Who knows whether emotive doxastics take *whether*-complements?

Matthew Czuba Mia Teixeira

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1 Introduction

1.1 Background

At least since Grimshaw (1979), theories of complementation have pursued the notion of S(emantic)-selection, whereby the embeddability of a complement is taken to be a matter of compositionality. On this view of selection, whether a complement may be embedded under a given predicate is determined (either in whole or in part) by the (i) lexical semantics of the embedding predicate and (ii) the semantics of the complement clause. Thus arises the prediction that predicates sporting a similar meaning will display a correlation in the kinds of their permissible subordinates. This paper evaluates the promise of such a methodology for understanding the embedding behavior obtaining of *hope*, *fear*, and question complements. We find that minimal adjustments to existing theories on the market fall short of producing desirable results and suggest avenues for further study.

A three-way typology exemplified in (1) (often attributed to Grimshaw (1979) and Lahiri (2002)) has served to guide much spirited work in the semantics of question-embedding. A predicate that is *responsive* (e.g. *know*) takes both declarative and interrogative complements. *Rogative* predicates (e.g. *wonder*) take only interrogative complements, and *anti-rogative* predicates exhibit a mirrored distribution taking only declarative complements.

(1) a. Alice knows/*wonders/believes that Ann left.

b. Alice knows/wonders/*believes who left.

Karttunen (1977) posits a generalization which has since been taken to heart in the question literature. Karttunen's (1977) claim is that predicates which cannot take a *wh*-complement also cannot take a *whether*-complement, exemplified in (2). However, two classes of exceptions to this generalization exist, as shown in (3); namely, emotive factives (e.g. *surprise*, *amaze*) which are claimed to take *wh*-complements but not

whether-complements, and dubitative verbs (e.g. *doubt*, *question*) which exhibit the opposite pattern.

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

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

These exceptions to the generalization have been shown to not be so clear-cut. Abenina-Adar (2019) presents data showing that the emotive factive *surprise* is judged acceptable with polar complements in certain contexts. In this paper, we aim to present novel data which shows yet another exception to the generalization in (2) in the form of the predicates *hope* and *fear* occurring with *whether*-complements.

1.2 *Hope* and *fear*

Another class of attitude predicates comprises the verbs *hope* and *fear*. These predicates are prototypically non-veridical preferential predicates (Uegaki and Sudo, 2019; Anand and Hacquard, 2013; Bolinger, 1968; Villalta, 2008, a.o.). Uegaki and Sudo (2019) further refer to *hope* and *fear* as desideratives, although Anand and Hacquard (2013) do not class them as such. Anand and Hacquard (2013) put forth that these two predicates together form the set of *emotive doxastics*.

(4) a. John fears that Mary will come.
b. John hopes that Mary will come.

Both of these predicates can take declarative complements, as in (4). They are both canonically assumed to be anti-rogative, which following Karttunen's (1977) generalization should manifest in unacceptability of each predicate with either polar or *wh*-interrogative complements. However, White (2021) presents corpus data suggesting that *hope* and *fear* are attested with *whether*-complements. This seems to be at least partially reflected in the data in (5), where the *wh*-complements are judged to be significantly less acceptable than their

whether-counterparts.

(5) a. *John fears who will come. (Non-FR Reading)

b. ?John fears whether Mary will come.

c. *John hopes who will come.

d. ?? John hopes whether Mary will come.

A large-scale corpus-study by White (2021) produces significant statistical correlations across the lexicon showing that progressive, modal, and infinitival morphology on the embedding predicate is significantly more likely than simple past, simple present, and perfect morphology to co-occur with *whether*-complements. These lexicon-wide correlations seems to be at first glance supported by contrasts like that in (6), especially for *hope whether* and perhaps less so for *fear whether*.

(6) a. ?? John hopes whether Mary will come.

b. ?John is hoping whether Mary will come.

This paper will be structured as follows. In §2 we will present novel data wherein certain contexts allow *whether*-complements to appear with emotive doxastics. Existing accounts for the exceptional *whether* complementation of emotive factives–in particular *surprise*–will be presented in §3, along with an overview of Uegaki and Sudo's (2019) analysis for the anti-rogativity of non-veridical preferential predicates. This will be followed in §4 by an exploration of ways in which said analysis may be extended to allow for *hope whether* and *fear whether*, and in §5 by an illustration of how our extended analysis bears on the novel data from §2. Finally, §6 presents discussion and conclusions.

