Uncertainty, prosody, and their interaction: a case of modal concord?

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September 30, 2014

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1 Introduction

When responding[1] to a question, a speaker can use rising intonation (*?*) to indicate uncertainty, as demonstrated in (1a). A speaker can also include an epistemic possibility adverb like *maybe* in (1b). Surprisingly, though, an epistemic possibility adverb alone appears curt and uncooperative in many contexts (indicated with #), demonstrated in (1c)[2].

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[1]Throughout I use the word "response" to refer to an utterance that is intended to address the Question Under Discussion. This is more liberal than a complete/partial "answer" in the sense of Groenendijk and Stokhof (1984).

[2]These responses can be improved with thoughtful pauses or inferential continuations such as *... I feel like he always wears blue shirts, so it would make sense for blue to be his favorite color.* I am assuming there is no such continuation in these examples and will return to this issue in Section 3.5.

(1)   Amy: What is John's favorite color?
      Ben:

    a.   Blue?
    b.   Maybe blue? $\approx$(1a)
    c. #Maybe blue.

Also surprising is the near-equivalence in meaning between (1a) and (1b); despite (1b) containing twice the uncertainty markers as (1a), it does not appear to mark any sort of double uncertainty, and instead they both express that the speaker is not certain that blue is John's favorite color.

    Note that other epistemic adverbs like *definitely* do not show this near-equivalence.

(2)   Amy: What is John's favorite color?
      Ben:

    a.   Blue?
    b. %Definitely blue? $\not\approx$(2a)
    c.   Definitely blue.

While (1a)/(2a)-(1b) seem to indicate speaker uncertainty with respect to the truth of the proposition that John's favorite color is blue, the addition of *definitely* in (2b) seems to favor a trick-question reading, which I mark here with a %[3]. The rising intonation here seems to indicate that, while the speaker thinks John's favorite color is definitely blue, he is uncertain that he has understood the question properly (e.g. believes Amy already knows John's favorite color and does not understand why she would ask him). Additionally, (2c) seems like a cooperative response, unlike (1c).

    When using non-fragment responses, the pattern changes again. The rising intonation in (3a) (and perhaps to a lesser extent (3b)) favors a trick-question reading, as in (2b), and some may argue that (3a) and (3b) are far from equivalent responses. Finally, similar to (1c), (3c) appears relatively uncooperative.

(3)   Amy: What is John's favorite color?
      Ben:

    a. % It's blue?
    b. % It's maybe blue? $\not\approx$(3a)
    c. # It's maybe blue.

    In this paper I provide explanations for these patterns, drawing from Gunlogson (2003, 2008) on rising intonation and Anand and Brasoveanu (2010) on modal concord. Gunlogson analyses rising intonation as marking a speaker's commitment to their utterance as contingent (see Section 2.1). Following this analysis, we expect the following paraphrases for the responses in (1):

(4)   Predicted interpretations
    (1a) Blue?
          'It's blue, but don't believe me that it's blue unless someone can verify.'
    (1b) Maybe blue?
          'It's possible that it's blue, but don't believe me that it's possible that it's blue unless someone can verify.'
    (1c) Maybe blue.
          'It's possible that it's blue.'

The predicted interpretation for (1b), however, is much too weak. As described above, (1b) means approximately the same as (1a), and (1c) is relatively infelicitous. I propose that the similarity between (1a) and (1b) is a result of concord between the two uncertainty markers in (1b). Infelicity of responses like (1c) is, I propose, a matter of cooperativity. Rising intonation, per Gunlogson's analysis, invites another discourse agent to confirm the proposition uttered with rising intonation. By using *maybe* with falling intonation, the

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[3]In Section 4.1 we will discuss contexts in which the felicity of such a response improves.

speaker is making only a weak commitment and is not providing an opening for any other agent to help answer the question.

The difference between fragment and full-declarative responses, I propose, is due to differing biases in the locus of uncertainty. I argue that epistemic adverbs like *maybe* are only interpreted with respect to the proposition they modify (e.g. *Maybe it's blue* indicates that the speaker is not certain that *It's blue* is true). Rising intonation can likewise mark a speaker's uncertainty with respect to the uttered proposition, but it has other possible interpretations, including the trick-question reading discussed above, where *It's blue?* indicates that the speaker is not certain whether *It's blue* addresses the broader question under discussion. I argue that this latter uncertainty reading of rising intonation is biased in full-sentence responses. So, while (3a) favors this latter uncertainty reading, *maybe* in (3b) may bias the former uncertainty reading, leading to the contrast shown in (3). Likewise, when rising intonation is used with *definitely* in (2b), *definitely* conveys high certainty in the proposition *It's blue*, a rising intonation is thus biased against a propositional-uncertainty reading and toward a reading where the speaker is unsure that *It's definitely blue* addresses the broader question under discussion, leading to the contrast in (2).

