Ignorance Implicatures and Non-doxastic Attitude Verbs*

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Abstract

This paper is about conjunctions and disjunctions in the scope of non-doxastic attitude verbs. These constructions generate a certain type of ignorance implicature. I argue that the best way to account for these implicatures is by appealing to a notion of contextual redundancy (Schlenker, 2008; Fox, 2008; Mayr and Romoli, 2016). This pragmatic approach to ignorance implicatures is contrasted with a semantic account of disjunctions under 'wonder' that appeals to exhaustification (Roelofsen and Uegaki, 2016). I argue that exhaustification-based theories cannot handle embedded conjunctions, so a pragmatic account of ignorance implicatures is superior.

1 Introduction

This paper is about conjunctions and disjunctions in the scope of non-doxastic attitude verbs. To see what is at issue, consider the following scenarios and reports that follow them (the embedded question in (2b) is a disjunctive polar question rather than an alternative question)[1]:

Visitors: On Friday, Bill gets a letter from his friends Alice and Ted saying that they will visit Bill on Sunday if they find enough free time. On Saturday, Bill gets a message from Alice saying that she won't be able to manage a visit — the message is silent about the prospects of Ted visiting. On Sunday, Bill hears a knock on the door and rushes to open it. Before Bill answers, I utter:

(1) a. Bill hopes that Ted is at the door.
    b. ?? Bill hopes that Alice or Ted is at the door.

(2) a. Bill wonders whether Ted is at the door.
    b. ?? Bill wonders whether-or-not Alice or Ted is at the door.

Dessert: Bill is having a dinner party and each guest brought something to eat. Bill's favorite desserts are apple pie and cherry pie. Bill sees that Mary brought apple pie, but he doesn't yet know what Chris brought. I utter:

(3) a. Bill hopes that Chris brought cherry pie.
    b. ?? Bill hopes that Mary brought apple pie and Chris brought cherry pie.

(4) a. Bill wonders whether Chris brought cherry pie.

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[1]Disjunctive polar questions are distinguished from alternative questions by their intonation contours (Biezma and Rawlins, 2012), as well as the fact that alternative questions, but not disjunctive polar questions, presuppose that exactly one of the relevant disjuncts hold. I follow others in using 'whether-or-not' for disjunctive polar questions. See §5 for further discussion.

b. ?? Bill wonders whether Mary brought apple pie and Chris brought cherry pie.

While (1a)-(4a) are acceptable in their respective contexts, (1b)-(4b) are not. Intuitively, what seems to be required for (1b)-(2b) to be acceptable is that it is compatible with Bill's knowledge that Alice is at the door; and what seems to be required for (3b)-(4b) to be acceptable is that it is compatible with Bill's knowledge that Mary did not bring apple pie. That is, Bill cannot know that Alice will not be coming, and he cannot know that Mary brought apple pie. Let us call these inferences *ignorance implicatures*.

I argue that the best way to account for ignorance implicatures is by appealing to a notion of *contextual redundancy*. In short, (1b)-(4b) are infelicitous because they have constituents that are redundant in context: the propositions that they express could have been expressed by syntactically simpler sentences, namely (1a)-(4a). This pragmatic approach to ignorance implicatures stands in contrast to a recent semantic account of ignorance implicatures involving disjunctions under 'wonder' developed by Roelofsen and Uegaki (2016) (henceforth 'R&U'). I argue that R&U's account makes problematic predictions when conjunctions are embedded under 'wonder', as in (4b). Thus, the pragmatic, redundancy-theoretic account is superior.[2]

2 Redundancy and Ignorance Implicatures

2.1 Redundancy

Consider the following scenarios and reports that follow them:

Wimbledon: We are watching the men's Wimbledon semi-final. Unfortunately, we all see Federer lose to Nadal in five sets. Then I utter:

(5) ?? Federer won or Nadal will win the final.

Holiday: A group of us are discussing our holiday plans. I ask Ted where he intends to spend the summer. He tells the group: 'I'm going to Costa Rica'. Then Ben utters:

(6) ?? Ted is going to Costa Rica and it is going to be very humid there.