2 *Hoping* and *fearing* whether

2.1 Speaker ignorance

It is observed by Abenina-Adar (2019) that *surprise whether* is acceptable when the speaker does not know the answer to the embedded interrogative. If the speaker conversely has full knowledge, then the embedded *whether* is unacceptable, while an embedded declarative is judged to be acceptable. In (7) and (8) we present analogous examples testing the effects of speaker ignorance on *hope whether* and *fear whether*.

(7) *Context:* I've recently made the final payment on my mortgage, and so I now have full ownership of my house. I love my house dearly. Suddenly, there is an earthquake, and I hear the house creaking. I run outside, unsure what is going to happen to my house, and say…

a. I fear whether my house is gonna collapse.

b. I fear that my house is gonna collapse.

In (7), the context establishes that the speaker does not know the answer to the question *Is my house gonna collapse?*. The context further establishes that the speaker does not desire for the house to collapse.

(8) *Context:* I've been thinking of dropping everything and moving to Indonesia. My house has a sizeable insurance policy taken out on it. Suddenly, there is an earthquake, and I hear the house creaking. I run outside, thinking how serendipitous it would be if my house collapsed, I cashed in the insurance policy, and used that to move to Indonesia. A neighbor asks me why I'm looking so smug, and I reply:

a. ?I'm hoping whether my house is gonna collapse.

b. I'm hoping that my house is gonna collapse.

The context in (8) similarly establishes ignorance as to whether the house will ultimately collapse. However, in this case the context further makes clear that the speaker desires for the house to collapse in order to cash in on the insurance money.

The contexts in (9) and (10) are such that the true answer to the embedded question is made known to the speaker:

(9) *Context:* I've recently made the final payment on my mortgage, and so I now have full ownership of my house. I love my house dearly. Suddenly, there is an earthquake, and I hear the house creaking. I run outside, and call the city housing inspector. He shows up shortly and conducts an inspection, and says that the house is maximally structurally sound, it will be standing for many decades (worth of earthquakes) to come.

a. #I fear whether my house is gonna collapse.

b. #I fear that my house is gonna collapse.

(10) *Context:* I've been thinking of dropping everything and moving to Indonesia. My house has a sizeable insurance policy taken out on it. Suddenly, there is an earthquake, and I hear the house creaking. I run outside, thinking how serendipitous it would be if my house collapsed, I cashed in the insurance policy, and used that to move to Indonesia. I call the city housing inspector, and he determines that my house is maximally structurally sound, and it'll be standing for many decades to come.

a. #I'm hoping whether my house is gonna collapse.

b. #I'm hoping that my house is gonna collapse.

Specifically, the speaker knows that the house is definitely not going to collapse. In such a context, both polar and declarative complements are judged unacceptable across the doxastic emotives.

2.2 Context-sensitivity

In addition to the speaker ignorance contexts above, there is a second condition that is identified as licensing *surprise whether* by Abenina-Adar (2019). Namely, under the scope of a quantifier, *surprise whether* is acceptable when different answers to the embedded question are true for different individuals or situations in the domain of the quantifier. We present such examples for the emotive doxastics in (11) and (12).

(11) *Context:* Ali, who is not particularly fond of spiders, is living in the midst of a spider infestation. Half of the time, when Ali goes to the bathroom, there's a spider in the toilet; the other half, there isn't.

a. Ali always fears whether there's a spider in the toilet.

b. Ali always fears that there's a spider in the toilet.

(12) *Context:* Ali, who is quite fond of spiders, is living in the midst of a spider infestation. Half of the time, when Ali goes to the bathroom, there's a spider in the toilet; the other half, there's isn't.

a. ?Ali is always hoping whether there's a spider in the toilet.

b. Ali is always hoping that there's a spider in the toilet.

In (11) and (12) the answer to the embedded interrogative *Is there a spider in the toilet?* is affirmative half the time and negative the other half. Further the context in (11) establishes that Ali does not desire for there to be a spider in the toilet, whereas (12) makes clear that Ali does indeed desire the spider's presence.

The contexts in (13) and (14) establish that for all situations in the domain, the answer to the embedded

question is always that there is a spider in the toilet. If the true answer to the embedded question does not vary across the domain of the quantifier in such a way, then neither complement type is acceptable.

(13) *Context:* Ali, who is not particularly fond of spiders, is living in the midst of a spider infestation. Every time she goes to the bathroom, she finds a spider in the toilet.

a. #Ali always fears whether there's a spider in the toilet.

b. #Ali always fears that there's a spider in the toilet.