Section 2 provides an overview of Gunlogson (2008)'s analysis of rising intonation. Section 3 provides an analysis of (1) and (2) by expanding on Gunlogson and treating rising intonation as a modal that participates in modal concord with epistemic possibility adverbs. Section 4 addresses the data in (3) by exploring two cases in which concord between *maybe* and rising intonation does not appear to be available. Section 5 concludes.

2   Rising intonation

In this section I describe some of Gunlogson's observations about rising intonation in declarative questions, as well as the analysis she provides to account for the unique behavior of these questions. I then apply this analysis to the rising declarative responses that were introduced in the previous section, and I discuss successes and shortcomings of this analysis. In particular, as shown above in (4), this analysis yields the wrong prediction when rising intonation appears with an epistemic possibility marker like *maybe*.

Before continuing, however, a quick note on intonation specifics is in order. As Gunlogson (2003) comments, rising intonation can take a number of different forms (including H* H H%, L* H H%, L* H L%, and L* L H% which are often, but certainly not always, interchangeable. Like her, I will assume the high-rise contour, H* H H% (see also Hirschberg and Ward, 1995), but other intonations may be appropriate, especially as length of utterance and locus of uncertainty changes.

2.1   Gunlogson on rising declaratives

Gunlogson (2003, 2008) discusses the use of declaratives as questions, as in (5b). While a typical polar question looks like (5a) and utilizes rising intonation along with interrogative syntax, sentences like (5b) can function as questions as well, using rising intonation with declarative syntax (cf. (5c))(Gunlogson, 2003, p. 8).

(5)   a.   Is it raining?   (rising polar interrogative)
       b.   It's raining?   (rising declarative)
       c.   It's raining.   (falling declarative)

Gunlogson demonstrates that though both polar interrogatives and rising declaratives can function as questions, rising declaratives have a more restricted distribution. In particular, they are infelicitous in out-of-the-blue contexts like (6) (Gunlogson, 2008, p. 104).

(6)   [Robin is sitting in a windowless computer room with no information about current weather conditions
       when another person enters from outdoors.] Robin to newcomer:
       a.   Is it raining?
       b. #It's raining?

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c. #It's raining.

With the proper contextual support, however, a rising declarative is licensed, as demonstrated in (7) (Gunlogson, 2008, p. 104).

(7)   [Robin is sitting, as before, in a windowless computer room when another person enters. The new-comer is wearing a wet raincoat and boots.] Robin to the newcomer:
    a.   Is it raining?
    b.   It's raining?
    c.   (I see that/So/Oh) It's raining.

Gunlogson's analysis, in a nutshell, is that a declarative introduces a discourse commitment, and rising intonation on a declarative marks that commitment as contingent. If the commitment is contingent on ratification by the addressee, the utterance is interpreted as question. Rising declarative questions, therefore, require a context that supports the speaker as having adequate evidence to make a (contingent) commitment (what I will refer to as 'Speaker Evidence'), as well as adequate evidence that the addressee as is more authoritative than the speaker, allowing the addressee to ratify the speaker's contingent commitment (what I will refer to as 'Addressee Authority') (Gunlogson, 2008, p. 114).

(8)   a.   'Speaker Evidence': the speaker is perceived as having adequate evidence to commitment to p
       b.   'Addressee Authority': the addressee is perceived as being more authoritative that the speaker so than the addressee may ratify the speaker's contingent commitment

Gunlogson formalizes this through a framework similar to Hamblin (1971), who uses commitment-slates (sets of worlds consistent with the speaker's commitments at a given point in a dialog). Gunlogson includes the idea of commitment-slates as commitment sets (cs), but also introduces source sets (ss), where a discourse context C contains, for each discourse participant, their discourse commitments (within their commitment set, or cs) and the commitments for which they are a source (their source set, or ss).

(9) $C_d = \langle \sigma_\alpha, \sigma_\beta, ... \rangle$, where each σ_χ is a triple $\langle cs, ss, \chi \rangle$, with χ as agent in d, and: (Gunlogson, 2008, p. 114)
    a. $cs = \{w \in W$: all discourse commitments of agent χ in discourse d are true in $w\}$
    b. $ss = \{w \in W$: all commitments of agent χ in discourse d for which agent χ is a source are true in $w\}$

Declaratives express speaker commitment, so if agent α declares p, p will be 'added' to α's cs and ss.[4] Gunlogson makes the important assumption that commitments require sources, so if a speaker utters a declarative, either the speaker or the addressee must be a plausible source for the commitment made by the declarative. Further, in an out-of-the-blue utterance, it is the speaker who must be the plausible source (i.e. the addressee cannot be assumed to be the source unless evidence has previously been provided), and hence the requirement of Speaker Evidence.

