages mark focus in different ways. English utilizes some syntactic forms to mark constituents as being in focus, *it*-clefts (such as *It was John who ate the cake*) being a prime example. However, intonational prominence is the most commonplace way to mark focus in English: to mark a constituent as focused, some syllable within that constituent must be prominent. The details of the relation between intonational prominence on a given syllable and focus marking of a constituent containing that syllable are complicated, and indeed the retrieval of the intended focus involves combining linguistic cues and pragmatic reasoning. In this paper, we indicate the

⁵ Note that this hypothesis presents *one* circumstance in which projection occurs: this is intentionally formulated with *if* and not *iff*.

intended focus and the intonation, without discussing how the focus is identified. (In examples, we will sometimes put the focused constituent(s) in capitals to give a sense of the intended intonation.)

We turn now to the semantic function of focus. As noted above, focused constituents are understood to correspond to the new information in the discourse. In example (15) below, focus on *John* indicates that the information about who ate the cake is what is new; the fact that the cake was eaten is unfocused, so indicated to be old or familiar.

(15) [_FJOHN] ate the cake.

Speakers of English, presented with an utterance of this sentence with prosodic prominence on *John*, typically think that the utterance can be used to answer the question *Who ate the cake?* or to serve as a correction to a previous claim like *Lily ate the cake*. With this intonation, the sentence would be inappropriate as an answer to *What did John eat?* or as a correction to *John ate the strawberries*.

A more formal model for understanding how focus indicates the structuring of information in a discourse is given by Roberts (1996/2012), which itself builds on proposals due to Rooth (1985, 1992). A variant of Roberts' model is proposed and utilized in Beaver & Clark 2008. The model we utilize in the account below builds on this work. To lay this out, we begin with Rooth's analysis of the semantics of focus.

Rooth proposes that focus in a sentence serves to make salient a set of alternative propositions: roughly, the alternatives that can be generated by replacing (the semantic value of) the focused constituent with any other type-appropriate object. We call each such proposition a *focal alternative* of the sentence; the set of focal alternatives is the *focal alternative set* of the utterance.^{6,7} For (15), let us make the fairly common assumption that proper names denote entities. In that case, the focal alternative set generated by Rooth's (1992) algorithm would be a set of propositions expressible by sentences of the form *x ate the cake*, where *x* is any referring expression. Crucially, all of these propositions entail that some individual ate the cake; they vary (hence are alternatives to one another) with respect to which individual ate the cake.

Focus, then, allows us to associate with each sentence a set of propositional alternatives. Sets of propositional alternatives have another role in semantics, too. On a very widely accepted view, questions are appropriately represented as sets of propositional alternatives. The basic intuition here is that a question can be represented as the set of its answers (Hamblin 1973, Karttunen 1977, Groenendijk & Stokhof 1984; for an overview, see Groenendijk & Stokhof 1997).

⁶ Focal alternatives can be generated at any syntactic level, but for simplicity, we discuss only focal alternatives of complete sentences.

⁷ We ignore throughout a further complication. On the account articulated by Beaver & Clark 2008, a complex sentence may be associated with multiple focal alternative sets, even when its structural description, including specification of its focused constituents, is fully determined. This is because focal alternatives can be calculated over clausal constituents of different sizes. For example, in a negated sentence such as *JOHN didn't eat the cake*, the focal alternatives can be calculated over the entire sentence, or just over the embedded atomic sentence. Although we will bring up this ambiguity in discussing particular examples, we ignore it in stating our definitions for the sake of simplicity.

For example, the question *Who ate the cake?* denotes the set of propositions which answer the question – exactly the set of propositions which we identified above as the focal alternative set of (15). This parallel between focal alternative sets and questions is central to our account.

Treatments of questions as sets of alternatives differ in their details, varying as to whether the alternatives represent possible answers, true answers, or complete (exhaustive) answers. We here follow Beaver & Clark (2008) in adopting a fully unified treatment of questions and focal alternative sets, so that any structure which counts as the representation of a question could also serve as a focal alternative set, and vice versa. This means that we can technically refer to focal alternative sets as questions. It's important to bear in mind, though, that in using this terminology, we mean no more than that focal alternative sets have a particular formal structure. The term *question* is used here in a technical sense; saying that a focus-marked sentence gives rise to a question is not to say that an interpreter would have the intuition that the use of that sentence in a context is the same as asking the associated question, or uttering an interrogative.