(14) *Context:* Ali, who is quite fond of spiders, is living in the midst of a spider infestation. Every time she goes to the bathroom, she finds a spider in the toilet.

a. #Ali is always hoping whether there's a spider in the toilet.

b. #Ali is always hoping that there's a spider in the toilet.

In the remaining sections of this paper, we aim to account for the fact that both declarative and polar complements are disallowed in contexts where the true answer is either known to the speaker or is constant across the domain. Our account further aims to provide a story for why these same sentences are judged acceptable in the complementary contexts (i.e. speaker ignorance and true-answer-variability). As a necessary ingredient of such an account, we must show that *whether*-complements can be generated without systematic unacceptability under these emotive doxastics. However, we make no serious attempts in the paper to distinguish between where judgments diverge, such as between the sentences in (8) and (12).

3 A degree-based treatment of non-veridical preferential predicates

To analyze preferential predicates, Uegaki and Sudo (2019) employ Romero's (2015) degree-based semantics, which is based on Villalta (2008). The choice of a degree-based account is predicated on the truth-conditional focus sensitivity of preferential predicates.[1] Their analysis is further based on a uniform approach to clause embedding wherein declarative and interrogative complements represent sets of propositions, and clause-embedding predicates take sets of propositions as their argument (Theiler et al., 2019, a.o.). Assuming a Roothian alternative semantics for focus (Rooth, 1992), preferential predicates are taken to make reference to

1. While this stands as one of Uegaki and Sudo's (2019) primary motivators for choosing a degree-based analysis, we will later show that our extensions to their analysis do not change the predictions made for the focus-sensitivity data. Further, we discuss possible shortcomings of such an analysis.

a contextually-provided set of alternatives, C, also referred to as a comparison class by Romero (2015), and defined in (15a). We adopt, following Uegaki and Sudo (2019), a measure function $\texttt{Pref}$, and a threshold degree $\theta\,(C)$ given the comparison set C, defined in (15b) and (15c), respectively.

(15) a. $[\![\alpha \sim C]\!]^{o}$ is defined iff $C \subseteq [\![\alpha]\!]^{f}$; if defined, $[\![\alpha \sim C]\!]^{o} = [\![\alpha]\!]^{o}$ (Rooth, 1992)

b. $\texttt{Pref}_{w}\,(x, p)$:= the maximum degree to which x prefers p at w

c. $\theta\,(C)$:= the standard threshold given the comparison class C

(16) $$[\![\text{hope}_{C}]\!]^{o} = \lambda Q_{\widehat{\langle s,t\rangle}}.\lambda x.\lambda w : \exists p \in Q\,[p \in C] \wedge \{p' \mid p' \in C \wedge \texttt{Pref}_{w}\,(x, p') > \theta\,(C)\} \neq \varnothing\,.\ \exists p'' \in Q\,[p'' \in C \wedge \texttt{Pref}_{w}\,(x, p'') > \theta\,(C)]$$

Uegaki and Sudo (2019) posit the denotation for *hope* presented in (16).[2] Their semantics for *hope* presupposes that the comparison term p is in the comparison class C, a presupposition argued by Romero (2015) to exist in degree constructions generally. Further, *hope* presupposes that there is at least one proposition in the comparison class such that the attitude holder prefers it in w to a degree which exceeds the standard threshold given C. Uegaki and Sudo (2019) refer to this presupposition as Threshold Significance, which they take to be a general property of gradable expressions (see Uegaki and Sudo, 2019, pp. 338–339 for empirical and conceptual motivations). The asserted content of *hope* then states that there is a proposition in the comparison class such that the attitude holder prefers it sufficiently.

In order to derive the anti-rogativity of these non-veridical preferential predicates, Uegaki and Sudo (2019) follow Beck (2006) in assuming that *wh*-items are necessarily focused. This results in the focus semantic value of a *wh*-complement being equivalent to its ordinary semantic value. Letting Q be the focus/ordinary semantic value of the interrogative complement and given the definition in (15a), the comparison class C in (17b) is restricted as in (17a).

(17) a. $C \subseteq [\![\text{who will come}]\!]^{f} = Q$

b. $[\![\text{John hopes}_{C}\,[\text{who}_{F}\text{ will come}] \sim C]\!]^{w}$

$$= \lambda w : \exists p \in Q\,[p \in C] \wedge \{p' \mid p' \in C \wedge \texttt{Pref}_{w}\,(j, p') > \theta\,(C)\} \neq \varnothing\,.$$

2. The second conjunct in the presupposed content of this denotation, corresponding to Threshold Significance, is formulated here set-theoretically. This is a departure from Uegaki and Sudo's (2019) representation of the condition as an existential presupposition, shown in (i). The two representations are logically equivalent and merely represent notational variance.