Neither (5) nor (6) are felicitous in their respective contexts. Intuitively, this is explained by the fact that both have parts that are trivial or redundant in the relevant scenarios (in (5) this is the first disjunct, and in (6) this is the first conjunct). That is, the content communicated by (5) and (6) could have been communicated by simpler sentences. If we suppose that more economical expressions are preferred to more complex ones, the unacceptability of (5) and (6) can be accounted for.[3] I maintain that a similar account of the infelicity of (1b)-(4b) can be given: these reports are problematic because their content could have been expressed by simpler sentences in context.

A theory that explains why (5) and (6) are redundant in their respective contexts is a *theory of redundancy*. A rather simple theory of redundancy accounts for (5) and (6), as well as (1b)-(4b):

[2] As a reviewer points out, ignorance implicatures also arise with disjunctions embedded under doxastics, e.g. 'Bill believes that Alice or Ted is at the door' is infelicitous when it is common knowledge that Bill believes Alice is not at the door. The account developed here can handle these cases as well. However, we focus on non-doxastics since, unlike both 'hope' and 'wonder', conjunctions under 'believe' do not give rise to ignorance implicatures.

[3] This is only to say that this is *one* way to account for their infelicity, there could be other explanations as well.

(7) Redundancy 1: (to be revised)
   a. ϕ cannot be used in context C if ϕ is contextually equivalent[4] to ψ, and ψ is a simplification of ϕ.
   b. ψ is a simplification of ϕ if ψ can be derived from ϕ by replacing nodes in ϕ with their subconstituents

To illustrate, (5) is contextually equivalent to 'Nadal will win the final' in *Wimbledon*, since every world in the context set is one in which Fed lost the match. Since 'Nadal will win the final' is a simplification of (5) (by (7b)), (5) is predicted to be unacceptable (by (7a)). Similarly, (6) is contextually equivalent to 'It is going to be very humid in Costa Rica' in *Holiday*, since every world in the context set is one in which Ted is going to Costa Rica. Since 'It is going to be very humid in Costa Rica' is a simplification of (6), (6) is predicted to be unacceptable.

2.2 Some attitude semantics

2.2.1 'hope'

(1a)-(4a) are simplifications of (1b)-(4b), respectively. So, if we can show contextual equivalence for each pair then we would have an explanation for the (b) member's infelicity. In order to show contextual equivalence we need to have a semantics for 'hope' and 'wonder' on the table. For 'hope' let us assume a simplified "ideal worlds" analysis (von Fintel, 1999). This acccount employs a notion of an "ideal" set of worlds with respect to a subject's desires: a set of worlds compatible with everything that S desires in w (denoted by $\text{Bul}_{w,S}$). On this approach, 'S hopes that p' is defined at w iff S does not believe p, S does not believe $\neg p$, and S's hopes are constrained by S's beliefs ($\text{Bul}_{w,S} \subseteq \text{Dox}_{w,S}$).[5] If defined, the report is true iff all of S's desire worlds are p-worlds. A bit more formally:

(8) Semantics for 'hope'
   a. 'S hopes that p' is defined at w iff (i) $\text{Dox}_{w,S} \cap p \neq \emptyset$, (ii) $\text{Dox}_{w,S} - p \neq \emptyset$, (iii) $\text{Bul}_{w,S} \subseteq \text{Dox}_{w,S}$
   b. If defined, 'S hopes that p' is true at w iff $\text{Bul}_{w,S} \subseteq p$

It is straightforward, but tedious, to show that (1a)-(1b) and (3a)-(3b) are contextually equivalent on this semantics for 'hope'.[6] Thus, both (1b) and (3b) are predicted to be unac-

[4] Sentences ϕ and ψ are contextually equivalent with respect to context C iff $\{w \in C : [\![\phi]\!](w) = 1\} = \{w \in C : [\![\psi]\!](w) = 1\}$ Singh (2011).

[5] As Heim (1992) points out, 'I hope to teach Tuesdays and Thursdays next semester' can be true even when there are worlds compatible with everything that I desire in which I don't teach at all. Instead, hope reports only make a claim about the relative desirability of the worlds *compatible with the subject's beliefs*. (As Heim (1992) notes, the relevant constraint isn't quite the subject's belief worlds, but as far as I can tell this subtlety shouldn't impact our argument.)