The role that focal alternative sets / questions will play in our account is to help us to characterize the alternatives amongst which the speaker intends to distinguish in making her utterance. For this purpose, we need to introduce *domain restrictions* on the alternative set. Consider an utterance of the sentence in (15) by a speaker in the course of a conversation. By placing the subject in focus, the speaker indicates an intention to distinguish among alternatives of the sort which make up the focal alternatives of her utterance. However, only some subset of those alternatives will be under consideration: those that involve an individual who might actually have eaten the cake. The sentence could, for example, be uttered by a mother, Lily, to her daughter, Jane, speaking about Jane's brother John. Perhaps the cake in question was the last slice of John's birthday cake, which Jane was hoping to finish off. The only people who have had access to the cake were Lily, Jane, John, and the children's father Larry. In this case, the alternatives amongst which the speaker intends her utterance to distinguish are just those which involve Lily, John, Jane and Larry. This set of alternatives corresponds formally to the question expressible as *Who ate the cake?*, where the domain of that question is restricted to those four individuals.

When a speaker asks an explicit question in discourse, the domain of that question is almost always contextually restricted in some way. Suppose Mark's daughter has been out on a bird-watching trip, and at the end of the day Mark asks her: *What did you see today?* Mark's intention is to ask about birds that she saw; a response that lists random objects she saw during the day does not answer Mark's question. Similarly, the focal alternative sets invoked by utterance of focus-marked sentences are typically understood to be restricted to some domain relevant to the discourse. We call these domain-restricted alternative sets the *Congruent Question* for an utterance.

Congruent Question (CQ) for an utterance: The CQ for an utterance is a privileged subset of the focal alternative set of the uttered sentence (given a structural analysis of that sentence, including focus marking) which meets the following conditions:

- (i) The proposition expressed is a member of the CQ and
- (ii) The CQ has at least one additional member.⁸

By this definition, sentences under a given structural analysis including focus marking are associated with a focal alternative set, and utterances (productions of linguistic forms in a context) are associated with CQs. A focal alternative set can be restricted in indefinitely many ways. The CQ for an utterance is a particular restriction, privileged in that it represents the alternatives that the speaker (in some sense) intends to distinguish among with her utterance.

We have so far emphasized that the alternatives within a focal alternative set or CQ differ from one another in some respect. Crucial to our account is the additional observation that the alternatives have some entailments in common. For example, all the alternatives in the focal alternative set associated with (15) entail that some individual ate the cake. Following Abusch 2002, 2009 and Beaver & Clark 2008, and in line with Geurts & van der Sandt's 2004 Background Presupposition Rule, we assume that where a question is made salient by virtue of being the CQ for an utterance, those propositions which are entailed by the disjunction of the alternatives within the question – those propositions on which the alternatives “agree” – are *backgrounded*, and are understood to be commitments of the speaker. These are the propositions which the speaker does *not* take to be part of what is currently under discussion. Let's introduce here some simplifying terminology: Where all the alternatives within a question entail some proposition *p*, we say that the question entails *p*.

Beaver & Clark provide an account of focus-induced projection utilizing the idea that a speaker is committed to the entailments of the CQ associated with their utterance.⁹ We illustrate this with the negated version of example (15):

(16) [F JOHN] didn't eat the cake.

The CQ for this sentence, with focus as shown, will be a domain restricted versions of either (17) or (18). (See fn. 7.):

(17) Who ate the cake?

(18) Who didn't eat the cake?

As discussed at length by Beaver & Clark (pp.45-49), details of the intonation may serve to choose between these possibilities, with (17), for a variety of reasons, being the more plausible CQ. As we've already noted, all alternatives in this question entail that someone ate the cake. So,

⁸ These additional conditions, which are based on the related proposal in Rooth 1992, guarantee that (i) the proposition expressed is an answer to the CQ and (ii) the CQ is not vacuous.

⁹ In fact, Beaver & Clark are interested in accounting for Association with Focus. But projection turns out to be just the other side of the coin in the account they propose for the apparent focus sensitivity of negation and other operators which they term “quasi focus sensitive”. The system proposed in Geurts & van der Sandt 2004 would make the same predictions regarding focus triggered projection, if combined with our assumptions about focal structure.

alternative set will entail that any particular person is having a graduation party; specifically, none will entail that Harry is having a graduation party.¹⁰ Since we do not assume that projection of the content of the complement is conventionally triggered, there is no need to explain why that content fails to project. Consequently, for examples of this type, our account is more parsimonious than accounts assuming conventional triggering.

