

A Modal Analysis of Propositional *how*

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1. Introduction

How questions are canonically said to ask about the manner in which an event took place, or something similar—sometimes, for example, the method by which it took place. That’s illustrated in (1). But there is also a form of *how*—illustrated in (2)—that occurs in a higher, clausal position, which has been termed the ‘cognitive resolution’ (Jaworski 2009) or ‘propositional’ reading (Pak 2017, Jarvis 2022):

(1) MANNER AND METHOD

A: How should Floyd leave?

B: { Quietly
By the back door. }

(2) PROPOSITIONAL

A: How are you not cold right now?

B: This shirt is actually really warm.

Whether (1) involves two readings or one is controversial (Sæbø 2016, Schwarz & Simonenko 2018), but our focus here will be on the use in (2b), which is relatively little-studied. It does have cousins in other languages, however (Zhou & Hsieh 2023, Nederveen & Rullmann In prep.).

Our aim will be to explore what propositional *how* means and its relation to *why* and to other readings of *how*. We will argue that it gives rise to two pragmatic effects. To capture this, we will analyze it as a kind of modal. Just as manner *how* is the *wh* counterpart to manner adverbs, so too, we will argue, propositional *how* is the *wh* counterpart to adverbials that express Kratzerian conversational backgrounds (e.g., *in view of*; Kratzer 1981 and elsewhere). We take it to ask, roughly, ‘what conversational background would be compatible with the truth of the prejacent?’

Section 2 distinguishes propositional *how* from manner *how* in more detail; section 3 distinguishes it from *why*; and section 4 examines its pragmatic effects. Section 5 discusses some previous work. Section 6 sets out the analysis. Section 7 concludes.

2. Relation to manner ‘how’

First, let’s further isolate the reading from the manner reading.

Propositional *how* modifies propositions, so it occurs high in the clause. Manner *how* modifies event descriptions, so it originates at the VP level. This gives rise to grammatical effects.

One such effect is that the syntactic position of *how* determines its reading. Where it *how* can be interpreted as either high or low, as in (3), there is an ambiguity. Where *how* is unambiguously high, as in (4), only the propositional reading is present:

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- (3) How did Floyd come to the party?
 a. The other thing he had got canceled. (*propositional answer*)
 b. He took the bus. (*manner/method answer*)
- (4) How is it the case that Floyd came to the party?
 a. The other thing he had got canceled. (*propositional answer*)
 b. #He took the bus. (*manner/method answer*)

Another effect of structural position involves negation. In general, negation also unambiguously yields the propositional reading:

- (5) How did Floyd not come to the party?
 a. He had another thing he had to go to. (*propositional answer*)
 b. $\left. \begin{array}{l} \# \text{by train/hovercraft} \\ \# \text{on foot} \end{array} \right\}$ (*method/manner answer*)

Manner *how* is impossible here because it attaches at the VP level, below negation, and would have to move out of it, violating a negative island (Szabolcsi & Zwarts 1993; cf. Bross 2020). But propositional *how* adjoins at the level of the clause, above negation, and is therefore possible without violating an island.

Another difference between the two readings of *how* is that only propositional *how* is natural with stative predicates:

- (6) a. How are you cold right now? It's July.
answer: #loudly
 b. How do you hate this song? It's so good!
answer: #loudly
 c. How is this art? It's just a pine cone. (*Nederveen & Rullmann In prep.*)
answer: #clearly

This is because stative predicates generally resist manner modifiers (Katz 2003, Ernst 2016), so with them, *how* can only be interpreted on its propositional reading (Pak 2017).

The two readings also behave differently with modals. Certain modal expressions can receive MODAL CONCORD readings, in which a modal downstream of another one isn't interpreted independently (Geurts & Huitink 2006, Anand & Brasoveanu 2010):

- (7) Floyd couldn't possibly paint an oil painting.
means: 'It's not possible for Floyd to paint an oil painting.'
not: 'It's not possible for it to be **possible** for Floyd to paint an oil painting.'

This is also possible with necessity modals, but crucially, the concordant modals must match in quantificational force. In the presence propositional *how*, certain weak modals get an 'emphatic' reading that resembles modal concord:

- (8) a. How $\left\{ \begin{array}{l} \text{could/can} \\ \# \text{should}/\# \text{must}/\# \text{may} \end{array} \right\}$ you be tired?
 b. How $\left\{ \begin{array}{l} \text{could/can} \\ \# \text{should}/\# \text{must}/\# \text{may} \end{array} \right\}$ you not like cats?