Rising intonation on a declarative marks the speaker's commitment to the content of that declarative as contingent on some discourse condition obtaining, as defined in (10).

(10)   A discourse move μ by an agent α is *contingent* upon a discourse condition δ if: (Gunlogson, 2008, p. 128)
    a. δ does not obtain at the time of μ
    b.   It is inferable in the discourse context that the update effected by μ is to be retained only if δ obtains after the discourse move immediately succeeding μ

If the discourse condition it is contingent on is ratification by the addressee, as defined in (11)-(13) (with β as the addressee), it is interpreted as a question, as defined in (14).

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[4]Here 'adding' p to a cs or ss means eliminating all worlds not compatible with p within the cs or ss.

(11) A discourse move μ committing an agent α to ϕ is *contingent* upon ratification by an agent β, $\alpha \neq \beta$, if: (Gunlogson, 2008, p. 128)

    a. β is implicitly authoritative [(12)] with respect to ϕ at the time of μ

    b. It is inferable in the discourse context that α's commitment to ϕ will be withdrawn unless the discourse move immediately succeeding μ has the effect of committing β to ϕ as a source

(12) An agent α is *implicitly authoritative* with respect to ϕ iff α is an implicit source [(13)] for both ϕ and $\neg\phi$ (Gunlogson, 2008, p. 125)

(13) An agent α is an *implicit source* for ϕ iff: (Gunlogson, 2008, p. 125)

    a. α is not committed to ϕ; and

    b. It is inferable in the discourse context that if α commits to ϕ, α will be a source for ϕ.

(14) An utterance of a declarative with content ϕ is *questioning* to the extent that the speaker's commitment is understood as contingent on the addressee's ratification of ϕ.   (Gunlogson, 2008, p. 129)

We see that for a rising declarative to be interpreted as a question, the speaker's commitment to be contingent on ratification by the addressee. To Gunlogson (2008, p. 129), this contingency requires an asymmetry where the addressee is more authoritative than the speaker, hence the requirement of Addressee Authority.

In both of Gunlogson's contexts in (6) and (7), Addressee Authority is met (the addressee just returned from outside and can be assumed to have more reliable information about the weather than Robin, who has no access to outside). The contrast between (6b) (*It's raining?* without evidence) and (7b) (*It's raining?* with evidence) is due primarily to Speaker Evidence, or the speaker's ability to act as a source for the expressed proposition. In both cases, the addressee has just come in from outside and is thus more authoritative with respect to the weather than the speaker is, so the rising declarative can be felicitously contingent on ratification by the addressee (i.e. interpreted as a question). And in (7b), the speaker has some weaker evidence (from the addressee's appearance) that it is raining. In (6b), however, the speaker has no such evidence and cannot felicitously commit to rain (even contingently).

In this framework, Gunlogson is able to account for the distribution of rising intonation in examples like (6) and (7). In the following subsection, we will examine the success of this framework on explaining examples like (1).

(1) Amy: What is John's favorite color?
    Ben:

    a. Blue?

    b. Maybe blue? $\approx$(1a)

    c. #Maybe blue.

2.2   Rising declarative responses

Moving beyond rising declarative questions, this section focuses on rising intonation in responses, as in (1). Following Gunlogson (2008), I assume that rising intonation marks a commitment as contingent, so in a rising declarative like (1a) the speaker's commitment to the proposition that blue is John's favorite color is contingent on some discourse condition. In order for this to be interpreted as a question, the addressee must be more authoritative than the speaker. However, in asking the question in (1), the addressee implied ignorance.[5] Therefore, a rising declarative like (1a) does not receive a question interpretation. It simply conveys a lack of speaker commitment without being contingent on ratification by the addressee. If someone can corroborate the response, it can be added to the discourse, but corroboration is not necessarily expected.

The responses in (1), however, do not have the interpretations that would be expected in Gunlogson's framework. These expected interpretations are given in (15), repeated from (4), where I paraphrase contingent commitment to a proposition p as 'p, but don't believe me that p unless someone can verify'.

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[5]In 4.1 we will consider contexts where ignorance is not implied, such as during an examination.

(15)   Predicted interpretations
   (1a) Blue?
        'It's blue, but don't believe me that it's blue unless someone can verify.'
   (1b) Maybe blue?
        'It's possible that it's blue, but don't believe me that it's possible that it's blue unless someone
        can verify.'
   (1c) Maybe blue.
        'It's possible that it's blue.'