4.3. More on focus marking and projection: predicting projection of clausal complements

The data we have used in developing our account consists of (mostly constructed) example utterances: sentences presented in a specified, particular context and produced with a particular prosody and intonation. This is very different from the kind of data which has typically motivated claims about projection, derived from example sentences presented in writing, with no information about the intended context and with no indication of intonation. Consider, for example, the standard method of demonstrating projection, using the Family of Sentences test.¹¹ In Chierchia & McConnell-Ginet (2000), where this diagnostic is first systematized, readers are asked to consider the following set of sentences (presented here as in the original):

- (21) a. Joan regrets getting her Ph.D. in linguistics.
b. Joan doesn't regret getting her Ph.D. in linguistics.
c. Does Joan regret getting her Ph.D. in linguistics?
d. If Joan regrets getting her Ph.D. in linguistics, she should consider going back to graduate school in computer science.
e. Joan got her Ph.D. in linguistics.

About this set, Chierchia & McConnell-Ginet state: "(Using) any of a.-d. will generally imply e. In this case, the implications are attributable to *regret*, which is a so-called factive verb...Other examples are *realize* and *know*" (p.28).

This claim is difficult to evaluate. In this paper, although we have not considered any cases involving *regret*, we have demonstrated non-projection readings of negated sentences with main verb *know* and *find out*. And Beaver 2010 provides pages of attested examples of (written) utterances with main verb *know* and *realize* (as well as other cognitive factives) which clearly have non-projection readings in the contexts in which they occur. So, while it is true that there are uses of sentences with factive verbs which imply the truth of the propositional complement, there are also uses of sentences with factive verbs which do not. We have little evidence as to whether one case is more frequent or common than the other.

¹⁰ Indeed, neither of the possible focal alternative sets entails that Harry is having a graduation party. The choice between (19) and (20) is relevant for the account of which proposition does project; but on either option, non-projection of the content of the complement is predicted.

¹¹ An implementation of this diagnostic suitable for use with linguistically untrained native speaker consultants, in either the field or the laboratory, and based on elicitation of judgments concerning specific utterances, is presented in Tonhauser et al. 2013.

We suspect that there is a belief that judgments about uncontextualized sentences provide evidence about purely linguistic aspects of meaning, judgments untarnished by real world knowledge relating to contextual information. We strongly contest this belief. We find it much more plausible that *all* interpretation takes place against some assumed context, and hence that when a reader (of a linguistics paper or of an experimental stimulus) is presented with an uncontextualized sentence and required to provide a judgment about its interpretation, he or she implicitly imagines that sentence uttered in some context – one whose properties the author or experimenter is unfortunately unable to discover. In addition, it is very plausible that the reader, even if reading silently, will assign prosodic structure and perhaps an intonation pattern to the presented sentence¹²; presumably, one that is consistent with the imagined context. Given the evidence offered here for the relevance of prosody to projection (a point originally made in Beaver 2010), it is clear that we can draw only limited conclusions from judgments about factive sentences, when we do not know what prosody the readers of those sentences assigned to them.

Moreover, the kinds of sentences that are used to motivate claims about projection are utterly implausible as discourse initial utterances – unless the discourse were embedded in a very rich context indeed. So instead, it seems that uncontextualized sentences of this type are likely to be treated by interpreters as mid-discourse utterances, putting the interpreter in the position of having to guess at what the discourse might be about, and what the discourse goals and background assumptions of the interlocutors might be.

Readers of uncontextualized examples are certainly in an artificial interpretation situation. There is, however, a real world situation which closely resembles it: the case of overhearing, as when someone walks past two individuals in conversation on a street corner and hears just a snippet of their talk. In such a case, the overhearer *does* have prosodic information about the utterance, and does have some minimal information about the interlocutors, but crucially lacks information about their discourse goals or shared knowledge. So to cast some light on the source of standard judgments about factive sentences, we explore the interpretation of overheard utterances of factive sentences uttered with neutral declarative intonation. (We will characterize the relevant prosodic patterns more precisely below.) In line with the claims of the previous sections, we will argue that focus can do much of the work for us. Additional work will be done by some minimal assumptions that overhearers plausibly make about the background assumptions and beliefs of a speaker who utters a particular factive sentence.

The utterance types that we are concerned with in this section have the following prosodic features. First, they have no prosodic indication of narrow focus (i.e. focus of a constituent smaller than a complete clause). Second, they contain a nuclear pitch accent within the complement clause. To be consistent with the first property, the pitch accent in the complement must *not* be in a position consistent with narrow focus on any sub-clausal constituent of the complement clause but

¹²Fodor 2002 argues that even during silent reading, readers generate representations of sentence intonation and prosody. Breen 2014 reviews the empirical literature which has investigated this hypothesis, and concludes that there is strong evidence for implicit prosody. She reports only one study of implicit intonation, which finds in favor of its existence.

rather in a position consistent with broad focus on the entire complement. Some examples of the prosodic patterns under consideration are given in (22)-(24), but there are other variants.¹³

- (22) Jane doesn't know that it's raining.
 H* !H* H* L-L%
- (23) Jane doesn't know that it's raining.
 H* !H* !H* L-L%
- (24) Jane doesn't know that it's raining
 H* !H* L- H* H-L%

We limit attention in this section to this prosodic pattern because, as we've already shown, patterns including indicators of narrow focus do not produce straightforward projection of the complement. Moreover, we surmise that uncontextualized examples are read with this prosodic pattern, because its appropriateness does not require rich contextual assumptions. Our goal is to establish how someone who overhears such an utterance would drive a projection reading for it.