Being stative, all these examples independently block the manner reading, which is why non-concordant modals result in anomaly. Modal concord is clause-bounded:

- (9) a. Floyd couldn't possibly play a harmonica. (*modal concord*)
 b. It couldn't be the case that Floyd possibly plays the harmonica. (*no modal concord*)

The same clause-boundedness is present with propositional *how*:

- (10) a. How could Floyd play the harmonica? (modal concord)
 b. How is it the case that Floyd could play the harmonica? (no modal concord)

Propositional *how* also seems to be incompatible with strong modal auxiliaries:

- (11) a. How $\left\{ \begin{array}{l} \text{should} \\ \text{must} \end{array} \right\}$ you leave?
 b. How $\left\{ \begin{array}{l} \text{should} \\ \text{must} \end{array} \right\}$ you feed a cat?

In (11) only the manner *how* readings are available.

3. Relation to ‘why’

Both *why* and propositional *how* can ask questions that seem roughly to be about causes and reasons, but they differ in crucial respects. *Why* lacks the note of skepticism or incredulity that propositional *how* often contributes. Suppose one has just opened a freshly delivered Amazon package that contains a product lavishly advertised to be made of wood. Upon discovering that it seems not to be, one might ask a propositional *how* question:

- (12) $\left\{ \begin{array}{l} \text{How} \\ \text{??Why} \end{array} \right\}$ is this wood?

But *why* here is unnatural, and can at best be interpreted as a question asked by a philosopher, or else a small innocent child questioning god. Likewise, if one has just heard it claimed implausibly that Floyd is tall, one might ask:

- (13) $\left\{ \begin{array}{l} \text{How} \\ \text{??Why} \end{array} \right\}$ is Floyd tall?

Why is always factive, but propositional *how* sometimes isn't:

- (14) a. How is this wood?!
 This is clearly *not* wood, as any fool can see.
 b. Why is this wood?
 #This is clearly *not* wood, as any fool can see.

Why questions don't manifest the modal effects of propositional *how*:

- (15) a. $\left\{ \begin{array}{l} \text{Why} \\ \text{How} \end{array} \right\} \left\{ \begin{array}{l} \text{could / can} \\ \text{should / must / may} \end{array} \right\}$ you be tired?
 b. $\left\{ \begin{array}{l} \text{Why} \\ \text{How} \end{array} \right\} \left\{ \begin{array}{l} \text{could / can} \\ \text{should / must / may} \end{array} \right\}$ you not like cats?

Why associates with focus (Egler 2021):

- (16) a. Why did **Floyd** come to the party?
 b. Why did Floyd come to the **party**?

But propositional *how* doesn't seem to:

- (17) a. How did **Floyd** come to the party?
 b. How did Floyd come to the **party**?

4. Two pragmatic effects

There seem to be two discourse effects a propositional *how* question can achieve. It can express reluctant acceptance of a proposition the speaker finds surprising:

- (18) RELUCTANT ACCEPTANCE:
How did Floyd not come to the party?

In (18), the speaker is surprised, but inclined to accept that Floyd came to the party. Alternatively, propositional *how* can express incredulity, that is, a kind of rejection of the proposition:

- (19) INCREDULOUS REJECTION:
How is this wood?

Here, the speaker is incredulous, and inclined to deny that this is wood. The two readings have in common that they convey that expectations haven't been met.

It's worth noting that propositional *how* can be used metalinguistically as well, in the sense of Barker 2002, to contest how to resolve a vague predicate:

- (20) How is Floyd tall?!
- a. ...His parents are so short! Vitamin supplements? (*not metalinguistic*)
 - b. ...He's 5'6"! That's not tall! (*metalinguistic*)

It appears to be the case that metalinguistic readings are a special case of incredulous rejection.

5. Prior work

There isn't a great deal of work on propositional *how*. Jaworski 2009, for example, is focused on philosophical concerns. The notable exception is Pak 2017, whose analysis is primarily focused on syntactic concerns, but builds on Jaworski 2009 in aiming to capture a particular rendering of the contribution of propositional *how*—that it is fundamentally about reconciling a puzzling fact with established beliefs. It's an intuition on which we will build.

More concretely, she suggests that a denotation for 'how *p*' would be, approximately, 'How do I reconcile *p* with the rest of my beliefs?'. To build this up, she proposes that propositional *how* is just an ordinary use of manner *how*, but interpreted in a high position, alongside the covert verum focus operator of Romero & Han 2004. They analyze English negated polar questions in terms of such an operator, which they call FOR-SURE. Pak renders this operator's semantics as in (21):

- (21) $\llbracket \text{VERUM} \rrbracket = \llbracket \text{FOR-SURE} \rrbracket = \lambda p. \text{it is for-sure that } p \text{ should be added to the common ground}$

Ordinary *how*, she suggests, would turn (21) into a question about how to reconcile *p* with existing beliefs.

