Surprise for Lauri Karttunen*

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Abstract

This paper is written in honor of Lauri Karttunen's seminal contributions to formal semantics, in particular his work on discourse referents (Karttunen, 1969), presuppositions (Karttunen, 1973, 1974) and questions (Karttunen, 1977). The present paper is connected to all these lines of work, suggesting that a long-standing issue concerning question embedding verbs like surprise, raised in Karttunen (1977), can be resolved by assuming that such verbs involve a presupposition that is sensitive to the discourse referents introduced by their complement.

1 Introduction

The first issue that Karttunen (1977) considers in his article on embedded questions is whether all such questions should be taken to belong to the same syntactic category. In particular, he raises the issue whether wh-questions should be treated as belonging to the same syntactic category as whether-questions. Karttunen (p.5) writes:

> "These two types of questions have virtually the same syntactic distribution. Nearly all verbs which take wh-questions as complements also take whether-questions. A verb which doesn't allow embedded wh-questions in general doesn't complement with whether-questions either. This is illustrated in (1) and (2).

(1)   a.   John knows what they serve for breakfast.
          b.   John knows whether they serve breakfast.

(2)   a.   *John assumes what they serve for breakfast.
          b.   *John assumes whether they serve breakfast.

There are two classes of exceptions to this generalization, both of which seem marginal to me. So-called 'emotive factives', such as amaze, surprise, and bother take wh-questions but do not allow whether-questions. Dubitative verbs, such as doubt, question, and be dubious, have the opposite characteristic. This is shown in (3) and (4).

(3)   a.   It is amazing what they serve for breakfast.
          b. *It is amazing whether they serve breakfast.

(4)   a. *I doubt what they serve for breakfast.
          b.   I doubt whether they serve breakfast.

The ungrammaticality of (3b) and the grammaticality of (4b) pose problems for me and require some special treatment. Nevertheless, it seems correct to assume, in the light of the great majority of cases of overlapping distribution, that wh-questions and whether-questions should be assigned to the same syntactic category."

In much subsequent work on questions, Karttunen's conclusion has been taken to heart. However, if wh-questions and whether-questions are indeed taken to be of the same syntactic category, a semantic or pragmatic explanation is needed for the contrasts in (3) and (4). Our focus will be on the first type of contrast, i.e., on emotive factive verbs like amaze, surprise, bother, disappoint, please, etcetera, which can take wh-questions as their complement but not whether-questions. We refer to this phenomenon as the *whether puzzle.[1]

Several accounts of the puzzle have been suggested; some semantic in nature (d'Avis, 2002; Abels, 2004; Nicolae, 2013; Romero, 2015), others pragmatic (Guerzoni, 2007; Sæbø, 2007). Each of these proposals, however, still has certain shortcomings.[2] In particular, as already noted by Egré (2008), one of the assumptions that is crucial for the pragmatic approaches, namely the assumption that emotive factives involve so-called *speaker factivity* (Guerzoni and Sharvit, 2007), faces systematic counterexamples. Furthermore, as pointed out in Roelofsen *et al.* (2016), these approaches do not account for examples that are somewhat more complex than the ones above, e.g., ones like (5) where the subject is quantificational rather than referential.

(5)   *Every guest was amazed whether he got breakfast.

The semantic approach initiated by d'Avis (2002) and further developed by Abels (2004), on the other hand, accounts for the fact that emotive factives do not take plain polar whether-questions as their complement, but it does not account for the fact that such verbs do not take *alternative questions* as their complement either, as illustrated in (6).

(6)   *It is amazing whether they serve eggs for breakfast, or cereals.

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[1]A semantic explanation of the second type of contrast, involving verbs like doubt, has been suggested in Pruitt and Roelofsen (2011); Farkas and Roelofsen (2012); Biezma and Rawlins (2012). However, as soon as we look beyond English such a semantic explanation becomes highly problematic, since the cross-linguistic behavior of verbs like doubt is far from stable. For instance, Italian dubitare only licenses that-complements, no whether- or wh-complements. See also footnote 12.

[2]Only a very brief discussion of these previous proposals is included here. For more extensive discussion see Roelofsen, Herbstritt, and Aloni (2016).

Finally, the semantic accounts of Nicolae (2013) and Romero (2015) predict that emotive factives are not only incompatible with whether-complements, but also with wh-complements receiving a strongly exhaustive interpretation. This prediction is controversial: while Heim (1994) and Guerzoni and Sharvit (2007), among others, have indeed claimed that wh-complements under emotive factives cannot receive a strongly exhaustive interpretation, more recently Klinedinst and Rothschild (2011) and Theiler (2014) have argued that they *can*, and experimental results of Cremers and Chemla (2016) seem to confirm this. These results are unexpected on Nicolae's and Romero's explanations of the *whether puzzle.[3] An additional problem for Romero's account is that it only applies to alternative questions. As noted by Romero herself, it remains to be seen whether it can be extended to polar questions.

We offer an account of the puzzle that explains the unacceptability of both polar and alternative questions, including cases with quantificational subjects, which does not need to assume speaker factivity, and which does not rely on any mechanism that prohibits strongly exhaustive wh-complements under emotive factives.

Interestingly, while mainly concerned with question embedding, the account is tightly connected to two other areas where Karttunen's work has been highly influential as well. Namely, the key idea is that emotive factive verbs involve a *presupposition* (Karttunen, 1973, 1974) that is sensitive to the *discourse referents* (Karttunen, 1969) introduced by their complements. While it is generally accepted that the discourse referents introduced by matrix questions are important to understand their role in discourse, in particular their potential to license discourse anaphora, we argue here that this dynamic aspect of meaning is also crucial for understanding embedded questions and the verbs that take such questions as their complement.

2 Proposal

In order to get a handle on the puzzle, we first need to understand what the crucial difference is between wh-questions and whether-questions, and second, what the relevant difference is between emotive factives and other question embedding verbs. We will consider these two issues in turn.