Recall that in our framework, interpretation requires determining the CQ for the utterance, and this requires assigning a focus structure to the sentence uttered. First, note that utterances of the types under consideration contain some important *negative* information about the CQ: because the speaker has *not* used any indicators of narrow focus, an overhearer (like an addressee) should assume that the CQ is no question which could have been so indicated. However, the prosodic patterns under consideration are all consistent with assignment of focus to the entire complement clause, as in (25).¹⁴

- (25) Jane doesn't know [_F that it's raining]

We then calculate the CQ in the standard way. We assume initially that the alternatives are calculated under negation, but this is not crucial; we revisit the alternative below. Under this assumption, the CQ has the form:

- (26) { Jane knows that *p*, Jane knows that *q*, Jane knows that *r*...}, where *p*, *q*, *r* ... are names of particular propositions

The structure of the alternatives is quite similar to the structure we get for a simple transitive sentence with focus on the object, as in:

- (27) Jane didn't break [_F a window].

¹³ Speakers of English can get a sense of the intended prosody by imagining how they would say this sentence if it was presented in written form with no context given and they were asked to read it aloud.

¹⁴ Another possibility for at least some of these prosodic patterns is that the entire sentence is focused. In a previous version of this manuscript, we proposed an account of projection readings for factives under such a focus assignment, but this proved too elaborate to include here. We delay further consideration of this issue for future work.

(28) {Jane broke an X, Jane broke a Y, Jane broke a Z... }, where X, Y, Z... are particular nominal predicates.

As we have already noted, CQs are associated with utterances, and hence they have a contextually given restriction on the domain. So, for example, if (27) is uttered in some context, the hearer doesn't assume that the alternatives invoked include *all* propositions of the form *Jane broke an X*, but only those where the *X* is contextually relevant and plausible for the speaker. An overhearer of (27), lacking any detailed information about the context, would have to guess what the intended contextual restriction might be. One assumption an overhearer seems licensed to make is that the alternatives under consideration exclude things that Jane could not possibly break, because they are not breakable: for example, a jellyfish, an answer, or a thunderstorm. The sense of possibility being invoked here is circumstantial possibility (Kratzer 1981). Given the way things are, it is not possible for a jellyfish to be broken. The assumption that such alternatives are ruled out is just the assumption that the alternatives under consideration respect the selectional restrictions of the predicate.

For someone overhearing an utterance of (25), the situation is the same. The alternatives in its CQ have the form shown in (26); but it is not reasonable to assume that the speaker would have in mind *all* alternatives of this form. It would instead be natural for the overhearer to assume that the speaker intends the alternatives to be restricted to some domain. Just as she is likely to assume, on hearing (27), that the intended alternatives include only things that Jane *could* break, it is likely that she will assume on hearing (25) that the intended alternatives include only things that Jane *could* know, circumstantially speaking; to put it another way, that the alternatives include only alternatives which respect the selectional restrictions of *know*. This requires that in all of the alternatives, each of the form *Jane knows that p*, *p* is a true proposition.

Of course, the speaker may be mistaken about what's true. But the interpreter's job is just to determine what the speaker is presenting as her commitments. When the speaker utters (25), she is eliminating the proposition that it's raining from the set of possibly-knowable propositions that Jane actually knows. Hence, she is treating the proposition that it's raining as possibly-knowable, hence as true.

If there were any evidence in the context that the speaker is taking into consideration alternatives which are not possibly-knowable, the interpreter could not assume this domain restriction. And indeed, the reading of (25) not involving projection of the complement arises when the speaker is taken to be willing to assert that Jane doesn't know that *p* for false *p*. However, we actually do not have definite evidence that a non-projection reading is possible with the intonation pattern under consideration, in the absence of additional contextual information.

The account given here is not entirely unlike various informal proposals that have been articulated in the past to explain the projectivity or presuppositionality of factive complements (e.g. Stalnaker 1974, Chierchia & McConnell-Ginet 2000, Simons 2004). Underlying these proposals is the idea that normally, one would not be interested in whether or not *x* knows that *p* unless one is already believes that *p*. Individuals who believe that *p* is false must also believe that *x knows that p* is false. And individuals who are uncertain whether *p*, it seems, would first want to establish the truth of *p* before considering whether *x* believes it.