(i) $\exists d \in \{\texttt{Pref}_{w}\,(x, p) \mid p \in C\}\,[d > \theta\,(C)]$

$$\exists p'' \in Q\ [p'' \in C \wedge \texttt{Pref}_w\,(j, p'') > \theta\,(C)\,]$$

A sentence where *hope* takes a *wh*-complement has a meaning like that in (b). The Threshold Significance presupposition holds whenever there is a proposition in C such that John prefers it sufficiently. More concretely, the Threshold Significance presupposition may be satisfied by any proposition in the set $Q = \{\lambda w.\texttt{will-come}_w\,(x) \mid x \in D_e\}$, of which C is a subset, that John sufficiently prefers. In such a case, the asserted content – namely, that there is a proposition in C which John prefers sufficiently – is necessarily true. Following Barwise and Cooper (1981), Gajewski (2002), and Chierchia (2013), they take such systematic triviality to result in ungrammaticality.

(18) a. $C \subseteq [\![\text{Mary}_F \text{ will come}]\!]^f = Q$

b. $[\![\text{John hopes}_C \text{ that [Mary}_F \text{ will come]} \sim C]\!]^w$

$$= \lambda w : M \in C\ \wedge\ \{p \mid p \in C \wedge \texttt{Pref}_w\,(j, p) > \theta\,(C)\} \neq \varnothing\ .$$
$$M \in C\ \wedge\ \texttt{Pref}_w\,(j, M) > \theta\,(C)$$

When taking a declarative complement, the comparison class is constrained as in (18a), and the sentence receives the meaning in (18b). The Threshold Significance presupposition can be satisfied by any proposition in C of the form *Bill will come*, *Lola will come*, etc. that John sufficiently prefers. However, since the set of propositions being passed to *hope* is simply the singleton set containing the proposition that *Mary will come*, the truth of the sentence relies only on John's sufficient preference of the proposition $M := \lambda w.\texttt{will-come}_w\,(m)$. Therefore, there is no systematic triviality leading to ungrammaticality in the case of declarative complements.

4 Allowing polar interrogative complements

In this section, we aim to evaluate how Uegaki and Sudo's (2019) account of *hope* and *fear*, as laid out in §3, may be extended to account for data presented in §2. As is, their account predicts that all instances of *whether*-complements will result in systematic triviality and therefore ungrammaticality. This is because the comparison class, constrained as in (19a), provides an alternative to M that can satisfy the Threshold Significance presupposition. Further, the set of propositions that is passed as the first argument to *hope*, given in (19b), provides two propositions that could satisfy the truth-conditions of the asserted content.

(19) a. $C \subseteq [\![\text{whether Mary will come}]\!]^{\mathrm{f}} = \{M, \neg M\}$

b. $[\![\,[\text{whether Mary will come}] \sim C]\!]^{o} = [\![\text{whether Mary will come}]\!]^{o} = \{M, \neg M\}$

Thus, a necessary first step in accounting for the data in §2 is to extend the above analysis to allow for *whether*-complements. We take the entire polar interrogative clause to be the object that constrains C. As a naïve first pass, one might assume the embedded subject to be the focused element, mirroring the analysis given for declarative complements.

(20) $[\![\,[\text{whether Mary}_F \text{ will come}] \sim C]\!]^{o}$ is defined iff

$$C \subseteq \{\lambda w.\texttt{will-come}_w\,(x) \mid x \in D_e\} \cup \{\lambda w.\neg\texttt{will-come}_w\,(x) \mid x \in D_e\}$$

if defined,

$$[\![\,[\text{whether Mary}_F \text{ will come}] \sim C]\!]^{o} = [\![\text{whether Mary}_F \text{ will come}]\!]^{o}$$
$$= \{\lambda w.\texttt{will-come}_w\,(x) \mid x \in D_e\} \cup \{\lambda w.\neg\texttt{will-come}_w\,(x) \mid x \in D_e\}$$

The comparison class is constrained as in (20). Such an analysis would result in systematic triviality for *whether*-complements, and therefore ungrammaticality.

Yet another possibility is to assume that the focused element in the embedded polar interrogative is *whether* itself. This would be analogous to Uegaki and Sudo's (2019) claim, following Beck (2006), that the *wh*-item is necessarily focused. However, this results in the comparison class being constrained as in (19), which yields systematic triviality. In order to get around this systematic triviality, what would be needed is for the *whether*-complement, like the declarative, to constrain C in such a way that it contains at least one other alternative that can satisfy Threshold Significance, while simultaneously making the set of propositions passed as the first argument to the predicate a singleton set containing only that proposition corresponding to replacing *whether* with *that*. In other words, for the sentence *John is hoping whether Mary will come*, the truth of the sentence should only rely on John sufficiently preferring that *Mary will come*, while C contains at least one other alternative.