2.1 The difference between **wh-questions** and **whether-questions**

A first important observation is that it is impossible to account for the given contrast between wh-questions and whether-questions just in terms of their answerhood/resolution conditions. To see this, consider the following examples (see Romero, 2015, for a different example making the same fundamental point).

(7)   *Context: Ann and Chris have placed an order online. They are kept up to date about the status of the order, which is first 'in progress' and then at some point turns into 'sent'. Ann looks at her email and then tells Chris:*
   a.   It is surprising what the status of the order is.
   b.   *It is surprising whether the order is still in progress.

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[3]See Romero (2016) for some ideas on how Cremers and Chemla's results might be reconcilable with her proposal.

The two embedded questions in these examples have exactly the same resolution conditions: if a certain piece of information resolves one of them, then it resolves the other as well. And yet, the wh-question in (7a) is licensed while the whether-questions in (7b) is not. So to account for the *whether puzzle, we have to look beyond resolution conditions. What is it, then, that distinguishes whether-questions from wh-questions?

Our answer is based on a contrast that is parallel to the one in (7), though this time it involves two *matrix* questions, rather than embedded ones, and the contrast between them concerns their ability to license yes/no responses.

(8) *Context: Ann and Chris have placed an order online. They are kept up to date about the status of the order, which is first 'in progress' and then at some point turns into 'sent'. Ann hasn't looked at her email for a while so she asks Chris about the status of the order.*
   a. Ann: Is the order still in progress?
       Chris: Yes, it is. / No, it isn't.
   b. Ann: What is the status of the order?
       Chris: *Yes, it is. / *No, it isn't.

The two questions in (8), just like their embedded counterparts in (7), have exactly the same resolution conditions. Thus, in order to explain the difference that exists between them when it comes to licensing yes/no responses, we again have to look beyond resolution conditions. In this case, however, it is quite clear in which direction we should look. Namely, it is natural to think of yes and no as anaphoric expressions, and we know that such expressions are only interpretable in the presence of suitable antecedents. Plausibly, then, what explains the contrast between the polar question in (8a) and the wh-question in (8b) is that the former introduces a discourse referent that can serve as an antecedent for yes and no, while the latter doesn't. This is indeed what is assumed in recent accounts of yes/no responses (e.g., Krifka, 2013; Roelofsen and Farkas, 2015).

The hypothesis that we will pursue is that the difference between polar questions and wh-questions that is responsible for the contrast in (8) is also responsible for the contrast in (7). We assume that this difference, in general terms, concerns the semantic objects that the two types of questions bring into **salience**—or, in the terminology of Roelofsen and Farkas (2015), the semantic objects that they **highlight**. It is natural to assume that such highlighted objects become available as discourse referents, serving as potential antecedents for subsequent anaphoric expressions. This makes it possible to account for the contrast in (8). On the other hand, we will show that it also leads to an account of the *whether puzzle, under the assumption that emotive factive verbs like surprise are sensitive to the semantic objects highlighted by their complement.

To make this more concrete, let us consider the sentences in (9) and see which semantic objects they may plausibly be taken to highlight.

(9) a. They serve breakfast.
     b. Do they serve breakfast?
     c. Do they serve eggs for breakfast, or cereals?
     d. What do they serve for breakfast?

First, following Krifka (2013) and Roelofsen and Farkas (2015), we assume that both the declarative in (9a) and the polar question in (9b) highlight the proposition 'that they serve breakfast'. Indeed, it appears that this proposition can be anaphorically referred

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to by yes and no:

(10)   They serve breakfast. / Do they serve breakfast?
    a.   Yes.   ⤳ they serve breakfast
    b.   No.   ⤳ they don't serve breakfast

Similarly, we assume that the alternative question in (9c) highlights two propositions: 'that they serve eggs for breakfast' and 'that they serve cereals for breakfast'. These propositions cannot be referred to by yes and no, presumably because these expressions require a *unique* most salient antecedent, just like anaphoric pronouns (Krifka, 2013; Roelofsen and Farkas, 2015); however, the two highlighted propositions *can* be referred to by means of anaphoric expressions that have slightly more descriptive content, like the former and the latter.

(11)   Do they serve eggs for breakfast, or cereals?
    a.   The former.   ⤳ eggs
    b.   The latter.   ⤳ cereals

Finally, we assume that the wh-question in (9d) does not highlight a proposition, but rather a *property*, i.e., a function from entities to propositions (cf., Groenendijk and Stokhof, 1984; Krifka, 2001; Aloni *et al.*, 2007; Roelofsen and Farkas, 2015). More specifically, we assume that the property highlighted by (9d) is the function that maps every entity x to the set of worlds where x is served for breakfast:[4]

(12) $\lambda x.\lambda w.$they-serve-for-breakfast$(x)(w)$

Groenendijk and Stokhof (1984) assume that this property is anaphorically accessed in the interpretation of short answers to the given question, as in (13a), and even in the interpretation of full sentential answers, to compute their exhaustive interpretation, as in (13b).[5]

(13)   What do they serve for breakfast?
    a.   Eggs and cereals.   ⤳ they only serve eggs and cereals
    b.   They serve eggs and cereals.   ⤳ they only serve eggs and cereals

To generalize over the various cases considered, it is useful to view propositions as 0-place properties. All sentence types considered, then, highlight one or more n-place properties, where $n \geq 0$ is the number of wh-elements in the sentence. The declarative in (9a) and the polar question in (9b) both highlight a single 0-place property, i.e., a proposition, the alternative question in (9c) highlights two 0-place properties, i.e., two propositions, and

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[4]Groenendijk and Stokhof (1984) call this the *abstract* of the question.