The problem with accounts along these lines is that a speaker who is uncertain whether *p* could nonetheless learn (and assert) that *x* does not know that *p*, and might find this interesting as

evidence about the truth of *p*. In other words, if the conversational goal was to determine whether *p*, it might be reasonable to utter *x does not know that p*, intending a non-projection reading of the complement.

What our account crucially adds to the commonsensical proposal just outlined is sensitivity to the information structure of the uttered sentence. When a sentence of form *x doesn't know that p* is uttered with the prosodic characteristics identified here, the speaker indicates an intention to address the question *What does x know?* We can conceive of all kinds of discourse goals to which an interest in this question would be relevant. But the goal of establishing whether *p* does not seem to be one of them. Evidence for this comes from the oddity of raising question (29)b. below, when question (29)a. is currently on the table and unresolved:

- (29) a. Is it the case that *p*?
b. What does Jane know?

The oddity of this sequence is explained by the framework of Roberts 1996/2012. Roberts argues that it is appropriate to raise a new question Q2 while question Q1 is still open only if answering Q2 constitutes a rational strategy for arriving at an answer to Q1. This is so just in case any complete answer to Q2 entails at least a partial answer to Q1. Clearly, there could be many answers to (29)b which contain no information about the answer to (29)a. So, a speaker who indicates an intention to address (29)b. could not reasonably be doing so with the intention of addressing the question of the truth of *p*.

Finally, let's return to the structure of the CQ our target utterance (25). So far, we have assumed that the alternatives will be calculated under negation. The focus theory, however, allows that the alternatives might include the negation, giving the result in (30).¹⁵

- (30) {Jane doesn't know that *p*, Jane doesn't know that *q*, Jane doesn't know that *r*...}

Suppose that the alternatives are as in (30). As before, any addressee or overhearer will assume that the alternatives are intended to be restricted in some way. An overhearer can also assume that the speaker intends to say something that has a conversational point. We suggest that a natural assumption to make is that the speaker will point out propositions that Jane does not know only if there is some significance to Jane not knowing them. And lack of knowledge of true propositions is generally more significant than lack of knowledge of false propositions. Hence, the addressee is likely to assume that the speaker intends to restrict the alternatives to ones in which the complement proposition is one which she (the speaker) believes to be true.

Again, the speaker's interest in which propositions Jane doesn't know could be motivated by an interest in the truth of *p*, if the speaker considers Jane to be well informed regarding *p*. But then the question the speaker would raise is not *What doesn't Jane know?*, but *Does Jane know that p?*, which, as noted, would require a different prosody than the one under discussion.

¹⁵ It seems plausible that, in general, positive alternatives are more salient or natural to assume than negative alternatives; the question *What does Jane know* more standard to assume than the question *What doesn't Jane know*. We do not have space here, however, to give an argument in support of this.

Summarizing, we have seen that in the cases of interest, “neutral” declarative prosody, in combination with some natural assumptions about domain restriction, triggers construction of a Congruent Question that entails the truth of the factive complement, giving rise to a projection reading. The crucial step involves restricting the domain in line with the selectional restrictions of the predicate. Other ways of restricting the domain might be salient in specific contexts. However, our argument is that in the case of overhearing – the case which, we argue, is the closest natural correlate of the situation of interpreting an uncontextualized example presented in writing – this is the most natural restriction for the interpreter to assume. But as soon as we consider an utterance of the same sentence, even with the same prosody, in a different context – say, given in answer to the request *Tell me something that Jane doesn't know* – the alternatives that are constructed will be different, and a non-projection reading might be assigned, thus arguing that the projection is pragmatic, not conventionally triggered.

Throughout this section, we have demonstrated the role of intonationally indicated focus in controlling projection. Focus serves to constrain the Congruent Question assigned to an utterance; and propositions entailed by the CQ project. On this account, variety in *what* projects is entirely expected, as is sensitivity to global pragmatic considerations. In the next section, we turn in more detail to how broader discourse properties give rise to projection.

5. Beyond the congruent question: Relevance-based projection readings

So far, we have shown that the interpretation of a factive sentence depends on the Congruent Question it gives rise to. Congruent Questions themselves must be relevant to the ongoing discourse. In this section, we show that sometimes attribution to the speaker of commitment to the factive complement is a consequence of this relevance requirement. To spell this out, we need to connect our notion of CQ explicitly to the model of discourse coherence based on questions that we assume, that of Roberts 1996/2012.