To this end, we appeal to the properties that are made *salient* or *highlighted* by different clause-types (Roelofsen and Farkas, 2015; Roelofsen et al., 2019). Any sentence is taken to highlight an n-place property, where $n \geq 0$ is the number of *wh*-elements in the sentence. Propositions are therefore 0-place properties. A declarative (e.g. *Mary will come*) and a polar interrogative (e.g. *Will Mary come?*) each highlight a 0-place property, i.e. the proposition that *Mary will come*. A *wh*-interrogative (e.g. *Who will come?*) highlights the 1-place property corresponding to the function that maps each individual to the set of worlds where that individual

will come, i.e. $\lambda x.\lambda w.\texttt{will-come}_w\,(x)$.

One way of achieving the conditions outlined above to get around systematic triviality is to introduce an intermediate operator $\mathcal{O}$ between hope and its complement that behaves as in (21).[3]

(21) $[\![\mathcal{O}\ [\text{CP} \sim C]]\!]$ = the set of propositions in [CP$\sim C$] that have the same polarity as the property highlighted by CP

Such an operator would ensure that for declarative and polar-interrogative complements, the set of propositions passed to the predicate is the singleton set containing the highlighted 0-place property. For *wh*-complements, we assume that Crucially, this operator would functionally serve as identity for declarative and *wh*-complements, thus maintaining the desired predictions made by Uegaki and Sudo's (2019) analysis. However, it is not clear whether such an operator would be logically possible. If $\mathcal{O}$ takes a set of propositions, it has no knowledge of how that set was created. In other words, the polarity of the property highlighted by the embedded clause is not accessible to $\mathcal{O}$. Therefore, it does not seem like such an operator could be defined in the first place.

(22) $[\![\alpha \sim C]\!]^o$ is defined iff $C \subseteq [\![\alpha]\!]^f$; if defined,

$$[\![\alpha \sim C]\!]^o = \begin{cases} [\![\alpha_H]\!]^o & , \quad \alpha_H \in [\![\alpha]\!]^o \\ [\![\alpha]\!]^o & , \quad \text{otherwise} \end{cases}$$

As a solution, we suggest a modification to the definition of $[\![\alpha \sim C]\!]^o$, presented in (22) and where α_H is the property highlighted by α. For the declarative complement *that Mary will come*, the property highlighted is indeed contained in the singleton set $\{M\}$, and so the value of $[\![\,[\text{that Mary will come}] \sim C]\!]^o$ will simply be the ordinary semantic value of the 0-place property *that Mary will come*. Similarly, for the polar *whether Mary will come*, the property highlighted is an element of the set $\{M, \neg M\}$, and so the value of $[\![\,[\text{whether Mary will come}] \sim C]\!]^o$ is the same as for the declarative complement. Finally, the *wh*-complement *who will come* highlights a 1-place property of type $\langle e, st\rangle$, which cannot be an element of $[\![\text{who will come}]\!]^o$,

3. Crucially, such an operator would have to pick out those propositions which match in polarity with the embedded CP, and *not* simply pick out those with positive polarity.

(i) John hopes that Mary will not come.

If $\mathcal{O}$ picked out the positive polarity alternatives, the asserted content of (i) would require that John prefer the proposition that *Mary will come*. Rather, it is desired that $\mathcal{O}$ pick out from $[\![\,[\text{Mary}_F \text{ will not come}] \sim C]\!]^o$ those propositions that agree in polarity with *Mary will not come*.

whose elements are of type $\langle st \rangle$. Therefore, the value of $[\![[\text{who will come}] \sim C]\!]^o$ will simply be the ordinary semantic value of the *wh*-complement, $\{\lambda w.\texttt{will-come}_w\,(x) \mid x \in D_e\}$. Crucially, this reformulation of $[\![\alpha \sim C]\!]^o$ adheres to the conditions imposed upon $\mathcal{O}$ above, and preserves the resulting values of $[\![\alpha \sim C]\!]^o$ when α is a declarative or *wh*-complement.[4]

While the proposed change to the Roothian $\sim$-operator provides the desired avoidance of systematic triviality for *whether*-complements under *hope* and *fear*, it remains to be seen whether this change would have adverse effects on the predictions made by the greater focus and alternative semantics literature. This evaluation is left for future work.