[5] It should be noted that Groenendijk and Stokhof's account of short answers and exhaustivity are not uncontroversial. On the one hand, some authors have argued that short answers actually involve *ellipsis*, and their interpretation involves reconstructing the syntactic structure of the elided material rather than purely anaphoric access to the semantic property made available by the question (see, e.g., Merchant, 2005 for such a proposal, and Jacobson, 2012 for a critique of it). On the other hand, some authors have argued that the exhaustive interpretation of answers to questions comes about through pragmatic reasoning, rather than a semantic process that involves anaphoric access to the property made salient by the question (see, e.g., Westera, 2017). Be this as it may, it remains plausible to assume that wh-questions bring a certain property into salience which could in principle serve as the antecedent for subsequent anaphora, and which could play other roles in the interpretation process as well.

the wh-question in (9d) highlights a 1-place property.

Now let us turn to the *embedded* variants of (9a)-(9d), given in (14a)-(14d):

(14)   a.   Peter knows that they serve breakfast.
       b.   Peter knows whether they serve breakfast.
       c.   Peter knows whether they serve eggs for breakfast, or cereals.
       d.   Peter knows what they serve for breakfast.

Of course, the simplest assumption is that these embedded clauses highlight exactly the same properties/propositions as the corresponding matrix clauses. For declaratives, wh-questions, and alternative questions, this assumptions indeed seems uncontroversial. In the case of polar questions, however, it has been argued by Starr (2014, p.6) that there is in fact a difference in highlighting between matrix and embedded cases. Namely, Starr argues that, while a matrix polar question like (9b) only highlights the proposition 'that they serve breakfast', an embedded polar question headed by whether also highlights the proposition 'that they don't serve breakfast'. He further argues that this is specific for embedded polar questions headed by whether; ones that are headed by if instead highlight only one proposition, just like the corresponding matrix question. The argument rests on the empirical claim that the choice between if and whether influences the anaphoric availability of the positive answer. To substantiate this claim, Starr offers the following minimal pair (the judgments given here are his):

(15)   a.   I wonder if Bob will dance. Then Leland will dance.
       b.   I wonder whether Bob will dance. ??Then Leland will dance.

This contrast, however, does not seem to be very clear-cut. There are certainly many cases in which anaphoric reference to the positive answer to a whether-question embedded under wonder is fine, as illustrated in (16)-(17):

(16)   I wonder whether you are still interested to go see the show, because then I'll have to make a reservation.

(17)   There is an incomplete backup and I wonder whether that's the problem. If so, is it ok to delete it?   [from the web]

It seems fair to conclude that more empirical work is needed to determine what exactly is highlighted by whether-complements. It is clear, however, that there are only two natural options: either they highlight one proposition, just like the corresponding matrix question and, presumably, the corresponding if-complement, or they highlight two propositions, the one highlighted by the corresponding matrix question as well as its set-theoretic complement. We will not try to settle here which of these assumptions is right. Rather, we will show that on either assumption, the *whether puzzle can be accounted for. For now, note that on either assumption there is a contrast between polar and alternative questions on the one hand and wh-questions on the other; the former highlight 0-place properties, i.e., propositions, while the latter highlight n-place properties, with $n \geq 1$.

So we have found a semantic distinction between whether-questions and wh-questions, one that is motivated by considerations involving anaphora, independently from the empirical phenomenon that we aim to account for here. What about the other ingredient of the puzzle, emotive factive verbs? What distinguishes them from other verbs, and how does this distinguishing feature interact with the difference in highlighting between

whether-questions and wh-questions?

2.2 The difference between emotive factives and other verbs

2.2.1 An empirical contrast

We start with an empirical observation due to d'Avis (2002): when surprise takes a wh-question as its complement, it triggers a strong existential presupposition. For instance, (18) below implies that something is served for breakfast, and this implication is preserved under negation.

(18)   It is surprising what they serve for breakfast.
         ↝ they serve something for breakfast

(19)   It is not surprising what they serve for breakfast.
         ↝ they serve something for breakfast

This presupposition seems to be characteristic for emotive factives in general. For instance, (20) also implies that something is served for breakfast, and this implication is again preserved under negation.

(20)   It is disappointing/pleasing what they serve for breakfast.
         ↝ they serve something for breakfast

(21)   It is not disappointing/pleasing what they serve for breakfast.
         ↝ they serve something for breakfast

Note that it is odd to cancel the existential implication with if anything.

(22)   It is surprising what they serve for breakfast, *if anything.

(23)   It is disappointing/pleasing what they serve for breakfast, *if anything.

This contrasts with other verbs:

(24)   The hotel manager knows/will tell you what they serve for breakfast, if anything.

2.2.2 Intensional, extensional, and instancional verbs

Which general feature of emotive factives could be behind the existential presupposition observed by d'Avis? We propose the following. Intuitively, emotive factives, when taking a wh-question as their complement, express a certain emotion/attitude (surprise, disappointment, happiness, et cetera) about one or multiple **true instances** of the property highlighted by the wh-question. For instance, to be surprised at who passed the exam is to be surprised about one or more people who did in fact pass the exam that they did. So, in order to be surprised at who passed, there has to be someone who passed.

Other verbs behave differently. First consider other factive verbs like know, remember, and discover. These express knowledge, memory, and discovery, respectively, of the **true extension** of the property highlighted by the wh-question, not necessarily of any true instances of this property—in case the true extension of the property is empty, there are no such instances. For example, to discover who passed the exam is to discover of the set of people who did in fact pass that they are the ones who did. If nobody passed the exam, this set of people is empty. However, one can still discover who passed the exam

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in this case, because, unlike in the case of surprise and other emotive factives, such a discovery does not have to involve any true instances of the property highlighted by the question, it just concerns the true extension of this property.

Leaving the realm of factive verbs and turning to non-factives like be certain, agree, and wonder, we again find a shift in subject matter. Namely, these verbs are not about the *true* extension of the property highlighted by the wh-question, i.e., its extension in the actual world, but rather about the **intension** of this property, or equivalently, its various extensions across different possible worlds. Thus, these verbs certainly do not express an attitude pertaining specifically to one or multiple true instances of the property highlighted by their complement, and as a consequence they do not require the existence of such true instances. For example, one can very well wonder who passed the exam if in fact nobody did. The wondering does not have to be about some particular person who passed.