Relating the two readings of *how* in this way is highly desirable, but it doesn't follow automatically. Manner adverbials, including manner *how*, are standardly assumed to denote properties of events. For type theoretic reasons, it is not possible to interpret a property of events intersectively with a proposition. There are, of course, various conceivable ways out. Perhaps a novel rule of semantic composition could be proposed. Alternatively, perhaps a higher speech-act predicate could be invoked, which would denote a property of events with which an intersective interpretation would be possible. This would not be a trivial project, of course, and it wouldn't straightforwardly lead to the intended semantics. If the content of the speech act predicate is something like 'I hereby ask whether *p*', the resulting question would be something like 'in what manner do I hereby ask whether *p*', or perhaps this combined with the FOR-SURE operator. We can't further pursue this line of analysis here.

6. Analysis: modality and extending conversational backgrounds

In crafting our analysis, we will return to the modal concord facts. In order to understand this effect as truly modal concord, there must be a modal for subsequent modals to be concordant with. That modal, it seems reasonable to assume, is associated with propositional *how* itself.

The two pragmatic effects—reluctant acceptance and incredulous rejection—may also be a hint that a modal is involved. Let's consider again a particular example:

- (22) How is Floyd tall?!
- a. **Reluctant acceptance:**
... His parents are so short!
 - b. **Incredulous rejection:**
... He's 5'6"! That's not tall!

The reluctant acceptance response in (22a) questions the facts of the matter, the circumstances under which the prejacent is true. The incredulous rejection response in (22b) questions addressee beliefs, asking for an explanation as to why the addressee has these beliefs rather than other, presumably less surprising, ones.

This, one might suspect, correlates with with a major axis of how modals vary: with respect to the conversational background against which they are interpreted (Kratzer 1981 and much other work). Reluctant acceptance seems to involve a circumstantial conversational background. Incredulous rejection seems to involve an epistemic one.

For Kratzer, conversational backgrounds can be expressed with *in view of* phrases such as (23):

- (23) a. In view of the law, Floyd must go to jail.
b. In view my needs, I must have dinner.

These conversational backgrounds provide accessibility relations among worlds that restrict an quantifier. In (23a), for example, it is the law that ultimately yields the set of worlds in all of which Floyd must go to jail. In (23b), it is my needs that ultimately yield the set of worlds in all of which I must have dinner.¹

Returning to *how*, the two pragmatic effects could be understood as involving questions about conversational backgrounds:

- (24) How is Floyd tall?!
- a. **Reluctant acceptance:**
'In view of what facts about the world is it possible that Floyd is tall?'
 - b. **Incredulous rejection:**
'In view of what beliefs is it possible that Floyd tall?!'

The wording here is a bit awkward, in part because it is actually a difficult meaning to paraphrase in any way. But the connection to conversational backgrounds yields an analytical hypothesis: propositional *how* is the *wh* counterpart of *in view of* phrases, specialized for questioning conversational backgrounds. More precisely, propositional *how* asks for *elaborations* of the current conversational background. Schematically, one might represent this to a first approximation as in (25):

- (25) $\llbracket \text{how}_{PROP} p \rrbracket = \text{'What could we supplement the current conversational background with to make the prejacent } p \text{ true?}'$

The answers to propositional *how* questions, then, are alternative propositions that, when added to the conversational background, make the prejacent *p* true.

This means propositional *how* questions denote an alternative set of conversational background elaborations that make make the prejacent true. We'll represent this in the Portner 2009 style, with a **Best**_w predicate that identifies the appropriate worlds to quantify over in *w* on the basis of the conversational

¹ We are suppressing here the important distinction between the modal base and the ordering source.

background provided as its argument. The conversational background f in (26) is a function from worlds to sets of propositions that collectively express this background—what is known, in this case, or, in principle, the law, the circumstances, etc.

$$(26) \quad \llbracket \text{Floyd might leave} \rrbracket^f = \lambda w . \exists w' \in \mathbf{Best}_w(f(w)) [\text{leave}_{w'}(\mathbf{Floyd})]$$

Before applying this to *how*, we need to add one additional assumption: that questions denote a set of alternatives (Hamblin 1973, Karttunen 1973). For *how*, by hypothesis it will be a set of alternatives consisting of ways of elaborating the conversational background. A way of elaborating a conversational background, for our purposes, is just a proposition (or set of conjoined propositions) that can be added to the set of propositions the current conversational background provides.