[6] Let us call the context of *Visitors* V. Take an arbitrary $w \in V$. Suppose that (1a) is undefined at w. Then at least one of (i)-(iii) in (8) fail with respect to (1a). If (iii) fails then clearly (1b) is also undefined at w. If (i) fails, then at w it is doxastically impossible for Bill that Ted is at the door. Since it is doxastically impossible for Bill that Alice is at the door, it follows that (1b) is undefined at w. If (ii) fails, then at w it is doxastically necessary for Bill that Ted is at the door. It follows that it is doxastically necessary that Ted or Alice is at the door, hence (1b) is undefined at w. So, if (1a) is undefined at w, then (1b) is undefined at w. Now suppose that (1a) is defined at w. Then it is doxastically possible but not necessary for Bill that Ted is at the door at w. Since it is doxastically impossible for Bill that Alice is at the door in w, it follows that it is doxastically possible but not necessary for Bill that Ted or Alice is at the door. Furthermore, if (1a) is defined at w then condition (iii) of (8) is satisfied. Thus, if (1a) is defined at w, (1b) is defined at w. Now suppose that (1a) is true at w. Then all of the worlds compatible with what Bill desires are worlds in which Ted is at the door. Hence, all of

ceptable given Redundancy 1.[7] More generally, if it is common knowledge that S believes p is false, 'S hopes that p or q' will be contextually equivalent to 'S hopes that q'. Thus, by Redundancy 1 the report will be unacceptable. Similarly, if it is common knowledge that S believes p is true, 'S hopes that p and q' will be contextually equivalent to 'S hopes that q'. Thus, by Redundancy 1 the report will be unacceptable.[8]

2.2.2 'wonder'

I will assume the semantics for 'wonder' developed by Ciardelli and Roelofsen (2015). Their theory is set in the framework of inquisitive epistemic logic, which combines notions from standard epistemic logic and inquisitive semantics. In epistemic logic, an *information state* is modeled as a set of possible worlds—those worlds that are compatible with the information available in the state. In inquisitive semantics, the basic propositional object is an issue I: a non-empty set of information states that is closed under subsets, i.e. if $s \in I$ and $s' \subset s$ then $s' \in I$. The maximal elements of I are called the *alternatives* of I. The *meaning of a sentence*, whether declarative or interrogative, is the issue that it expresses. For example, $[\![\text{whether Ted is at the door}]\!] = \{s \mid \forall w \in s : \text{Ted is at the door in } w\} \cup \{s \mid \forall w \in s : \text{Ted is not at the door in } w\}$. An information state s *settles* an issue I iff $s \in I$. For instance, if Ted is at the door at the actual world $w_{@}$, then $\{w_{@}\}$ settles the issue of whether Ted is at the door.

Each agent α is assigned an *inquisitive state* at a world w denoted as $\Sigma_\alpha(w)$: a set of information states such that each information state settles all the issues that α entertains at w. For instance, if at w Bill entertains the issue of whether Ted is at the door, then every $s \in \Sigma_{\text{Bill}}(w)$ settles that issue. Intuitively, Σ_α tells us 'where the agent wants to get to' in terms of inquiry; how they would like their information state to be in the future, and which issues they want to see settled. Like issues, inquisitive states are assumed to be non-empty and closed under subsets. Moreover, it is assumed that $\Sigma_\alpha(w)$ forms a *cover* of α's information state at w, denoted as $\sigma_\alpha(w)$. That is, $\bigcup \Sigma_\alpha(w) = \sigma_\alpha(w)$.