These considerations lead us to a refinement of the traditional distinction between extensional and intensional question-embedding verbs, made by Groenendijk and Stokhof (1984) and adopted in much subsequent work. This basic distinction separates verbs like know, remember, and discover on the one hand from ones like be certain, agree, and wonder on the other. Under this classification, emotive factives fall into the class of extensional verbs, together with know, remember, and discover. What we have seen, however, is that within this general class a further natural distinction can be made. On the one hand, verbs like know, remember, and discover express attitudes about the true extension of the property highlighted by their wh-complement, while emotive factives like surprise and disappoint actually express attitudes about something more specific, namely one or more true instances of this property. To mark this distinction, we will only refer to the former as proper extensional verbs, and to the latter as **instancional** verbs. Our hypothesis is that all verbs which have been earmarked in the literature as 'emotive factives' are instancional verbs, and that it is this property which explains their incompatibility with whether-questions. Let us see why.

2.2.3 Instancional verbs presuppose the existence of true instances

Since instancional verbs express attitudes about true instances of the property highlighted by their wh-complement, it is natural to assume that they presuppose the existence of such true instances. To make this more precise, let us say that an n-place property P has a true instance in a world w just in case there is a tuple t of n individuals such that $P(t)$ is true in w. Note that if P is a 0-place property, i.e., a proposition, then it has a true instance in w just in case it is itself true in w.

The existential presupposition of instancional verbs can then be formulated as follows.

(25)   **Existential presupposition of instancional verbs**
         Instancional verbs presuppose that every property highlighted by their comple-
         ment has a true instance in the world of evaluation.

To illustrate this, consider again the example in (18). The wh-complement in this sentence highlights a 1-place property:

(26) $\lambda x.\lambda w.\text{they-serve-for-breakfast}(x)(w)$

The presupposition triggered by surprise, then, is that this property has a true instance in the world of evaluation, i.e., that something is served for breakfast. This is exactly the

existential requirement observed by d'Avis (2002).

Now consider what the presupposition in (25) amounts to when surprise takes a declarative complement, as in (27):

(27)   It is surprising that they serve breakfast.

In this case, the complement highlights a 0-place property, i.e., a proposition, namely the proposition 'that they serve breakfast':

(28) λw.they-serve-breakfast(w)

The presupposition triggered by surprise, then, is that this proposition is true—a standard *factivity* presupposition. So, when applied to a wh-complement the presupposition postulated in (25) yields the existential requirement observed by d'Avis, and when applied to a declarative complement it yields standard factivity.

Notice that the existential presupposition in (25) requires that *every* property that is highlighted by the complement clause (rather than, say, *at least one* of these properties) should have a true instance in the world of evaluation. To justify this, we have to consider a somewhat more complex case.

(29)   It is surprising what they serve for breakfast and what they serve for lunch.
        ⤳ Presupposition: they serve something for breakfast and something for lunch

Assuming that the conjunctive complement in (29) highlights two 1-place properties, each contributed by one of the wh-clauses, the observed presupposition is predicted by (25). It is crucial in this case that *every* property highlighted by the complement is required to have a true instance, rather than just one of these properties.

One might be tempted to raise an objection against this argument by pointing out that (29) may actually be seen as an elided version of (30) below, where conjunction does not apply to the interrogative complement clauses but rather to the declarative root clauses (the part that must be elided in order to obtain (29) is displayed in gray).

(30)   It is surprising what they serve for breakfast and it is surprising what they serve for lunch.

Under this analysis, it is possible (given certain assumptions about presupposition projection) to derive the conjunctive presupposition of (29) even if the existential presupposition associated with instancional verbs just requires that at least one of the properties (rather than every property) highlighted by the complement clause have a true instance.

This does not invalidate our argument, however, for two reasons. First, while (29) *could* indeed be seen as an elided version of (30), it could also be analyzed as involving conjunction directly at the level of the interrogative complement clauses. Thus, if we adopted a weaker formulation of the existential presupposition in (25), it would still be predicted that (29) *has a reading* under which it only presupposes that something is served for either breakfast or lunch—a prediction that should be avoided.

Moreover, it is easy to construct a variant of (29) which is immune to the objection considered here. A case in point is (31).

(31)   It is only surprising what they serve for breakfast and what they serve for lunch.
        (. . . It is not surprising what they serve for dinner)
        ⤳ Presupposition: they serve something for breakfast and something for lunch

The conjunctive presupposition is still present, and clearly this sentence cannot be analyzed as an elliptical version of (32) below, where conjunction again applies to the declarative root clauses instead of the interrogative complement clauses.[6]

(32)   It is only surprising what they serve for breakfast and it is only surprising what they serve for lunch.

Another potential objection, brought up an anonymous reviewer, concerns cases like (33), where the two interrogative complements are *disjoined* rather than conjoined.

(33)   It is surprising what they serve for breakfast or what they serve for lunch; I forget which meal they are open for.

The reviewer suggests that the existential presupposition as formulated in (25) wrongly predicts that (33) should be anomalous, because the sentence would inconsistently presuppose that something is served for breakfast and something is served for lunch, while also implying that only one of those meals is available.

Upon closer inspection, however, this prediction does not arise. After all, as we saw for the conjunctive case in (29) above, (33) may be analyzed as an elided version of (34) below, where the disjunction does not apply directly to the interrogative complement clauses but rather to the declarative root clauses.

(34)   It is surprising what they serve for breakfast or it is surprising what they serve for lunch; I forget which meal they are open for.

Under this analysis no contradiction arises. Thus, (33) is not predicted to be anomalous.

We conclude that there are good reasons to formulate the existential presupposition of instancional verbs as we did in (25). With this in place, we now specify concrete, semi-formal lexical entries for some emotive factives.

2.2.4   Lexical entries for some emotive factives

Below we provide semi-formal entries for surprise, bother, and please. We consider three different verbs in order to show that they can all be taken to follow the same pattern. We assume that this extends to other emotive factives as well; in particular, we take it that all emotive factives have the same presuppositional component (conditions 1 and 2 below). After having spelled out the entries for surprise, bother, and please, we will zoom in on the case of surprise and discuss some specific features of its entry in more detail.