In the reluctant acceptance example about Howard not coming to the party, one set of potential answers is in (27):

$$(27) \quad \begin{array}{ll} \text{a. question:} & \text{How did Howard not come to the party?} \\ \text{b. answers:} & \left. \begin{array}{l} \text{he was sick,} \\ \text{he wasn't feeling social,} \\ \text{he forgot about it,} \\ \vdots \end{array} \right\} \end{array}$$

To generate this set of alternatives, we need each of the alternatives to be a proposition that can be added to the ones the current conversational background provides:

$$(28) \quad \llbracket \text{how}_{PROP} \text{ did Howard not come to the party?} \rrbracket^f \\ = \lambda w . \{ q_{\langle s,t \rangle} \mid \exists w' \in \mathbf{Best}_w(f(w') \cup \{q\}) [\text{come-to-party}_{w'}(\mathbf{Howard})] \}$$

Each possible value for q in (28) is a potential answer, and a potential additional assumption about the circumstances that would need to be added for Howard not to have come to the party.

To get a denotation for *how*_{PROP}, it suffices to factor out the prejacent, which yields (29):

$$(29) \quad \llbracket \text{how}_{PROP} \rrbracket^f = \lambda p_{\langle s,t \rangle} \lambda w . \{ q_{\langle s,t \rangle} \mid \exists w' \in \mathbf{Best}_w(f(w) \cup \{q\}) [p(w')] \}$$

It's worth emphasizing that this denotation builds the modal force directly into *how*_{PROP}. That's not the only conceivable choice—we might have assumed a null modal, for example—and it's one that makes this form of *how* unlike ordinary manner *how* and fixes the modal force as existential. That seems plausible.

The party case is a circumstantial reluctant-acceptance example. Let's briefly return to the epistemic incredulous-rejection one:

$$(30) \quad \llbracket \text{how}_{PROP} \text{ is this wood?} \rrbracket^f \\ = \{ q_{\langle s,t \rangle} \mid \exists w' \in \mathbf{Best}_w(f(w') \cup \{q\}) [\text{wood}_{w'}(\mathbf{this})] \}$$

The compositional machinery is perfectly parallel, yielding potential answers like those in (31):

$$(31) \quad \left\{ \begin{array}{l} \text{sometimes plastic looks like wood,} \\ \text{plastic is technically a synthetic wood resin,} \\ \text{some small parts of it are wood,} \\ \vdots \end{array} \right\}$$

Each of these is a potential way of adding to one's beliefs.

If, as this approach suggests, propositional *how* is on its own a possibility modal, we should expect it to participate in modal concord with other possibility modals. As we noted earlier, that seems to be the case:

$$(32) \quad \text{How } \left\{ \begin{array}{l} \text{could/can} \\ \text{\#should/\#must/\#may} \end{array} \right\} \text{ you be tired?}$$

Necessity modals conflict with *how_{PROF}* in force, so modal concord is impossible with them:

- (33) How $\left\{ \begin{array}{l} \#_{\text{must}} \\ \#_{\text{shall}} \end{array} \right\}$ you be tired?

These are essentially just odd, but at best they might have a non-concordant reading on which they ask something like ‘how is it the case that you must be tired?’

Of course, the position facts follow from this type of denotation as well. The propositional reading is the only one available when *how* overtly combines with a proposition for straightforward type reasons. The island facts follow in the same way.

7. Conclusion

The empirical contribution here has been to more finely characterize the facts around propositional *how*, including its behavior around modals, its differences from *why*, its focus behavior, and the pragmatic effects it gives rise to. Analytically, we argued that propositional *how* asks for elaborations of the conversational background. Specifically, propositional *how* questions denote sets of propositions that, when added to the conversational background, make prejacent true. To implement this, we treated propositional *how* as providing its own inherent existential modal force. This explains its behavior with respect to modal concord and its differences from manner *how* and from *why*.

One broader question that arises from this is what exactly the relation between manner *how* and propositional *how* is. Perhaps it’s purely historical. Presumably propositional *how* grew out of the manner use, and has simply drifted sufficiently that it now has a quite different semantics. But there are reasons to think this may be too strong. It is, for example, possible to achieve an effect quite similar to propositional *how* with questions such as *In what way, exactly, is this wood?* To explain this effect, we might need to stipulate distinct denotations for manner and propositional *way*. Perhaps less awkward is the fact that propositional *how* has cousins in other languages, often also built around ‘how’. That might simply be a pattern of similar historical developments, which is a phenomenon widely attested in other areas of the grammar. Notably, it seems that the effects achieved by propositional *how* are not, in fact, restricted to ‘how’. In some Slavic languages, one can achieve a similar effect with ‘from where’ and ‘since when’. The latter is possible even in English.²

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