In this system, α *knows* an issue I at w when $\sigma_\alpha(w) \in I$. α *entertains* an issue I when $\Sigma_\alpha(w) \subseteq I$ (all of the information states that α would like to get to are ones where I is settled). The 'wonder' modality, denoted W, is given in terms of these notions and has the following truth conditions: $w \models W_\alpha\phi$ iff$_d$ $\sigma_\alpha(w) \notin [\![\phi]\!]$ and $\Sigma_\alpha(w) \subseteq [\![\phi]\!]$. Finally, the semantics for 'wonder' is given in terms of this modality:

(9) Semantics for 'wonder'
'S wonders ϕ' is true at w iff $w \models W_S\phi$ (iff $\sigma_S(w) \notin [\![\phi]\!]$ and $\Sigma_S(w) \subseteq [\![\phi]\!]$)

In other words, S wonders about an issue when they do not know it, but would like to see it settled, i.e. they entertain it. It is easy to check that (9) makes 'wonder' non-monotonic (since the underlying 'wonder' modality is non-monotonic).[9]

the worlds compatible with what Bill desires are worlds in which Ted or Alice is at the door. So, if (1a) is true at w, (1b) is true at w. Finally, suppose that (1a) is false at w. Then it is not the case that all of the worlds compatible with what Bill desires are worlds in which Ted is at the door. Since Bill's desire worlds are a subset of his belief worlds, it follows that it is not the case that all of the worlds compatible with what Bill desires are worlds in which Ted or Alice is at the door. Thus, if (1a) is false at w, (1b) is false at w. Hence, (1a) and (1b) are contextually equivalent with respect to V. The other case is similar.

[7] The same result obtains if a "similarity" semantics for 'hope' is adopted (Heim, 1992).

[8] Note that the "Presupposed Ignorance Principle" of Spector and Sudo (2017) does not predict that either (1b) or (3b) should be unacceptable in their respective contexts, since the negative and positive presuppositions of 'hope' create a non-monotonic environment. See (Spector and Sudo, 2017) for further discussion.

[9] In this framework, for issues I, G: $I \models G$ iff $I \subseteq G$. See (Ciardelli et al., 2016) for more on the logic of issues.

Given (9), it is straightforward to show that (2a)-(2b) and (4a)-(4b) are contextually equivalent.[10] Similar cases involving alternative, rather than polar questions can also be handled (but see §5 for further discussion).

To be clear, we have explained why, e.g. 'S hopes that p or q' is unacceptable when, e.g. it is common knowledge that 'S knows $\neg p$' is true. However, what might be more naturally called an "ignorance implicature" is the following phenomenon: 'S hopes that p or q' uttered *out of the blue* suggests that (the speaker thinks that) 'S knows $\neg p$' is $false$. The account presented here predicts something weaker; namely that such an utterance will merely suggest that it is not common knowledge that 'S knows $\neg p$' is true. That is, what is predicted is $\neg$CK(S knows $\neg p$), but what is required is CK($\neg$(S knows $\neg p$)). It is plausible that the strengthened result is obtained by an "epistemic step" similar to those that have been proposed for inferences involving scalar implicatures, e.g. (Sauerland, 2004), and presuppositions, e.g. (Chemla, 2007). We leave the development of an account of such auxiliary pragmatic reasoning for future work.

3 A refinement

In this section, we refine the account of redundancy introduced above by considering some data that has recently been discussed by Rostworowski (forthcoming). In the course of trying to defend the Russellian analysis of definite descriptions, Rostworowski considers reports such as the following:

(10) a. Bill hopes that the dictator is dead and was assassinated.
b. Bill wonders whether the dictator is dead and was assassinated.

(11) a. Bill hopes that Mary is pregnant and expecting a daughter.
b. Bill wonders whether Mary is pregnant and expecting a daughter.

These reports raise two issues. First, a report such as (10a) is unacceptable if Bill already knows that the dictator is dead. Redundancy 1 can explain this: (10a) and 'Bill hopes that the dictator was assassinated' are contextually equivalent in any context in which Bill knows that the dictator is dead, so (10a) is ruled infelicitous. There are, however, contexts in which (10a) is acceptable, e.g. when Bill has no idea about the health of the dictator. But Redundancy 1 predicts that (10a) will *always* be infelicitous. This is because 'The dictator was assassinated' entails 'The dictator is dead'. So, (10a) and 'Bill hopes that the president was assassinated' are contextually equivalent in *any* context. What is needed, then, is an account that predicts that (10a) is problematic only in contexts where Bill knows that the dictator is dead.