4.1 The Doxastic Condition

Non-veridical preferential predicates like *hope* have been noted to encode the inference that the attitude holder takes the embedded proposition to be a live possibility.

(23) *Context:* Said by a student who correctly takes themselves to live in a world where time proceeds independently of one's attitude toward it:

a. #I hope that time stands still for the rest of the night.

b. #I fear that this night will never end.

Anand and Hacquard (2013) treat examples like (23) as underlining the inference that the attitude holder's doxastic state is compatible with the possibility that φ (Doxastic Assertation). Uegaki and Sudo (2019) adopt this as their *doxastic condition*, implementing it as a conjunct in the presuppositional content of their denotation for emotive doxastives like *hope* (the relevant definedness condition is underlined below):

(24) $$[\![\text{hope}_C]\!]^{\text{o}} = \lambda Q_{\widehat{\langle s,t\rangle}}.\lambda x.\lambda w : \exists p \in Q\,[p \in C] \wedge \{p' \mid p' \in C \wedge \texttt{Pref}_w\,(x,p') > \theta\,(C)\} \neq \varnothing \wedge \underline{\forall q \in C\,[\text{Dox}_x^w \cap q \neq \varnothing]}\,.\,\exists p'' \in Q\,[p'' \in C \wedge \texttt{Pref}_w\,(x,p'') > \theta\,(C)]$$

Uegaki and Sudo (2019) note that the inclusion of this presupposition is not incompatible with their analysis. In the section that follows, we show that utilizing this presupposition to restrict the comparison class C such

4. In (21) and (22), we make reference to *the* property highlighted by the embedded clause. For the three clause-types discussed here, there is only ever one property highlighted. However, alternative questions and multiple-*wh* questions highlight more than one property. We are not addressing alternative questions under *hope* and *fear* in this paper, but with minimal modifications to (22), our analysis would predict sentences like (i) to result in systematic triviality.

(i) ?? John is hoping whether Mary will come or Bill will leave.

that it only contains those alternatives which the attitude holder considers possible can account for the data presented in §2.

5 Analysis in action

In this section, we illustrate the predictions made by our analysis, based on Uegaki and Sudo (2019) in addition to the modified formulation of the $\sim$-operator in (22) as well as the incorporation of the doxastic condition as presented in §4.1. Our denotations for *hope* and *fear* are given in (25).

(25) a. $[\![\text{hope}_C]\!]^{\text{o}} = \lambda Q_{\widehat{\langle s,t\rangle}}.\lambda x.\lambda w : \exists p \in Q\,[p \in C] \wedge \{p' \mid p' \in C \wedge \texttt{Pref}_w\,(x,p') > \theta\,(C)\} \neq \varnothing \wedge$
$\forall q \in C\,[\text{Dox}_x^w \cap q \neq \varnothing]\,.\,\exists p'' \in Q\,[p'' \in C \wedge \texttt{Pref}_w\,(x,p'') > \theta\,(C)]$

b. $[\![\text{fear}_C]\!]^{\text{o}} = \lambda Q_{\widehat{\langle s,t\rangle}}.\lambda x.\lambda w : \exists p \in Q\,[p \in C] \wedge \{p' \mid p' \in C \wedge \texttt{Pref}_w\,(x,\neg p') > \theta\,(C)\} \neq \varnothing \wedge$
$\forall q \in C\,[\text{Dox}_x^w \cap q \neq \varnothing]\,.\,\exists p'' \in Q\,[p'' \in C \wedge \texttt{Pref}_w\,(x,\neg p'') > \theta\,(C)]$

Throughout this section, we will illustrate how our current analysis handles the data in §2 for the predicate *hope*. While we will not explicitly show the derivations for *fear*, they are fully analogous.

5.1 Speaker ignorance

Consider a sentence of the form "*x* hopes whether φ". When the speaker x is ignorant as to the true answer to the embedded question φ, as in (8), neither the proposition φ or $\neg\varphi$ is excluded by the doxastic condition from the comparison class C. Letting $HC := \lambda w.\texttt{gonna-collapse}_w\,(\textit{my house})$, the denotation for (8a) is given in (26).