(35) $[\![\varphi \text{ surprises } x]\!]^w$ is defined iff conditions 1-2 below hold, and true iff 1-3 hold:

1. Every property P highlighted by φ has at least one **true instance** in w;

2. One or more of these true instances, $P(t_1), \ldots, P(t_m)$, where $m \geq 1$, are such that x **believes** $P(t_1) \wedge \ldots \wedge P(t_m)$ in w;

3. $P(t_1) \wedge \ldots \wedge P(t_m)$ is incompatible with x's **prior expectations** in w.

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[6]We refer to the appendix of Roelofsen *et al.* (2016) for some further discussion of this issue, including supporting evidence from Hungarian, which, according to Szabolcsi (1997, 2015), overtly marks whether the two interrogative clauses in cases like (29) are directly conjoined or first composed with the verb before conjunction applies.

(36) $[\![\varphi \text{ bothers } x]\!]^w$ is defined iff conditions 1-2 below hold, and true iff 1-3 hold:

    1. Every property P highlighted by φ has at least one **true instance** in w;

    2. One or more of these true instances, $P(t_1), \ldots, P(t_m)$, where $m \geq 1$, are such that x **believes** $P(t_1) \wedge \ldots \wedge P(t_m)$ in w;

    3. $P(t_1) \wedge \ldots \wedge P(t_m)$ is incompatible with x's **preferences** in w.

(37) $[\![\varphi \text{ pleases } x]\!]^w$ is defined iff conditions 1-2 below hold, and true iff 1-3 hold:

    1. Every property P highlighted by φ has at least one **true instance** in w;

    2. One or more of these true instances, $P(t_1), \ldots, P(t_m)$, where $m \geq 1$, are such that x **believes** $P(t_1) \wedge \ldots \wedge P(t_m)$ in w;

    3. $P(t_1) \wedge \ldots \wedge P(t_m)$ satisfies x's **preferences** in w.

To illustrate the predictions that arise from the entry for surprise when it takes a wh-complement, consider the following example:

(38)   It surprises Peter who came to the party.

First of all, it is predicted that this sentence presupposes that at least one person came to the party. Second, the sentence is predicted to presuppose that for one or more people who came, Peter believes that they came. And finally, if $t_1, \ldots, t_m$ are the people of which Peter correctly believes that they came, the sentence is predicted to assert that the fact that $t_1, \ldots, t_m$ came is incompatible with Peter's prior expectations.

    For instance, if Mary, Bill, and Susan came, Peter only believes of Mary that she came, and he had not expected Mary to come, the sentence is predicted to be true. If Mary, Bill, and Susan came, Peter believes of Mary and Bill that they came, and he had not expected that they would both come (e.g., because they are known to hate and avoid each other), the sentence is also predicted to be true. On the other hand, if Peter knows that Mary and Bill came but Susan didn't, while he had expected Susan to come as well, the sentence is not predicted to be true.

    As mentioned at the outset, there is disagreement in the literature concerning the exact range of possible interpretations of wh-questions under surprise. While George (2011, 2013) proposes that surprise only allows for non-exhaustive ('mention-some') readings of wh-complements, Heim (1994) and Guerzoni and Sharvit (2007) suggest that it only allows for weakly exhaustive readings, and Klinedinst and Rothschild (2011) and Theiler (2014) argue that strongly exhaustive readings are also possible. Experimental results of Cremers and Chemla (2016) confirm the availability of strongly exhaustive readings. At a more fine-grained level, Spector and Egré (2015) argue that the epistemic presuppositional component of the verb (our condition 2) should involve strong exhaustivity, though not the assertive component (our condition 3). Finally, Theiler (2014) distinguishes between a *literal* and a *deductive* reading of the verb, and argues that strong exhaustivity arises only on the deductive reading.

    We do not want to and do not need to take a stance in this debate. The predictions of our entry as formulated above are in line with George (2011, 2013), but the entry could easily be adapted in order to generate exhaustive readings, and the distinction between literal and deductive readings could be incorporated as well. As far as we can see, this would not affect our account of the *whether puzzle.

Now let us consider the predictions that arise from the entry in (35) when surprise takes a declarative complement. Consider the following example:

(39)   It surprises Peter that Mary came to the party.

In this case the complement highlights a 0-place property, i.e., a proposition, namely the proposition that Mary came to the party. The sentence is predicted, first of all, to presuppose that this proposition is true. This captures the fact that surprise is a factive verb. Second, the sentence is predicted to presuppose that Peter believes that Mary came to the party. And finally, it is predicted to assert that the fact that Mary came is incompatible with Peter's prior expectations. These predictions appear to be right.

Two general features of our entry for surprise are worth emphasizing. First, as we have just exemplified, the entry applies in a uniform way to declarative and interrogative complements. This contrasts with the most common approach to responsive verbs, which is to view their declarative-embedding variant as basic, and then to *reduce* their interrogative-embedding variant to their declarative-embedding variant (see, e.g., Karttunen, 1977; Lahiri, 2002; Spector and Egré, 2015). Although we cannot substantiate our choice for a uniform approach in any detail here, we would like to note that this choice is not arbitrary; we believe that the uniform approach has significant advantages over the reductive one (see Theiler *et al.* 2016).

Second, note that our entry for surprise does not make direct reference to the truth conditions or resolution conditions of the complement φ; rather, it only makes reference to the properties/propositions that are highlighted by φ. While this keeps the entry neat and simple, it is not essential for our account of the *whether puzzle. What *is* essential is that the presupposition requiring the existence of at least one true instance (condition 1) is formulated in terms of highlighting. The other two conditions could in principle be formulated in terms of truth/resolution conditions rather than highlighted properties/propositions.