Intuitively, the reason that (10a) can be acceptable is that the second conjunct adds information to the first conjunct: once we have processed the first conjunct it is compatible with what we know that the second conjunct is false. What needs to be done is somehow incorporate the fact that we process sentences in linear order into the redundancy conditions. Thankfully, this has already been done for us by Mayr and Romoli (2016) (following Fox (2008), who in

[10] Take an arbitrary $w \in V$. Suppose that (2a) is true in w. Then $\sigma_{\text{Bill}}(w) \notin [\![\text{whether Ted is at the door}]\!] = \{s \mid \forall w \in s : \text{Ted is at the door in } w\} \cup \{s \mid \forall w \in s : \text{Ted is not at the door in } w\}$. Also, $\Sigma_{\text{Bill}}(w) \subseteq [\![\text{whether Ted is at the door}]\!]$. $[\![\text{Whether-or-not Alice or Ted is at the door}]\!] = \{s \mid \forall w \in s : \text{Alice or Ted is at the door in } w\} \cup \{s \mid \forall w \in s : \text{neither Alice nor Ted is at the door in } w\}$. $\sigma_{\text{Bill}}(w) \cap \{w \mid \text{Alice is at the door in } w\} = \emptyset$ (by assumption). It follows that $\sigma_{\text{Bill}}(w) \notin \{s \mid \forall w \in s : \text{Alice or Ted is at the door in } w\}$, and that $\sigma_{\text{Bill}}(w) \notin \{s \mid \forall w \in s : \text{neither Alice nor Ted is at the door in } w\}$. Thus, $\sigma_{\text{Bill}}(w) \notin [\![\text{whether-or-not Alice or Ted is at the door}]\!]$. Given that $\Sigma_{\text{Bill}}(w)$ covers $\sigma_{\text{Bill}}(w)$, it also follows that $\Sigma_{\text{Bill}}(w) \subseteq [\![\text{whether-or-not Alice or Ted is at the door}]\!]$. Hence, (2b) is true in w. The other direction is similar (as is the other case).

turn follows Schlenker (2008)). The result is a more complex redundancy condition that allows us to talk about *parts* or constituents of sentences being redundant:

(12) Redundancy 2
Incremental non-redundancy condition: ϕ cannot be used in context C if any part ψ of ϕ is incrementally redundant in ϕ given C.

a. Incremental redundancy:
   i. ψ is incrementally redundant in ϕ given a context C if it is globally redundant in all ϕ', where ϕ' is a possible continuation of ϕ at point ψ.
   ii. ϕ' is a possible continuation of ϕ at point ψ iff it is like ϕ in its structure and number of constituents, but the constituents pronounced after ψ are possibly different.

b. Global redundancy:
   i. ψ is globally redundant in ϕ given a context C if ϕ is contextually equivalent to ϕ', where ϕ' is a simplification of ϕ without ψ.
   ii. ψ is a simplification of ϕ if ψ can be derived from ϕ by replacing nodes in ϕ with their subconstituents.

Redundancy 2 handles Rostworowski's reports. First, the ignorance implicature of, e.g. (10a) is predicted, since the first conjunct in the complement is incrementally redundant in any context where it has been established that Bill knows that the dictator is dead (the first conjunct is globally redundant in any possible continuation of (10a) at the point of the first conjunct). Moreover, Redundancy 2 does *not* predict that (10a) is always infelicitous. In contexts where Bill does not know that the dictator is dead, there are continuations of (10a) at the point of the first conjunct that are not globally redundant, e.g. 'Bill hopes that the dictator is dead and Mary is happy'.

4 Roelofsen and Uegaki's (2016) account

R&U take as their point of departure Ciardelli and Roelofsen's (2015) semantics for 'wonder' and try to develop an account that captures the ignorance implicatures of disjunctions embedded under this verb. R&U enrich Ciardelli and Roelofsen's semantics with a built-in exhaustivity operator:

(13) R&U's semantics
$\ulcorner\text{wonder } Q\urcorner = \lambda x.\text{EXH}_{\{W_x(\ulcorner Q'\urcorner) | Q' \lesssim Q\}}\, W_x(\ulcorner Q\urcorner)$[11]

(13) can account for the ignorance implicatures that arise for (2b). On this entry, (2b) is true just in case (14a) is true, (14b) is false, and (14c) is false.[12] However, if Bill knows that

