

A Whether Forecast

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Abstract. It is a well-known fact that only factive propositional attitude predicates are felicitous with *wh*- (indirect question) complements. It has also been noted that so-called emotive factive predicates are only felicitous with some, not all, indirect question complements. But the reasons for these two constraints have remained unclear. I propose a competition-based explanation in terms of optimality theoretic pragmatics: Due to the competition with factive predicates, predicates like *believe* are infelicitous with complements automatically verifying the factive presupposition; and emotive factive predicates are infelicitous with *wh*- complements to the extent that these complements compete with more informative *that* complements. To arrive at these results, it is necessary to assume an analysis of questions on which they denote propositions and to be more careful than has been customary about the formulation of the presuppositions of factive and what I call super-factive predicates.

1 Introduction: Two Problems

1. Since Boër (1978) and Lewis (1982), it has been a mystery why not *believe* but only *know* (or generally, as it seems, only factive predicates) are felicitous with *wh*- (indirect question) complements:

- (1) Nani knows how high Mt. Shkhara is.
- (2) #Nani believes how high Mt. Shkhara is.
- (3) Nani knows that Mt. Shkhara is 5068 m high.
- (4) Nani believes that Mt. Shkhara is 5068 m high.

On a standard view, the view taken, i.a., by Kiparsky and Kiparsky (1970), *know* and *believe* only differ semantically in the factive presupposition that only *know* has, and, *wh*- and *that* complement clauses uniformly denote propositions (the former denoting world-dependent propositions, the intension a nonconstant function from worlds; the latter denoting world-independent propositions, the intension a constant function from worlds). I will refer to this view as the **simple semantics**.

It should thus be possible to interpret (2) as saying that however high Mount Shkhara is, Nani believes that it is that high – that is, the same as (1) (minus the factive presupposition). But in fact, (2) does not seem to have any interpretation.

There have been various attempts at accounting for this (see Egré 2005 for a recent survey). The simple semantics has been challenged, e.g., by Ginzburg (1995: 582ff.), who suggests that a verb like *know* takes facts in its denotation, while a verb like *believe* takes only propositions, and a question cannot be coerced to a proposition. This account has been criticized for being essentially stipulative (Egré 2005). It would certainly be nice if we could maintain that both *know* and *believe* embed propositions. I will adhere to the simple semantics – the theory of Groenendijk and Stokhof (1982), opting for a pragmatic, competition-based account vindicating suggestions made by Boër (1978: 333):

It is the inherent factivity of ‘who’-clauses which makes them bad company for nonfactive verbs of propositional attitude. Usually, the pragmatic point of using a nonfactive is to leave open the question of the truth-value of the proposition which is the object of that attitude, and this point is frustrated by the semantics of ‘who’-clauses.

I will base this account on Bidirectional Optimality Theory (BOT) and on the ideas developed by Blutner (1998, 2000, 2002, 2004, 2006).

2. Elliott (1982) and Grimshaw (1977) noted that emotive predicates like *incredible* are only felicitous with some *wh*- complements:

- (5) I agree it’s amazing what sounds they can make.
- (6) ?It’s amazing which team won the Champions League.
- (7) It’s amazing that Valencia won the Champions League.
- (8) #It is amazing whether Real won the Champions League.

Their conclusion was that these predicates do not embed interrogatives but exclamatives, and, in particular, *whether* clauses can only be interrogatives. This view has met with criticism more recently (Huddleston 1993, Lahiri 2000, d’Avis 2002, Abels 2005). At any rate, as long as the semantic difference between interrogatives and exclamatives or that between *know* and *amazing* is not clear, it is not explanative. Again, my account will be based on BOT, centering on the competition between *wh*- and *that*.

2 The Semantics of *Savoir Si* and *Croire Que*

Groenendijk and Stokhof (e.g. 1982) work with two-sorted type theory (Gallin 1975), and so will I. Here, world variables are in the semantic representations and can be abstracted over, and there is a designated variable (*i*) for the actual world.