Related to this, one may wonder whether the truth/resolution conditions of a sentence may in general be *derived* from the properties/propositions that it highlights. In that case, our semantics would not have to compute truth and resolution conditions recursively at all. However, this is not possible. To see this, recall that a declarative sentence (e.g. Bill is sleeping) and the corresponding polar question (e.g., Is Bill sleeping?) both highlight the same proposition. Clearly, the two sentences do not have the same truth/resolution conditions. Thus, highlighting cannot in general *replace* truth/resolution conditions as the core notion of our semantics.[7]

2.3   Back to the *whether puzzle

We have seen that when surprise takes a wh-complement, the presupposition that every property highlighted by the complement has to have at least one true instance amounts to the existential requirement observed by d'Avis, and when surprise takes a declarative complement, the presupposition amounts to standard factivity. Now, what if surprise takes a whether-complement?

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[7]If we leave declarative sentences and truth conditions out of the picture, focusing solely on questions, then highlighting *could* be taken as the basic notion of our semantics, with resolution conditions as a derived notion. Such an approach is explicitly taken in Aloni *et al.* (2007) and in a sense already implicit in Groenendijk and Stokhof (1984). As noted above, what we call the property highlighted by a question is referred to in this earlier work as the *abstract* of the question.

2.3.1 Polar questions

Let us first consider a case with a polar interrogative complement:

(40)   *It surprises Peter whether Mary came to the party.

Recall that we considered two possible hypothesis as to what is highlighted by polar interrogative complements. One possibility is that whether Mary came to the party only highlights the proposition 'that Mary came to the party', just like the corresponding matrix polar question. The other possibility, argued for by Starr (2014), is that, in addition, it also highlights the proposition 'that Mary didn't come to the party'.

We will consider both possible hypotheses in turn, starting with the second because it yields the most straightforward account of the *whether puzzle. Recall that surprise presupposes that every property/proposition highlighted by its complement has a true instance in the world of evaluation. This means that, if the complement in (40) highlights both the proposition 'that Mary came to the party' and the proposition 'that Mary didn't come to the party', then (40) as a whole presupposes that both of these propositions are true in the world of evaluation, something that is impossible. So the sentence has a contradictory presupposition, and the same holds for any other sentence in which surprise takes a polar whether-complement. This systematic contradictoriness can be taken to account for its perceived ungrammaticality.[8]

Now consider the other possible hypothesis as to what is highlighted by polar interrogative complements.[9] Under this hypothesis, (40) is predicted to presuppose that Mary came to the party and that Peter knows this, and to assert that Mary's presence is incompatible with Peter's prior expectations. Note that this is precisely the same as what our account predicts for (39), which differs from (40) only in that it involves a declarative complement rather than a whether-complement. This equivalence does not rely on any specific feature of the example under consideration; it occurs systematically, whenever an emotive factive verb takes a polar interrogative complement. We propose that this systematic equivalence, together with the fact that declarative complements are plausibly less complex than polar interrogative complements in terms of processing,[10] and therefore more likely to ensure communicative success, explains why emotive factive verbs do not license polar interrogative complements. That is, in the spirit of neo-Gricean pragmatics (e.g., Horn, 1984) and bidirectional optimality theory (e.g., Blutner, 2000), we take this to be a case where one construction is **blocked** with regard to a certain interpretation because that same interpretation can be expressed by another construction in a better way, i.e., one that reduces processing effort and thereby increases the likelihood of communicative success.

Such blocking effects have been found in many other empirical domains as well. An example discussed by both Horn (1984, p.24) and Blutner (2000, p.194) is that of 'disjoint reference effects', illustrated in (41):

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[8]See Gajewski (2002) for a general discussion of explaining perceived ungrammaticality in terms of systematic contradictoriness or triviality.

[9]Even if Starr (2014) is right that this hypothesis is not suitable for whether-complements, what follows would still be needed to account for the fact that polar if-complements are just as bad under emotive factives as polar whether-complements.

[10]We assume, as is quite widely done, that computing the semantic value of a polar interrogative complement involves the same operations that are needed to compute the proposition expressed by the corresponding declarative complement, plus an additional operation (roughly, 'adding the complement proposition'). For a more in-depth discussion of this issue, see Farkas and Roelofsen (2017).

(41)   John washed him.   ⤳ him ≠ John

The pronoun him cannot be taken to refer to John in this configuration, because that would yield an interpretation that could be expressed by (42) as well:

(42)   John washed himself.

Assuming that the range of possible antecedents of reflexive pronouns like himself is heavily constrained by the grammar, using such a reflexive pronoun instead of a non-reflexive one is much more likely to ensure communicative success. Hence, the availability of (42) blocks coreference in (41).[11]

Interestingly, there is one particular phenomenon that has been explained in terms of blocking which is very closely related to the phenomenon we are trying to explain here. Namely, as noted by Adger and Quer (2001), there is a peculiar contrast between whether- and if-complements in certain contexts. For instance, while the whether-complements in (43a) and (44a) are perfectly acceptable, the corresponding if-complements in (43b) and (44b) are not.

(43)   a.   The bartender told me whether I was drunk.
         b.   *The bartender told me if I was drunk.

(44)   a.   Jones admitted whether he was drunk.
         b.   *Jones admitted if he was drunk.

Eckardt (2007) proposes an account of this contrast in terms of blocking. Given her lexical semantics for verbs like tell and admit and her treatment of whether- and if-complements, sentences like (43b) and (44b), in contrast with ones like (43a) and (44a), are systematically equivalent with ones where the if-complement is replaced by the corresponding that-complement. Given this equivalence, Eckardt reasons precisely as we did above: if-complements are blocked in these constructions because they are arguably more complex than that-clauses in terms of processing, and therefore non-optimal. To the extent that this account is correct, it provides independent support for the idea that the selectional restrictions of clause-embedding verbs are partially determined by blocking effects, in particular ones resulting from the competition between if/whether-complements and that-complements.