[11] The exhaustivity operator takes an expression φ and a set of alternatives $\mathcal{A}$, and 'strengthens' φ by negating every $\psi \in \mathcal{A}$ that is not entailed by φ: $\text{EXH}_{\mathcal{A}}(\varphi) := \varphi \wedge \bigwedge\{\neg\psi |\ \psi \in \mathcal{A} \text{ and } \varphi \not\models \psi\}$ (strictly speaking only the 'innocently excludable' alternatives should be negated, but that complication won't be relevant here). R&U assume that the set of alternatives $\mathcal{A}$ is generated by considering the formal structure of φ, rather than its semantic content. More specifically, $\varphi' \in \mathcal{A}$ with respect to φ just in case $\varphi' \lesssim \varphi$, where $\varphi' \lesssim \varphi$ iff φ' can be obtained from φ by deleting constituents or replacing them with other constituents of the same syntactic category, taken either from the lexicon or from φ itself Katzir (2007).

[12] We leave the complements in English, since it makes the sentences easier to read.

Ann isn't at the door, then the only way for (14a) to be true is for (14c) to be *true*.[13]

(14) a. W_{Bill} (whether-or-not Ann or Ted is at the door)
b. W_{Bill} (whether-or-not Ann is at the door)
c. W_{Bill} (whether-or-not Ted is at the door)

As for conjunctions under 'wonder', R&U's approach does predict that (4b) should be unacceptable. Because W is non-monotonic, both (15b) and (15c) are alternatives for exhaustification for (15a). But if Bill knows that Mary brought apple pie, then (15a) is true only if (15c) is *true*.

(15) a. W_{Bill} (whether Mary brought apple pie and Chris brought cherry pie)
b. W_{Bill} (whether Mary brought apple pie)
c. W_{Bill} (whether Chris brought cherry pie)

Although it captures the relevant ignorance implicature in *Dessert*, overall R&U's semantic approach makes incorrect predictions when conjunctions are embedded under 'wonder'. There are two related problems here. First, the truth-conditions for sentences with conjunctions under 'wonder' seem too strong. It is a consequence of the account that (4b), 'Bill wonders whether Mary brought apple-pie', and 'Bill wonders whether Chris brought cherry pie' cannot all be true together (assuming that the second is false if (15b) is, and that the last is false if (15c) is). But it is quite easy to imagine contexts where all three reports are acceptable, e.g. consider a scenario like *Dessert* where Bill does not know whether Mary brought apple pie. More generally, 'S wonders whether A and B', 'S wonders whether A', and 'S wonders whether B' can all be acceptable in a single context.

Second, R&U's account does not predict ignorance implicatures in all cases. Consider (10b) ('Bill wonders whether the dictator is dead and was assassinated') once again. As discussed above, (10b) is only felicitous if Bill does *not* know that the dictator is dead. However, (16b) is an alternative for exhaustification for (16a):[14]

(16) a. W_{Bill} (whether the dictator is dead and was assassinated)
b. W_{Bill} (whether the dictator is dead)

On R&U's account, (10b) is true only if (16b) is false. (16b) is false just in case either $\sigma_{\text{Bill}}(w) \in [\![\text{whether the dictator is dead}]\!] = \{s \mid \forall w \in s : \text{the dictator is dead in } w\} \cup \{s \mid \forall w \in s : \text{the dictator is not dead in } w\}$ or $\Sigma_{\text{Bill}}(w) \not\subseteq [\![\text{whether the dictator is dead}]\!]$. If Bill knows that the dictator is dead, then $\sigma_{\text{Bill}}(w) \in \{s \mid \forall w \in s : \text{the dictator is dead in } w\} \subseteq [\![\text{whether the dictator is dead}]\!]$. Thus, R&U's account does *not* predict that (10b) is unacceptable when Bill knows that the dictator is dead.[15]

[13] If Bill knows that Ann isn't at the door in w, then $\sigma_{\text{Bill}}(w) \notin [\![\text{whether-or-not Ann or Ted is at the door}]\!]$ only if $\sigma_{\text{Bill}}(w) \notin [\![\text{whether-or-not Ted is at the door}]\!]$. Also, $\Sigma_{\text{Bill}}(w) \subseteq [\![\text{whether-or-not Ann or Ted is at the door}]\!]$ only if $\Sigma_{\text{Bill}}(w) \subseteq [\![\text{ whether-or-not Ted is at the door}]\!]$, since $\Sigma_{\text{Bill}}(w)$ covers $\sigma_{\text{Bill}}(w)$.