Central to Roberts’ model is the *QUD stack*: the stack of questions currently under discussion. The QUD stack is an ordered push-down store, where each newly raised question is added to the top of the stack. (Questions can be raised explicitly, with interrogatives; implicitly, by question-introducing assertions; or by real world goals.) Whenever a question is answered or determined to be unanswerable, it is removed from the stack.

If discourse proceeded by raising questions and then answering them with assertions, the QUD stack would never contain more than one question. But a second central idea of the model is that once a question is raised, interlocutors may proceed by raising additional questions, explicitly or (typically) implicitly, which help to answer the original question. This gives rise to multiple open questions. A sequence of questions raised in order to answer a prior question is called a *strategy of inquiry*. Let’s illustrate this idea with a simple example (modified from Roberts 2012: 16). In this example, we assume that there are only two individuals under discussion, Hilary and Robin, and that it is contextually given that each individual ate only one food.

- (31) 1. Who ate what?
 a. What did Hilary eat?
 i. Did Hilary eat bagels?
 Ans(a₁): Yes
 b. What did Robin eat?

- ii. Did Robin eat bagels?
Ans(b₁): No
- iii. Did Robin eat tofu?
Ans(b₂): Yes

For each question q , we can identify the sequence (sometimes empty) of further questions raised to help answer q : the strategy of inquiry for q . The strategy of inquiry for question 1.b. consists of questions ii. and iii. The strategy of inquiry for question 1. consists of questions 1.a. and 1.b; but each of these has its own strategy of inquiry, which is embedded inside the strategy for question 1. Hence, strategies are hierarchical. For each strategy of inquiry, we call the question which the strategy is intended to help answer the *root* of that strategy. A strategy of inquiry is judged reasonable by a discourse participant just in case she can recognize how each question in the strategy will help to answer the root.¹⁶

Strategies of inquiry impose hierarchical structure on the QUD stack¹⁷; we can use this structure to identify a hierarchical structure within the discourse itself. Let us associate with each strategy of inquiry the segment of discourse whose first move is the move which introduces the root of the strategy, and whose last move is the answer to the most deeply embedded question in that strategy. We will call such segments *sub-inquiries*. And we will call the root of each sub-inquiry the *Discourse Question* for the sub-inquiry. These Discourse Questions correspond intuitively to the topic of the sub-inquiry, what we take that piece of the discourse to be about. In the example above, question 1 is the root of the strategy consisting of all subsequent questions (and their strategies); that question is the Discourse Question for the entire sequence of utterances.

We now need to consider how assertions are judged to cohere with the discourse. For Roberts, as for us, prosodic focus plays a central role. Roberts takes prosodic focus to carry the presupposition that the utterance is congruent with the question on the top of the QUD stack, where congruence requires (roughly) that the focal alternative set of the utterance is identical to the QUD. Often, of course, this is not the case. When it is not, according to Roberts, an appropriate question must be added (accommodated) to the top of the stack. This addition will be allowable only if the added question can be added to whatever strategy of inquiry is ongoing: in other words, if the added question is a way to help answer the root of the current strategy. If it isn't, then the utterance will be judged not to cohere with the discourse.

The terminology introduced in this paper allows us to express this point succinctly: the CQ of an assertoric utterance must be the top question on the stack. This requirement will be satisfied straightforwardly in simple question/direct answer sequences such as *Who ate the cake?* [_FBill] *ate*

¹⁶ This is essentially a Relevance constraint. Roberts imposes the constraints on the QUD stack itself, but there is no substantial difference between the approaches. Roberts formulates rather tight Relevance constraints, although she has explored ways of relaxing them in more recent work.

¹⁷ Actually, things are a little more complicated than this, because as questions are answered they are popped off the stack, so the questions in a strategy are not all in the QUD stack at the same time. See also Büring 2003, which models entire strategies as tree structures.

the cake. If the CQ is *not* identical to the top question on the stack, then it must be added as the top question – subject to Relevance constraints.

Determining whether a sequence of questions constitutes a reasonable strategy of inquiry is not necessarily straightforward. Consider the following example:

- (32) A: Is it too late to call Phil?
B: Is it after 10 o'clock?

A will judge B's question an appropriate discourse move just in case she takes it to constitute a reasonable strategy of inquiry for answering her own question. It would be, if finding out whether it is after 10 o'clock is a way to find out whether it is too late to call Phil. If it's being after 10 o'clock has no bearing on whether or not it's too late to call Phil, then B should not have asked that question. So, A is likely to infer that (B believes that) 10 o'clock is the cut-off time for calling Phil.

Clearly, the inference here is driven by the standard Gricean assumption that B intends to make a coherent contribution to the discourse. We can extend this style of explanation even to classic implicature examples. Example (33) is a minor modification of the previous example:

- (33) A: Is it too late to call Phil?
B: It's after 10 o'clock.