The semantics of some salient words can be represented as follows:

$$\begin{aligned}
 \textit{that}'_i &= \lambda\phi_{\langle s,t \rangle} \phi \\
 \textit{whether}'_i &= \lambda\phi_{\langle s,t \rangle} \lambda j (\phi_j = \phi_i) \\
 \textit{know}'_i &= \lambda\psi_{\langle s,t \rangle} \lambda x \mathcal{B}_i(\psi)(x) \langle \lambda i(\psi_i) \rangle \\
 \textit{believe}'_i &= \lambda\psi_{\langle s,t \rangle} \lambda x \mathcal{B}_i(\psi)(x)
 \end{aligned}$$

The subjunctive *that* simply denotes the identity function on propositions. Normally, neither that nor the subjunctive *whether* will meet a type $\langle s, t \rangle$, proposition denoting expression but a type t , truth value denoting expression; however, a composition rule enables the function to apply to the sister's intension:

Intensional Functional Application

$$f_{\langle \langle s, a \rangle, b \rangle} + \xi_{\langle a \rangle} = f(\lambda i \xi)$$

The angled brackets in the representation of *know* enclose the presupposition of factivity. This subscript notation has become customary (cf. Beaver 1997). I assume a standard, general formulation of presupposition verification (CG = Common Ground):

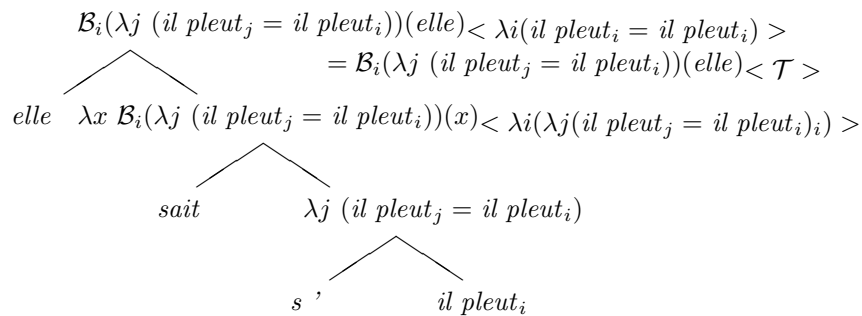
Presupposition Verification

$\phi_{i \langle \pi \rangle}$ is only defined if π follows from the Common Ground at i
 $(CG_i \subseteq \pi)$.

Note that the factive presupposition cannot simply be ψ . When ψ is a *whether* clause, the sentence would presuppose that ϕ has the same truth value as in the actual world. That is, the sentence would presuppose what the subject of *know* is claimed to know, and that is obviously too strong. The presupposition of (1) would only be verified if the hearer and the speaker, conscious of the Common Ground, were to know how high Mt. Shkhara is. Presupposed is instead that which in the *whether* case is a tautology but in the *that* case reduces to ψ , the complement proposition. I will call this, the **diagonal** (cf. e.g. Zimmermann 1991), the *rectified complement proposition* (the RCP).

With these components in place, we can represent the meaning of the sentence (9) compositionally in the tree below. The presupposition of factivity emerges as the tautology.

- (9) Elle sait s' il pleut.
 She knows whether it's raining.



3 Blocked Content, Blocked Form

I would like to propose that (2) (or any case of *believe wh-*) is systematically (and thus in a sense conventionally) dispreferred because of the competition it gets from (1) (or any case of *know wh-*), which due to its factive presupposition is only compatible with the situation that the Rectified Complement Proposition (RCP) follows from the Common Ground (CG) – a necessity when the complement is a question; while (2) is left with the implicature that it does not – an impossibility.

3.1 Contingent Case: Partial Blocking

Let us first consider the case of *know that* versus *believe that*.