(26) $[\![\text{hope}_C\,[\text{whether}_F \text{ my house is gonna collapse}] \sim C]\!]^o$
$= \lambda w : HC \in C \wedge \{p \mid p \in C \wedge \texttt{Pref}_w\,(x,p) > \theta\,(C)\} \neq \varnothing \wedge \forall q \in C\,[\text{Dox}_x^w \cap q \neq \varnothing]\,.$
$HC \in C \wedge \texttt{Pref}_w\,(x,HC) > \theta\,(C)$

The asserted content of (26) simply requires that HC be an alternative that is sufficiently preferred by the attitude holder. Since neither HC nor $\neg HC$ is excluded by the doxastic condition from C, either one is able to satisfy Threshold Significance, and the sentence is not trivially true. Because our analysis treats declarative and polar-interrogative complements as informationally equivalent, both of the sentences in (8) are predicted to be equally grammatical in these speaker ignorance contexts.

In cases where the speaker is not ignorant – that is, when the speaker knows the true answer to the embedded question – both declarative and polar complements are judged unacceptable, as in (10). Here, the denotations for the sentences with either a declarative or polar complement are the same as in (26). The main difference is that because the speaker knows that the house is definitely not going to collapse, the proposition $\neg HC$ is excluded from C. Therefore, Threshold Significance can only be satisfied by the attitude holder sufficiently preferring HC, which makes the asserted content trivially true.[5]

5.2 Context-sensitivity

When the true answer to the embedded question is varied across the individuals or situations in the domain, polar interrogatives or declaratives embedded under *hope* and *fear* are judged acceptable, if not marginal, shown in (12). However, they are unequivocally judged unacceptable when the context is such that the true answer is the same across the domain, as in (14).

Letting $S := \lambda w.\texttt{is-in-the-toilet}_w\,(\textit{spider})$, when the true answer varies, as in (12), neither S nor $\neg S$ are excluded from C. Analogous to the case of speaker ignorance above, Threshold Significance can be satisfied by either S or $\neg S$, and so there is no systematic triviality.

(27) $[\![\text{hope}_C\ [\text{whether}_F \text{ there's a spider in the toilet}] \sim C]\!]^o$

$$= \lambda w : S \in C \wedge \{p \mid p \in C \wedge \texttt{Pref}_w\,(x,p) > \theta\,(C)\} \neq \varnothing \wedge \forall q \in C\,[\text{Dox}_x^w \cap q \neq \varnothing]\,.$$
$$S \in C \wedge \texttt{Pref}_w\,(x,S) > \theta\,(C)$$

In a context like (14), the true answer to the question *Is there a spider in the toilet?* is affirmative for all situations in the domain. Therefore, the proposition $\neg S$ is excluded by the doxastic condition from C, leaving sufficient preference for S as the only option for satisfying Threshold Significance. However, this results in (27) being trivially true, resulting in ungrammaticality.

5.3 Focus-sensitivity

One of the primary empirical cases that Uegaki and Sudo (2019) sought to account for was the focus-sensitivity of *hope* and *fear*. The contrast presented by them is recreated in (28c–d), showing that *hope* is truth-conditionally sensitive to the focused element in an embedded declarative clause (Uegaki and Sudo, 2019). We present the

5. Note that in this particular example, the true answer that was contextually provided was $\neg HC$. However, our analysis similarly predicts systematic triviality if the true answer established by the context were HC. The only difference would be that the asserted content would be trivially false rather than trivially true.

analogous data for *fear* in (29c–d), along with correlates of both predicates with *whether*-complements in (28a–b) and (29a–b).

(28) *Context:* Natasha does not like to teach logic and prefers to teach syntax. She is not allowed to teach both. This year, it is likely that she needs to teach logic and, if so, she prefers to do so in the morning, as she prefers to do all her teaching in the morning. …

a. Natasha fears whether she'll teach logic in the MORNING. FALSE

b. Natasha fears whether she'll teach LOGIC in the morning. TRUE

c. Natasha fears that she'll teach logic in the MORNING. FALSE

d. Natasha fears that she'll teach LOGIC in the morning. TRUE

(29) *Context:* Natasha does not like to teach logic and prefers to teach syntax. She is not allowed to teach both. This year, it is likely that she needs to teach logic and, if so, she prefers to do so in the morning, as she prefers to do all her teaching in the morning. …

a. ?Natasha is hoping whether she'll teach logic in the MORNING. TRUE

b. ?Natasha is hoping whether she'll teach LOGIC in the morning. FALSE

c. Natasha is hoping that she'll teach logic in the MORNING. TRUE

d. Natasha is hoping that she'll teach LOGIC in the morning. FALSE

We find the judgements for the sentences with *whether*-complements above to be quite difficult to discern. However, modulo the acceptability (or not) of the *hoping whether* focus sensitivity examples, these data pattern the same as their declarative counterparts with regard to their truth conditions. Therefore, our extensions to Uegaki and Sudo (2019) do not affect their treatment of focus-sensitivity. The same treatment can straightforwardly be applied to the *whether* sentences, which should not be surprising given that our analysis treats them as informationally equivalent.