On the current model, we must add the CQ associated with B's utterance – plausibly, "Is it after 10 o'clock?"-- to the QUD stack. And this will induce accommodation of the assumption that 10 o'clock is the cut-off for calling Phil.

It's now time to show how all of this relates to the interpretation of factives. The point is this: sometimes, even when the content of the complement is not entailed by the CQ associated with a negated factive, that content needs to be accommodated in order to render the CQ an appropriate addition to the QUD stack – to understand it as part of a reasonable strategy aimed at addressing the DQ of the current sub-inquiry. Consider the following (necessarily complicated) scenario.¹⁸

Phil, Amy and Polly have just had lunch together. Phil and Amy are a couple, with a shared car. Amy came to lunch in that car, while Phil and Polly each arrived separately. Amy was running late so, contrary to her usual habit, parked the car in a nearby garage which requires payment, instead of parking for free a little further away. As they finished lunch, Phil volunteered to fetch the car and come back for Amy and Polly. Phil has now been gone for longer than expected. The following dialogue ensues:

- (34) Polly: Why is it taking Phil so long to get back here?
Amy: [with sudden realization] He doesn't know the car's parked in the garage!

Amy's utterance would plausibly be spoken with intonational prominence on *garage*, so the focus must be on a constituent which includes that expression.

In this short exchange, Polly's question serves as the DQ, so Amy's utterance must be relevant to it – it should be an answer to that question. To make sense of it as an answer, Polly must identify some causal link between Phil's not-knowing that the car is in the garage, and the delay in

¹⁸ This example is a variant on one due to Daniel Drucker (p.c.).

his return. Here is an obvious connection: if the car is in the garage but Phil doesn't know it, then he won't look for it there, won't find the car, and will be delayed. If that is the intended explanation, then Amy's utterance must be given a projection reading.

However, there is at least one other way to make Amy's assertion relevant to Polly's question. Suppose that the car is not in the parking garage, but Phil falsely believes that it is, and is looking for the car there.¹⁹ Then it is true that he doesn't know that the car is in the parking garage, and his not knowing explains why he is delayed. But in order for Polly to construct this explanation of Amy's utterance, she would have to infer that although Phil does not *know* that the car is in the parking garage, he does *believe* it, and to construct further inferences about Phil's actions on the basis of this.

But how could Polly be expected to make this inference from not-knowing to believing? This would require a context which entails that either Phil knows that the car is in the garage, or he believes it. But the context doesn't have this entailment, so it would be unreasonable for Amy to expect Polly to make this inference. Moreover, if the context *did* have this entailment, then Amy's utterance would be intended to address the following question:

(35) {Phil knows that the car is in the garage, Phil believes that the car is in the garage}

But if these were the intended alternatives, then Amy would have used intonation which indicates narrow focus on the attitude verb, contrary to the initial assumptions. So it is both practically unreasonable, and inconsistent with information-structural evidence, that Amy intends this inference.

The entire analysis just given could be reformulated in terms of the CQ. Given the intonation assumed for Amy's utterance, multiple focus assignments are possible, but perhaps most plausible is that the entire sentence is focused (as none of the content has recently been mentioned). We take this focus assignment to be consistent with the CQ being the polar question *Does Phil know that the car's parked in the garage?* On the account laid out above, this question must be added to the QUD stack, which requires that it be understood as relevant to Polly's question, the DQ. It is relevant to the DQ just in case answering it helps to answer the DQ. We have already established that one answer to the CQ, the one that Amy gives in her assertion, can do so – under a projection reading of the answer.

Whether we articulate the account in classical Gricean terms, invoking relevance of the assertion, or in terms of the DQ and CQ, the account must explain how relevance between the question and answer is established. Both articulations make clear that relevance requires the hearer to attribute to the speaker the belief that the car is in the garage. However, information structure provides essential constraints on the reasoning involved. The DQ/CQ version of the account can thus make predictions which are not found in standard Gricean reasoning.

¹⁹ This observation due to David Manley, p.c.

In the account of example (34), the veridicality of *know* plays no role.²⁰ Sure enough, we find that veridicality is not essential in generating the implication in this case. Consider this variant of the example:²¹

(36) Polly: Why is it taking Phil so long to get here?

Amy: He didn't believe that the car's parked in the parking garage.

By reasoning very similar to that described above, Polly will conclude that the car is parked in the parking garage; otherwise, Phil's non-belief would be irrelevant to answering her question.