A particular interpretation of a given expression can be blocked if it can be expressed more precisely by an alternative expression. Bidirectional Optimality Theory (BOT) (Blutner 1998, . . . , 2006) can account for such blocking effects. Consider the minimal pair (10) and (11), where the factive presupposition is in both cases verified but the factive *know* is preferred over the nonfactive *believe*:

- (10) Hi Polly. Love your column. I have a difficult question. I am married. But I recently met a woman who I really like and am attracted to. When I met her, we really hit it off and talked for hours. I was very tempted to, as they say, “come on” to her, but I did not. She is unmarried. I did not know how she would react – she knows I am married.
- (11) Hi Polly. Love your column. I have a difficult question. I am married. But I recently met a woman who I really like and am attracted to. When I met her, we really hit it off and talked for hours. I was very tempted to, as they say, “come on” to her, but I did not. She is unmarried. I did not know how she would react – ?? she believes I am married.

Note that the oddity of (11) does not follow from the semantics of *believe*. The absence of factivity is just as compatible with the situation where factivity is verified as with the situation where factivity is not verified. In BOT, however, the pairing of the nonfactive *believe* with the situation that factivity is verified can emerge as suboptimal and be blocked. It is a partial blocking, since pairing *believe* with the situation that factivity is not verified will emerge as optimal. Partial blocking is mostly accounted for in terms of the notion of weak optimality, but here it is sufficient to use the notion of strong (bidirectional) optimality, for a pair of an interpretation (or “content”) and an expression (or “form”).

Strong Bidirectional Optimality

A form-content pair $\langle f, c \rangle$ is strongly optimal iff
 f is at least as good for c as any candidate form f' and
 c is at least as good for f as any candidate content c' .

Goodness can be defined in terms of a variety of constraints; here it suffices to use the measure of the probability of the content given the meaning of the form, and only this; the two competing forms are in themselves equally harmonic.

Goodness

$\langle f, c \rangle$ is at least as good as $\langle f', c' \rangle$ iff $P(c/\llbracket f \rrbracket) \geq P(c'/\llbracket f' \rrbracket)$

Consider, in the abstract, the four form-content pairs $\langle f_1, c_1 \rangle$, $\langle f_1, c_2 \rangle$, $\langle f_2, c_1 \rangle$, $\langle f_2, c_2 \rangle$, where c_1 and c_2 are mutually exclusive and jointly exhaustive specifications of the meaning of f_1 or f_2 . If c_1 is more probable given f_1 than given f_2 , this means that f_1 is more informative than f_2 in relation to c_1 , reflecting the Gricean Maxim of Quantity in the speaker's, production perspective; and if c_2 is no less probable than c_1 given f_2 , c_2 is a Quantity-based conversational implicature of f_2 in the hearer's, interpretation perspective.

Let us now pair the forms (f_1) *Jane knows ψ* and (f_2) *Jane believes ψ* with the pair of contents ($\mathcal{B}_i(\psi)(Jane)$, i.e. Jane believes ψ , the common denominator for the two more specific interpretations, and) (c_1) $CG_i \subseteq \lambda i(\psi_i)$ (i.e. the RCP follows from the Common Ground, factivity is verified) and $\neg(CG_i \subseteq \lambda i(\psi_i))$ (i.e. the RCP fails to follow from the Common Ground, factivity is falsified) (see **Table 1**).

$P(\cdot/\llbracket \cdot \rrbracket)$	$CG_i \subseteq \lambda i(\psi_i)$	$\neg(CG_i \subseteq \lambda i(\psi_i))$
<i>Jane knows ψ</i>	$\Rightarrow 1$	0
<i>Jane believes ψ</i>	$\frac{1}{2}$	$\Rightarrow \frac{1}{2}$

Table 1. Probability of factivity \pm verified given \pm factivity

The cells in the tableau represent the conditional probability values of the contents (c_1 and c_2) given the semantics of the forms (f_1 and f_2). These values should be as high as possible. We see that the conditional probability of ($c_1/\llbracket f_1 \rrbracket$) is maximal – the best situation – while that of ($c_2/\llbracket f_1 \rrbracket$) is (due to the presupposition) minimal – the worst situation. The upper left 1 compares favourably to the lower left $\frac{1}{2}$ as well, reflecting the Gricean Maxim of Quantity: The form f_1 , but not the form f_2 , is maximally informative with regard to the content c_1 , and the latter form is blocked for this content.