[14] In inquisitive semantics, $[\![\text{whether the dictator is dead and was assassinated}]\!] = [\![\text{whether the dictator was assassinated}]\!]$. So, '$W_{\text{Bill}}$ (whether the dictator was assassinated)' is not an alternative for exhaustification for (16a), since the latter entails the former.

[15] Since 'hope' carries presuppositions, an analogue of the exhaustification entry for this verb presents various options depending on how the exhaustification operator is defined. Spector and Sudo (2017) consider some of these alternatives. Overall, these alternatives struggle with embedded conjunctions. Briefly, if EXH_1 is used then it is predicted that (3b) should *always* be infelicitous. Alternatively, EXH_2 does not generate any alternatives at all for (3b) assuming an "ideal worlds" semantics, so cannot account for its ignorance implicatures. If a "similarity" semantics is adopted then EXH_2 raises problems similar to those raised by R&U's account, namely the truth conditions of (3b) are too strict and the ignorance implicatures of (10a) are not accounted for.

5 Further issues

Here we consider some concerns that have been raised about the pragmatic account developed above, as well as pragmatic treatments of ignorance implicatures more generally. First, R&U point out that ignorance implicatures involving *alternative* questions under 'wonder' seem to be *local* in the sense that they take scope below operators, e.g. quantifiers, that are syntactically above this verb:

Crime: There is a crime with three suspects, Ann, Bill, and Carol. There are five detectives investigating the case; one has already ruled out Carol but is still wondering whether it was Ann or Bill. The others don't know anything yet. I say:

(17) Exactly four detectives are wondering whether it was Ann, Bill, or Carol.

As R&U comment, (17) is acceptable in context. However, it is $false$ on (9) since *all five* detectives are such that (i) they do not know whether it was Ann, Bill or Carol, and (ii) every information state they want to be in resolves the issue of whether it was Ann, Bill or Carol. So, the pragmatic, redundancy-theoretic approach cannot capture our judgments, although R&U's theory can.

However, the empirical picture here is rather complex. For one thing, embedded *disjunctive polar* questions do *not* always seem to pattern the way of (17), nor do embedded disjunctions under 'hope':

Cake: Bill and Alice run a birthday cake delivery service. Five of my friends are waiting for a delivery for my surprise party. Everyone knows that either Alice or Bill will make the delivery, but Ted is the only one that knows Bill is at home sick. Nobody is sure of the exact time of the delivery. The doorbell rings. Consider:

(18) ?? Exactly four people are wondering whether-or-not Bill or Alice is at the door.

(19) ?? Exactly four people hope that Bill or Alice is at the door.

To my ear, (18) is unacceptable in context. This is predicted by (9), since this account makes the report false (*all five* friends are such that (i) they do not know whether-or-not Bill or Alice is at the door, and (ii) every information state they want to be in resolves the issue of whether-or-not Bill or Alice is at the door). However, this report is true on R&U's account, since exhaustification takes place regardless of whether the embedded question is an alternative question or a disjunctive polar question. Similarly, (19) is unacceptable in context. This is predicted on (8), since this account makes the report false (*all five* friends are such that (i) it is doxastically possible but not necessary that Bill or Alice is at the door, and (ii) every desire world is one where Bill or Alice is at the door).

Moreover, the ignorance implicatures generated by embedded conjunctions *also* appear to be local:

Dictator: Five professors heard a rumor that the dictator was killed by a sniper. One of them knows for sure that the dictator is dead but isn't sure how he died. I say:

(20) Exactly four professors are wondering whether the dictator is dead and was assassinated.

(21) Exactly four professors hope that the dictator is dead and was assassinated.

Like (17), (20) is acceptable in context. But just like (17), it is false and thus predicted to be unacceptable on (9). However, it is *also* false on R&U's account, since for *all five* professors x, 'W_x(the dictator was assassinated)' is true. Similarly, (21) is acceptable, yet it is false on (8).