It should be emphasized that the account we are proposing, as well as theories of other phenomena in terms of blocking, are compatible with the possibility that certain blocking effects are fully grammaticalized (see, e.g., Levinson, 2000; Blutner and Strigin, 2011). That is, it may well be that the competition between polar interrogative complements and declarative complements under emotive factives does not play a role anymore in actual processing, but has been the driving force behind a diachronic development which has led to the ungrammaticality of the non-optimal construction.

Finally, before turning to the case of alternative questions, let us note that our account is reminiscent of the pragmatic approaches of Guerzoni (2007) and Sæbø (2007), briefly mentioned in the introduction, in that they also allude to competition between declarative and polar interrogative complements. There are, however, two crucial differences. First, on our account the competition is not with one out of two declarative complements (that

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[11]This example of blocking is only briefly discussed in Horn (1984) and Blutner (2000). See Levinson (2000), Kiparsky (2002), Beaver (2004), and Mattausch (2004), among others, for full-fledged theories of pronominal anaphora where blocking plays an important role.

Mary came or that Mary didn't come), depending on which one is true in the world of evaluation, but rather always with the same declarative complement, which is simply obtained by replacing whether with that. As a consequence, we do not need to include speaker factivity as an additional assumption, something we identified as a weakness of the pragmatic approach.

Second, our semantics predicts that replacing a polar interrogative complement by the corresponding declarative complement does not yield a stronger interpretation, but rather the *same* interpretation. This renders a polar interrogative complement systematically dispreferred w.r.t. the corresponding declarative complement, whose semantic computation involves less effort and is therefore more likely to be interpreted as intended. Thus, while our account also has a pragmatic component, it is not *quantity* based ("the speaker should have been more informative"), but rather *manner* based ("the speaker could have expressed the same meaning in a way that would have been easier to process and would thus have been more likely to lead to successful communication").[12]

2.3.2 Alternative questions

Now let us consider a case where the complement of surprise is an alternative question.

(45) *It surprises Bill whether Susan is drinking coffee or tea.

Here, the complement highlights two 0-place properties, i.e., two propositions, namely 'that Susan is drinking coffee' and 'that Susan is drinking tea'. The verb presupposes that both of these properties have a true instance in the world of evaluation. Since the properties are 0-place, this again just means that they have to be true. So the verb contributes the presupposition that Susan is drinking both coffee and tea.

From here we can proceed in either one of two ways. A first option is to adopt the commonplace assumption that alternative questions by themselves, i.e., independently of the embedding verb, imply that *exactly one* of the listed alternatives holds (see, e.g., Karttunen and Peters, 1976; Roelofsen and van Gool, 2010; Biezma and Rawlins, 2012). In our example, this implication says that Susan is drinking either coffee or tea, but *not*

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[12]It would be problematic for the present account if there were verbs which, when combined with a whether-complement, would systematically yield exactly the same interpretation as when combined with the corresponding declarative complement, and yet would not be perceived as ungrammatical with a whether-complement. At first sight, doubt appears to be such a verb. For instance, I doubt whether Eric will come and I doubt that Eric will come are both grammatical and seem to mean roughly the same. Upon closer inspection, however, there might be subtle differences in meaning between doubt whether and doubt that constructions. According to the American Heritage dictionary (www.ahdictionary.com):

> "The choice of what conjunction to use following doubt and doubtful is a perennial usage problem. [...] When the expectation for the outcome is negative, that tends to be used. Some 86 percent of the Usage Panel prefer that in the sentence I doubt [that/whether/if] it will rain tomorrow (where the expectation is that it probably won't rain), with whether getting the preference of only 6 percent and if getting 7 percent. Note that, in certain kinds of sentences, the choice of conjunction can carry subtle differences in implication. That is the best choice when the truth of the clause following doubt is assumed, as in negative sentences and questions. Thus I never doubted for a minute that I would be rescued implies "I was certain that I would be rescued." By the same token, Do you doubt that you will be paid? may be understood as a rhetorical question meaning "Surely you believe that you will be paid," whereas Do you doubt whether you will be paid? expresses a genuine request for information (and might be followed by Because if you do, you should make the client post a bond)."

both. This is incompatible with the presupposition generated by the verb. Thus, the sentence as a whole comes out contradictory, and this explains its oddness.

If we do not want to rely on any specific assumption about the implications of alternative questions, there is also another way to account for the oddness of (45). This explanation starts with the observation that (45) comes out equivalent to (46), with a conjunctive declarative complement:

(46)   It surprises Bill that Susan is drinking coffee and tea.

Given this equivalence, we could argue, just as in the case of polar questions, that alternative questions are ruled out under verbs like surprise through competition with declarative complements, which are preferable because they are less complex and therefore also more likely to lead to successful communication.

Thus, the two possible explanations for the infelicity of alternative questions under emotive factives are parallel to the two possible explanations we gave for the infelicity of polar questions under such verbs. The first possible explanation is that the relevant constructions, under certain (independently motivated) auxiliary assumptions, involve contradictory presuppositions. The second possible explanation, which does not require any auxiliary assumptions, is that they are blocked through competition with declarative complements.

2.3.3   A quantificational case

Now let us consider a case with a quantificational subject, which we mentioned in the introduction as a problem for the pragmatic approaches of Guerzoni (2007) and Sæbø (2007).

(47)   *Every guest was surprised whether he got breakfast.

Our explanation for the oddness of this sentence is essentially the same as that for (40). Namely, due to the existential presupposition of surprise, we predict that (47) is semantically equivalent with (48), which involves a declarative complement rather than a polar interrogative complement.

(48)   Every guest was surprised that he got breakfast.

This equivalence, together with the lower complexity of the declarative complement, accounts for the infelicity of (47) through blocking. Thus, quantified cases do not require any additional stipulations.

2.3.4   Concealed questions

There is one additional prediction that is worth mentioning before concluding. Consider the following contrast, pointed out by Martin Stokhof:

(49)   a.   *Whether they serve breakfast is surprising.
         b.   The answer to the question whether they serve breakfast is surprising.