Basically, ($c_2/\llbracket f_2 \rrbracket$) has the same conditional probability value as ($c_1/\llbracket f_2 \rrbracket$), however, because its value is higher than that of ($c_2/\llbracket f_1 \rrbracket$), the content c_1 is blocked for the form f_2 , reflecting a Gricean conversational implicature. Hence the oddness of (11). “She believes I am married” is forced to convey that the RCP (here that I am married) does not follow from the CG. If it does follow, the speaker should choose (10); (11) with its implicature clashes with CG reality.

This clash is a mild one, as it is a contingent, a conversational matter. The speaker may have reason to ignore the prior “cancellation” of the implicature, creating a shift in perspective, a suspension of belief in the Common Ground.

What is blocked is a certain interpretation for a certain form, and vice versa; and deblocking is possible. So although the oddity of (11) is distinct enough, it does not border on ungrammaticality.

3.2 A Priori Case: Total Blocking

But in addition to this contingent *that* case, there is the apriori *wh*- case.

(12) #She believes whether I am married.

Here the RCP follows from the – any – CG by virtue of the meaning of *whether*. The reason the last sentence in (11) is not out *per se* is that it *can* make sense – it depends on the CG; whereas the reason (12) *is* out *per se* is that it *cannot* make sense – irrespectively of the CG. Before the sentence is finished, the signal that the RCP does not follow from the CG clashes with the signal that it does.

Recall from Section 3.1 that *Jane believes ψ* implicates $\neg(\text{CG}_i \subseteq \lambda i(\psi_i))$; for $\psi = \lambda j (\phi_j = \phi_i)$ this implicature amounts to saying that the tautology fails to follow from the Common Ground, which is impossible, since a (the) tautology follows from any set of propositions.

More generally, whenever ψ comes from a *wh*- clause, we necessarily have that $\text{CG}_i \subseteq \lambda i(\psi_i)$. Only one content is thus possible, and the form *Jane believes ψ* is blocked for that content because the $\neg(\text{CG}_i \subseteq \lambda i(\psi_i))$ implicature persists.

As long as only the truth conditions of a sentence like (12) are considered, there is nothing to distinguish it from the corresponding *know* sentence:

$P(\cdot/[\cdot])$	$\text{CG}_i \subseteq \lambda i(\psi_i)$	$\neg(\text{CG}_i \subseteq \lambda i(\psi_i))$
<i>Jane knows ψ</i>	1	0
<i>Jane believes ψ</i>	1	0

Table 2. Probability of factivity verified given \pm factivity; $\psi = \textit{whether } \phi$

Once the implicature is taken into account, however, this changes:

Jane believes ψ implicates $\neg(\text{CG}_i \subseteq \lambda i(\psi_i))$. For $\psi = \textit{whether } \phi$, this is

$$\begin{aligned} \neg(\text{CG}_i \subseteq \lambda i(\lambda j (\phi_j = \phi_i)_i)) &= \\ \neg(\text{CG}_i \subseteq \lambda i(\phi_i = \phi_i)) &= \\ \neg(\text{CG}_i \subseteq \top) &= \perp \end{aligned}$$

In words, the *believe* sentence conversationally implicates the contradiction. This causes what amounts to a “total blocking”, accounting for its infelicity, bordering on ungrammaticality, while anchoring it in pragmatics.

Note that what might save cases like (11) – the speaker may have reason to disregard the prior “cancellation” of the implicature – could not apply to (12); a simultaneous “cancellation” cannot be disregarded.

On this account, then, the inappropriateness of a form is attributed to its neurotic content. Zimmermann (2006) offers an account of the infelicity of (the German version of) *Jane wants to know that ϕ* along similar lines.

There are some uses of *believe* where the missing factivity is not the only distinctive feature vis-à-vis *know*, so that there is no minimal competition in this regard. One such use can be paraphrased by *accept*. When *believe* is used in this sense, *Jane believes ψ* presupposes that someone tries to convince her of ψ , and the blocking with regard to *wh-* complements is to a certain extent lifted. This provides indirect evidence in support of the competition-based account.