Advocates of the standard approach to projection in factive sentences offer entirely different accounts of how the speaker becomes committed to the truth of the complement in examples (34) and (36). We suggest that the two cases have explanations of the same sort. However, in other cases, semantic differences between *know* and *believe* lead to differences in projection behavior. One crucial difference is that *know* is veridical, while *believe* is not. This affects the predictions of our account in many cases. For example, the reasoning discussed in section 4.3. with respect to overheard utterances of negated *know* sentences relies crucially on this veridicality, and hence does not apply to overheard utterances of negated *believe* sentences. So our account does not predict that overheard utterances of negated *believe* sentences will normally be given projection readings. But in this particular case, the projection reading of the *know* sentence is a consequence of general considerations of conversational coherence. In this discourse situation, a claim about Phil's belief will play the same discourse role as a similar claim about Phil's knowledge, and hence both require accommodation of the same proposition.

The examples above show how coherence with the DQ may give rise to projection of the factive complement. In other cases, similar considerations lead to the conclusion that the speaker is ignorant of the truth of the complement, preventing projection. The examples in section 4.2.2. are of this type. Consider again example (13):

(13) ...I haven't tried this with wombats though, and if anyone discovers that the method is also wombat-proof, I'd really like to know. (Beaver 2010, ex.(32))

In the context – a description by the writer of a new method s/he has devised for keeping animals out of the chicken pen – it is clear that when the writer says that s/he hasn't *tried* the method with wombats, it follows that she doesn't know whether or not it works with wombats.²² Any interpretations of the second conjunct that attribute to the speaker the assumption that the method works with wombats are ruled out, and hence the content of the factive complement cannot project.

²⁰ A verb *V* is veridical iff an atomic sentence *S* with main verb *V* entails the truth of the clausal complement of *V*. *know* is veridical because sentences of the form *a knows that p* entail *p*.

²¹ This example due to Ezra Keshet (p.c.). While this utterance implies also that Amy had told Phil that the car is parked in the parking garage, there is no implication that Polly was aware of that previous exchange.

²² A natural move here would be to say that the utterance introduces onto the stack not only its CQ, but also the topical DQ *Does the method work with wombats?* We do not yet have any systematic account of the introduction of implicit questions which are not CQs.

If the intonation pattern on the conditional were consistent *only* with a CQ which entails the factive complement, we predict that the utterance would be judged infelicitous. But for reasons of space, we cannot look at this issue in detail.

In summary, we have argued in this section that commitment to the content of a factive complement is sometimes the consequence of quite general considerations of discourse coherence, which we model in terms of the construction of reasonable strategies of inquiry. We note that these considerations apply to factive and non-factive sentences alike, which explains why the complement of *believe* is sometimes be taken to be a commitment of the speaker. In situations where general discourse considerations are in conflict with prosodic indicators of the CQ, we expect infelicity to occur, but must save detailed consideration of relevant cases for another occasion.

6. Conclusion

We've argued that the projection of complements of cognitive factive attitude verbs – and perhaps of non-factive attitude verbs too – can be explained by reference to the questions which sentences containing these verbs are understood to address. We have argued that this type of account explains observations about variability as to what, if anything, projects. And we have accounted in detail for the observed sensitivity of projection to indicators of information structure.

In Simons et al. 2010, we hypothesized that all and only those implications of embedded sentences which are not-at-issue relative to the question under discussion have the potential to project. This is a hypothesized descriptive generalization (which is still under investigation), and does not describe a mechanism whereby not-at-issue content comes to project. In subsequent work (Tonhauser et al. 2013), we demonstrated that there are several subtypes of not-at-issue, projective content. It is entirely plausible that each subtype becomes projective through different mechanisms.

In this paper, we have focused on factives, a sentence type where the division of content into at-issue and not-at-issue is not fixed at the sentence level, but only at the utterance level, where speakers signal their intentions as to what question they intend to address. We have spelled out an account of the relation between intended questions, and projection of content. Content which projects is either not-at-issue because entailed by the CQ; or not-at-issue because required to be invariant across all alternatives (true in the assumed common ground) in order to render the CQ of an utterance conversationally coherent. In both cases, the content which projects is content which does not address any current conversational question, either the CQ or the DQ.

In arguing against conventional triggering, our account is in the tradition of pragmatic approaches to presupposition and projection. Moreover, the theory is no radical departure from familiar Gricean pragmatics. In many cases, standard Gricean explanations can be restated in terms of Questions under Discussion with no loss, and vice versa. However, standard Gricean theory cannot account for interactions between information structure and projection such as we have discussed here and in our prior work. It is precisely these interactions which make manifest the advantage of recasting and developing Gricean theory in terms of questions, since information structural marking is the device that languages use in order to relate an utterance to Questions under Discussion. That is why we have sought in this paper to model projection in terms of a question-based extension to Gricean theory.

7. References

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