To sum up, the ignorance implicatures of alternative questions embedded under ‘wonder’ do seem to be local, and thus are not predicted by pragmatic approaches that operate at the utterance level. However, the ignorance implicatures of disjunctive polar questions under ‘wonder’ as well as disjunctions under ‘hope’ do not seem to be local, contrary to the predictions of semantic accounts such as R&U’s. Furthermore, the ignorance implicatures of embedded conjunctions *do* seem to be local, but this is captured by neither semantic nor pragmatic accounts. Overall, then, the data appears to paint a rather complex picture and does not clearly count in favor of either a pragmatic or semantic approach to ignorance implicatures.

Second, on (9) it makes a semantic difference whether an embedded *alternative* question has exactly two alternatives, or more than two alternatives:
Visitors: Bill knows that either Alice or Ted will visit on Saturday at noon. On Friday, Bill gets a message from Alice saying that she won’t be able to manage a visit. At noon on Saturday Bill hears a knock on the door and rushes to open it. Before Bill answers, I utter:

(22) ?? Bill wonders whether Alice or Ted is at the door.

Visitors 2: Bill knows that exactly one of Alice, Chris and Ted will visit Bill on Saturday at noon. On Friday, Bill gets a message from Alice saying that she won’t be able to manage a visit. At noon on Saturday Bill hears a knock on the door and rushes to open it. Before Bill answers, I utter:

(23) ?? Bill wonders whether Alice, Chris or Ted is at the door.

Neither (22) nor (23) are acceptable in their respective contexts. However, it is easy to check that (22) is $false$ on (9) while (23) is *true*. Given that the pragmatic account developed here uses (9) as a baseline semantics, it holds that while (22) is false, (23) is merely ‘pragmatically unacceptable’. As several anonymous reviewers point out, this does not appear to be a good prediction, since one can respond to (23) with ‘That’s false, since Bill knows that Alice isn’t at the door’. That is, we seem to want to be able to say something *stronger* in response to (23) than what is licensed by the pragmatic account. By contrast, R&U’s account predicts that *both* (22) and (23) are false in their respective contexts.

But it is worth noting that it does *not* seem acceptable to respond to (2b) (‘Bill wonders whether-or-not Alice or Ted is at the door’) with ‘That’s false, since Bill knows that Alice isn’t at the door’. This is not predicted by R&U’s account, since (2b) is made false by it. Also, it *is* acceptable to respond to (10b) (‘Bill wonders whether the dictator is dead and was assassinated’) with ‘That’s false, since Bill knows that the dictator is dead’, but neither the pragmatic approach nor R&U’s account predicts this. Once again, the data here does not clearly speak in favor of either a pragmatic or semantic approach to ignorance implicatures.

6 Conclusion

Roelofsen and Uegaki (2016) showed that disjunctions embedded under inquisitive verbs such as ‘wonder’ generate a certain type of ignorance implicature. I have suggested that a similar sort of ignorance implicature arises from embedded *conjunctions*; moreover, that such implicatures arise for a variety of non-doxastic attitude verbs. On the proposal developed here, ignorance implicatures arising from both disjunctions and conjunctions are handled within the same framework. On this account, these implicatures are fundamentally pragmatic, and can be explained by a suitably sophisticated theory of contextual redundancy. I argued that such an account is superior to a semantic approach to embedded disjunctions based on exhaustification, since such accounts struggle with embedded conjunctions.

We have made progress on the topic of ignorance implicatures, but it should be clear from our discussion that more work needs to be done. First, as mentioned at the end of §2, the account presented here generates inferences that are often too weak; a strengthening mechanism needs to be developed. Second, the judgments reported in §5 are based on introspection and discussion with only a few native speakers; more work is needed to get a better sense of the empirical landscape. Finally, it is not clear whether the sort of approach to redundancy presented in §3 is ultimately adequate, and perhaps an account that employs local contexts should be used instead (Mayr and Romoli, 2016). However, this would require giving a precise characterization of the local contexts of attitude verbs which, as far as I am aware, has not yet been done.

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