- (13) No one believes how old I am.
- (14) I think he actually believes how serious this is now.
- (15) The American 1st Marine Division answered but their operator refused to believe who our operator was speaking for.

It is true that we still do not find *whether* complements. The reason, it can be argued, lies in a competition between *whether* and *that* – a phenomenon which plays a major role in the next section.

4 Surprise Predicates and the *wh-* / *that* Competition

It has often been noted that “surprise predicates”, like *surprised* or *surprising*, do not embed polar interrogatives (cf. e.g. Abels 2005). Thus:

- (16) #I’m surprised (at) whether he was found guilty.

This has been contrasted with other *wh-* clauses which such predicates do embed:

- (17) We will be surprised who goes to Heaven.

So in much of the relevant literature, the common notion has been that there is something special about *whether* clauses. Elliott (1982) and Grimshaw (1977) held that surprise predicates do not embed interrogatives but exclamatives and that *whether* clauses can only be interrogatives, not exclamatives.

Abels (2005) assumes that these clauses denote singleton sets of propositions, contradicting presuppositions carried by surprise predicates. However, first, there is scarce evidence for this assumption. Indeed, in the theory of Groenendijk and Stokhof (1982), any *wh-* clause has the same type of denotation – a proposition. The *who* clause in (17), say, denotes the set of worlds where the set of people going to Heaven equals the set of people going to Heaven in the actual world. Second, the proposed presupposition would seem to be more reasonable as an entailment.

Moreover and more importantly, more thorough investigations, some made by Lahiri (2002), suggest that the facts are really not as clear-cut as previous work has made them appear. Rather, we can observe that

- some *wh*- clauses, beyond *whether* clauses, are easier than others,
- some surprise predicates are stricter than others,
- there are cases where surprise predicates do embed polar interrogatives.

The total picture suggests a gradience in several dimensions and an account in terms of a competition with *that* clauses. The “easy” *wh*- clauses, the “sloppy” emotive predicates, and the cases where polar interrogatives are possible all serve to, in various ways, weaken the competition with corresponding *that* clauses; this is what makes them relatively felicitous.

The “strict” predicates, like *(it’s) amazing, incredible*, seem to presuppose the embedded proposition (and not just, like *know*, the RCP):

- (18) “It’s incredible what he has done today,” said Armstrong’s team coach,
...
It’s incredible what he has done today ⇒
I (we) know what he has done today

At least, they presuppose that the speaker knows the embedded proposition. I will call these predicates **super-factive**. The more liberal predicates do not strictly presuppose (that the speaker knows) the embedded proposition, but there is in any case a tendency for the speaker to know:

- (19) Paul was surprised what had happened to the Galatians.

Now when the *wh*- proposition does follow from the CG or the speaker’s beliefs, there is in principle a competition with a corresponding *that* clause, – only, there can be a variety of reasons that the competition is not as strong as, say, in (20): There may be a need to withhold information, cf. (21), where a *that* clause would ruin the hearer’s suspense; it may be that a certain information structure can only be conveyed with the *wh*- clause, cf. (22), where, say, *Dumbledore died* instead of *who died* would preclude the sole focus on the verb.

- (20) ??“It’s incredible who won,” said Italy’s coach, Arrigo Sacchi.¹
(21) I was disappointed at who did it.
(22) I was surprised who died, weren’t you?

Or – importantly – a corresponding *that* clause may in some way or other be indeterminate or radically uneconomical, as in the case of (23).

- (23) It’s incredible who you meet on the train.

¹ Google returns one hit for “amazing who won”; there Amazing is the name of a race horse.

While (20) invites the reaction ‘if you know that Italy or Brazil won, why don’t you say so?’, although the speaker of (23) will know the embedded proposition, he will be unable to spell it out in terms of values for *who* in a *that* clause. The only realistic *that* clause alternative would be something like *that you meet the people you meet* – a clause with the same meaning as the *who* clause. This is a case of an essentially world-dependent proposition. Such cases are not rare; *how* (+ adj.) clause propositions are usually impossible to express by *that* clauses.

These properties of the utterance situation and the content of the *wh*- word facilitate *wh*- complements by rendering competing *that* complements less appropriate and thus less competitive. This leaves us with the following generalization.