This example shows that, whereas surprise does not license a plain polar question as its complement, it does license a so-called 'concealed question' concerning the answer to that polar question. This contrast is expected on our view, under the assumption that

concealed questions involve a type-shifting operation that turns the determiner phrase (here, **the answer to the question whether they serve breakfast**) into a **wh**-question concerning the identity of the referent of that phrase (**What is the answer to the question whether they serve breakfast**), an assumption that has been argued for in some detail in Aloni and Roelofsen (2011).[13] Concealed questions are, under this assumption, expected to pattern with **wh**-questions rather than with **whether**-questions, and thus correctly predicted to be licensed under emotive factives.

3   Summary and outlook

We have posited that emotive factive verbs like **surprise**, **bother**, and **please** are, unlike other factive verbs like **know**, **remember**, and **discover**, not just about the true extension of their complement clause, but rather about something more specific, namely, about one or more **true instances** of the properties that are *highlighted* by their complement. As a natural consequence, these verbs presuppose that every property highlighted by their complement has at least one true instance in the world of evaluation.

When the complement is declarative, this presupposition amounts to a standard factivity presupposition. In the case of a **wh**-complement, it amounts to the requirement that there be at least one individual that has the property highlighted by the question, in line with empirical observations by d'Avis (2002). And finally, in the case of **whether**-complements, the proposed analysis predicts oddness, either due to contradictory presuppositions or to systematic equivalence with the corresponding declarative complements.

Central to our account is the notion of highlighting, which was initially motivated by observations concerning **yes**/**no** responses and other kinds of propositional anaphora. If highlighting is indeed an important aspect of the semantics of questions, one would expect it to be relevant for other question-related phenomena as well, beyond anaphora and the interaction with question-embedding verbs. It seems that there are indeed many such phenomena. We will give one brief illustration here, having nothing to do with anaphora or question embedding but rather with the felicity conditions of questions in discourse.[14] Consider the following contrast:

(50)   A: Is Peter coming for dinner tonight?
        B: Is he in town this week?

(51)   A: Is Peter coming for dinner tonight?
        B: #Is he out of town this week?

This contrast is striking because the response questions in (50) and (51) are equivalent in terms of resolution conditions. Both questions elicit a choice between two alternatives: 'in town' and 'out of town'. But they differ in which alternative they highlight: the first highlights the 'in town' alternative, the second highlights the 'out of town' alternative. Apparently this matters.

The contrast is perhaps even more marked if we insert the particle *even* (see Iatridou and Tatevosov, 2015, for discussion of this use of *even* in polar questions):

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[13]Several other approaches to concealed questions exist as well (see, e.g., Nathan, 2006; Schwager, 2007; Romero, 2010; Frana, 2013). We refer to Aloni and Roelofsen (2011) for comparison.

[14]Beyond the phenomena discussed here, highlighting has also played a role in recent work on conditionals (Onea and Steinbach, 2012; Starr, 2014), modified numerals (Coppock and Brochhagen, 2013), and discourse particles (Csipak and Zobel, 2014; Rojas-Esponda, 2014).

(52)   A: Is Peter coming for dinner tonight?
       B: Is he even in town this week?

(53)   A: Is Peter coming for dinner tonight?
       B: #Is he even out of town this week?

Notice that from A's question, B can infer that *if* Peter is out of town, then A would not be able to confirm this—otherwise she would not have asked whether he is coming for dinner. So, if A can answer B's response question, the answer must be that Peter is in town. Let us say that the 'out of town' alternative in B's question is *doomed*.

These examples suggest the following preliminary generalization:

(54)   *Preliminary generalization: Don't highlight doomed alternatives!*
       If a speaker asks a question Q and one of the alternatives in $[\![Q]\!]$ is doomed, i.e., it can be inferred in the context of utterance that the addressee will not be able to confirm it, then the speaker should not highlight this alternative.

However, the following response questions are fine:

(55)   A: Is Peter coming for dinner tonight?
       B: Isn't he out of town this week?

(56)   A: Is Peter coming for dinner tonight?
       B: He is out of town this week, isn't he?

Assuming that these response questions highlight the 'out of town' alternative (which can be justified by considering what yes and no mean in response to these questions), these are counterexamples to our preliminary generalization.

Interestingly, a rising declarative highlighting the 'out of town' alternative is again infelicitous:

(57)   A: Is Peter coming for dinner tonight?
       B: #He is out of town this week?

In Farkas and Roelofsen (2017) it is argued based on other contrasts between rising declaratives and tag questions that, while both signal that the speaker has access to some evidence for the highlighted alternative, rising declaratives indicate that the speaker's credence in this alternative is at most low (possibly even zero), while tag questions signal that the speaker's credence in the highlighted alternative is moderate to high.

It is often assumed that high negation questions also signal that the speaker is epistemically biased towards the highlighted alternative. It seems reasonable to assume that the speaker's credence in the highlighted alternative must be moderate to high in this case as well, just like in the case of tag questions. This, then, leads to the following revised generalization:

(58)   *Refined generalization: Only highlight doomed alternatives if probable!*
       If a speaker asks a question Q and one of the alternatives in $[\![Q]\!]$ is doomed, then she should only highlight this alternative if she believes that it is true with moderate to high confidence, and in this case the form of the question should signal that she has such a belief.

This generalization may have to be further refined, and of course one would ultimately like

to derive it from more basic principles. This is left for future work. For now, we conclude that the notion of highlighting seems to be useful not only in capturing phenomena to do with anaphora and question embedding, but also in characterizing the felicity conditions of questions in discourse.

Taking a step back, one could ask what all these phenomena have in common. The answer is that they all bring out certain contrasts between different types of questions that are indistinguishable in terms of resolution conditions. These contrasts may concern two 'opposing' polar questions (e.g., Is he in town? versus Is he out of town?), a polar question and a wh-question (e.g., Is the order still in progress? versus What is the status of the order?), or any other combination. Whenever we find such contrasts, we could ask whether they might be due to the fact that the different types of questions bring different properties or propositions into salience. If so, highlighting will most likely be useful in accounting for the observed contrasts.

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