5.4 Informational equivalence of *that* and *whether*

As has been heretofore mentioned, our current analysis treats *that* and *whether*-complements under *hope* and *fear* as informationally equivalent. What is meant by this is that the denotations assigned to the sentences in (30) are equivalent. The only difference between the sentences is the manner in which the comparison class C is constrained.

(30) a. John is hoping whether Mary will come.

b. John is hoping that Mary will come.

While the informational equivalence between the two clause-types yields the desired predictions for the novel data presented in this paper, it is not wholly accurate. Despite the acceptability (marginal or not) of *whether*-complements in these various contexts, the declarative complements are systematically preferred over the polar interrogative counterparts.

A possible account of these gradient acceptability judgments comes from Roelofsen et al. (2019), however a full treatment of this is left for future work. The semantics they provide for *surprise* treats the sentences in (31) as systematically equivalent.

(31) a. *It surprises Bill whether Susan is drinking coffee.

b. It surprises Bill that Susan is drinking coffee.

Following Roelofsen and Farkas (2015), Roelofsen et al. (2019) take declarative complements to be less complex in terms of processing than polar interrogative complements. This is because computing the semantic value of a polar interrogative involves computing the semantic value of the corresponding declarative plus the additional operation of computing the negated proposition. The systematic equivalence together with complexity differences are taken to suggest that the polar interrogative is systematically disprefered in competition with the declarative via a *manner* implicature.

Rather than the stronger claim made by Roelofsen et al. (2019) that greater processing complexity result in ungrammaticality, a weaker statement is speculatively proposed. Such processing complexity could be assumed to result in simply a markedness or mere dispreference that might possibly account for the gradient effects observed.

6 Discussion

As noted in §3, Uegaki and Sudo (2019) follow Beck (2006) in choosing to F-mark the *wh*-proform itself in order to derive anti-rogativity for non-veridical preferentials. Recall from §4 that we have likewise inherited this second assumption in treating polar interrogative complements, where we were faced with either focusing the embedded subject, as with the declarative predicates, or focusing *whether*, as in the case of *wh*-complements. This choice allowed us to satisfy Threshold Significance, side-stepping the triviality (and ungrammaticality) of

whether-embeddings and thereby rendering them informationally equivalent to declaratives.

Likewise, in dealing with their declarative data, Uegaki and Sudo (2019) assume that *Alice* is a focused element in a sentence like *John hopes that Alice jumped*. Formally, this choice appears to be entirely arbitrary, as indeed focusing any element in the embedded clause will generate the necessary alternatives but – crucially – in order to guard against presupposition failure of Threshold Significance, one such element *must* be focused.

At the outset, we note that the cost of these decisions appears non-trivial for a unified theory of focus and F-marking. Especially in the case of F-marked embedded subjects, choosing to focus such an element in order to derive the correct predictions appears rather arbitrary in the absence of any obligatory accentual correlates.

(32) a. John is hoping that Alice jumped. NO STRESS/INTONATION

b. John is hoping that ALICE$_F$ jumped.

c. John is hoping that Alice JUMPED$_F$.

d. John fears whether Alice jumped. NO STRESS/INTONATION

e. John fears WHETHER$_F$ Alice jumped.

Note that in the dataset above, for either given choice of focused element, Uegaki and Sudo (2019)'s analysis (and hence our own) predicts (32a) to have precisely the same informational content as (32b,c). Furthermore, with the aforementioned assumptions *à la* Beck (2006) in place, we see no reason to predict that (32d,e) should be indistinguishable. A continuation of (32e) which serves to disambiguate can be produced as follows:

(33) a. John fears WHETHER$_F$ Alice jumped, not THAT$_F$ she jumped.

Recall from §2 that we have not discussed in any depth divergences that obtain between declarative and *whether* complements for either of these doxastic emotives, and that under our analysis, (32e) is predicted to be informationally equivalent to its declarative variant. However, we observe that the sentence nonetheless does not appear unassertable – even though it is at present rather unclear to us as to what it should mean.

These data suggest that whatever mechanism for focus is at play in our account should be viewed with some suspicion. Whether the generation of the relevant alternatives should hinge upon a theory of focus which is insensitive to, or distinct from, intonationally-realized focus marking remains a concern to be left to future research.

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