Generalization

The stronger the competition with a *that* clause, the worse the *wh*- clause.

To account for the limiting case of *whether* complements, it is useful to observe the following.

Observation

The competition is at its strongest when a “strict” – super-factive – predicate combines with a *whether* clause.

Simplifying a bit (the presupposition is probably not simply ϕ but $\phi[i/v]$ for some v and verifiable not with respect to the Common Ground but to the speaker’s beliefs), we can define a super-factive predicate like *amazing* as follows:

$$amazing'_i = \lambda\psi_{\langle s,t \rangle} \mathcal{A}_i(\psi)_{\langle \psi \rangle}$$

Due to this presupposition there are in the case of *whether* only two cases: Either (the speaker believes that) ϕ follows from the Common Ground or (she believes that) $\neg\phi$ follows from the Common Ground, – and *whether* loses in both cases; cf. **Table 3**. Whether the “content” is one or the other, its probability value given the semantics of the *whether* form is lower than its value given the semantics of this or the other *that* form.

$inf(\cdot/\llbracket \cdot \rrbracket)$	$CG_i \subseteq \phi$	$CG_i \subseteq \neg\phi$
<i>it's amazing that ϕ</i>	$\Rightarrow 1$	0
<i>it's amazing whether ϕ</i>	$\frac{1}{2}$	$\frac{1}{2}$
<i>it's amazing that $\neg\phi$</i>	0	$\Rightarrow 1$

Table 3. Probability of ϕ or $\neg\phi$ in CG wrt. super-factivity with *that* ϕ or *whether* ϕ

With a predicate like *surprised*, however, we do find *whether* clauses embedded when a corresponding *that* clause is for some reason indeterminate. This is a strong indication that the relevant constraint has nothing to do with syntax or semantics as such but everything to do with competition and pragmatics.

The reasons that a corresponding *that* clause is indeterminate is, to be sure, in part semantic: In (24), there is, in effect, a quantification (through *seldom*, binding *a person*) over several *whether* clauses, some corresponding to one *that* clause, some to the other; in (25), there is a need to withhold information from the reader; in (26), there is a real lack of information on the part of the speaker.

- (24) Not that I was a boffin at psychometric testing, but we were seldom surprised at whether a person went to an Officer company or an NCO company.
- (25) Don't read this installment before seeing the episode if you want to be surprised at whether or not Hercules makes it.
- (26) I think we both feel this one will be a boy. But, we would rather be surprised whether it is a boy or not.

The common denominator, however, is this: The situation depicted in Table 3 fails to obtain because the premiss that ϕ or $\neg\phi$ follows from the common ground fails – be it that one must consider several instances, some where ϕ , some where $\neg\phi$ follows from the common ground, that ϕ or $\neg\phi$ follows from the speaker's ground but not from the hearer's ground (and this should remain so), or, finally, that ϕ or $\neg\phi$ fails to follow even from the speaker's ground – and this should remain so as well.

5 Conclusions

I have sketched pragmatic, optimality theoretic solutions to two problems which have seemed to require semantic stipulations: The fact that *believe*, unlike *know*, cannot embed *wh*- clauses would seem to force the conclusion (Ginzburg 1995) that *wh*- clauses and *that* clauses do not both denote propositions; and the fact that emotive predicates cannot embed *whether* clauses would seem to call for a special semantics for this type of *wh*- clause (Abels 2005). But of course, both courses of action carry a certain theoretical cost.

By contrast, the account I have proposed, appealing to a competition with *know* and with *that*, is free of extra semantic assumptions; indeed, it rests on the premiss that *know* and *believe*, and *that* and *whether*, are of the same type, differing minimally. In addition, certain observations attesting to a gradience in acceptability support the competition-based analysis: As it appears, when the competitor – *know* and *that* clauses – is less competitive, differing more than minimally from *believe* and *wh*- clauses, the constraints soften. In sum, although the analysis I have suggested may not be the final formulation, an explanation based on optimality theoretic pragmatics does seem basically correct.

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