(1a) should contingently commit the speaker to the proposition that blue is John's favorite color, whereas
(1b) should contingently commit the speaker to the weaker proposition that blue *might* be John's favorite
color, and (1c) should express that it is possible that John's favorite color is blue, non-contingently. In
reality, however, (1a) and (1b) seem nearly equivalent in meaning. (1b) contingently commits the speaker to
something stronger than the mere *possibility* that blue is John's favorite color. For example, if Amy replies
to (1b) with *Ah, yes, you're right*, she will likely be committing to the proposition that blue is John's favorite
color, not the proposition that blue *might* be John's favorite color.

I propose that the near-equivalence between (1a) and (1b) is a consequence of modal concord, and the
relative infelicity of (1c) is due to the uncooperative use of *maybe* without rising intonation. These solutions
will be explored in the following section, in which I provide a novel concord analysis where a modal adverb
in combination with rising intonation gives rise to modal concord. This will draw on Gunlogson (2008), but
will provide motivation for a revised analysis of rising intonation as a modal operator.

3   Concord in rising declarative responses

This section begins with an overview of modal concord, which is then applied to the data in (1) to explain
the near-equivalence between (1a) and (1b). Finally, I address (1c), whose infelicity is unrelated to modal
concord but stems from the uncooperativity of underinformative statements uttered with falling intonation.

3.1   The phenomenon of modal concord

Modal concord occurs when multiple modal items give rise to the reading of just a single modal item, as in
(16).

(16)   a.   John <u>might</u> possibly be home by curfew.
             (i)   'It's possible that it's possible that John is home by curfew.'   (no concord)
             (ii)   'It's possible that John is home by curfew.'   (concord)
        b.   John <u>must</u> <u>mandatorily</u> be home by curfew.
             (i)   'It's mandatory that it's mandatory that John is home by curfew.'   (no concord)
             (ii)   'It's mandatory that John it home by curfew.'   (concord)

(16a) and (16b) each contain two modals: a modal auxiliary (*might*, *must*) and a modal adverb (*possibly*,
mandatorily). These sentences allow a 'cumulative' reading where both modals contribute to the interpreta-
tion, as paraphrased in (i). Notably, however, they also allow a 'concord' reading, paraphrased in (ii), where
the sentence is interpreted as if it contained only one modal.[6]

Modal concord can occur when a modal auxiliary and a modal adverb have the same (or similar) flavor
(i.e. modal base) and quantificational force. In (16a), we can note that the auxiliary and adverb share

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[6]Modal concord is similar to the phenomenon of negative concord, though with negative concord, the concord reading is
often obligatory.

(i)   Non ha telefona a nessuo
       Neg has called   to n-body
       'He hasn't called anybody.'   Italian (Zeijlstra, 2008, p. 319)

epistemic flavor and existential force, and in (16b) they share deontic flavor and universal force. A concord reading is generally[7] not available if there is a mismatch between force (17b) or flavor (17c). (E = epistemic, D = deontic; $\exists$ = existential, $\forall$ = universal.)

(17)   a.   John   perhaps$_{E,\exists}$ might$_{E,\exists}$ be home.   (concord)

          b.   John   perhaps$_{E,\exists}$ must$_{E,\forall}$ be home.   (no concord)

          c.   John legitimately$_{D,\exists}$ might$_{E,\exists}$ be home.   (no concord)

3.2   An analysis of modal concord

For an analysis of modal concord, I draw on Anand and Brasoveanu (2010), who suggest that modal concord occurs when a modal adverb takes a modal auxiliary as an argument and causes both to share the same modal base. They provide denotations for modal auxiliaries (following Kratzer, 1977, 1981) and adverbs as in (18). (In what follows f is the modal base. The ordering source is omitted for clarity. I use overbraces to highlight quantificational force.)

(18)   a.   Modal aux: (Anand and Brasoveanu, 2010, pp. 23-24)

$$\text{(i)}\quad [\![\mathbf{must}]\!] = \lambda w \lambda f_{\langle s\langle\langle st\rangle t\rangle\rangle} \lambda p_{\langle st\rangle}. \overbrace{\bigcap f(w) \subseteq p}^{\forall}$$

$$\text{(ii)}\quad [\![\mathbf{may}]\!] = \lambda w \lambda f_{\langle s\langle\langle st\rangle t\rangle\rangle} \lambda p_{\langle st\rangle}. \overbrace{\bigcap f(w) \cap p \neq \emptyset}^{\exists}$$

          b.   Modal adverb: (Anand and Brasoveanu, 2010, p. 24)

$$\text{(i)}\quad [\![\mathbf{obligatorily}]\!] = \lambda M_{\langle s\langle\langle s\langle\langle st\rangle t\rangle\rangle\langle\langle st\rangle t\rangle\rangle\rangle} \lambda w \lambda f_{\langle s\langle\langle st\rangle t\rangle\rangle} \lambda p_{\langle st\rangle} : f \text{ is deontic .}$$

$$M(w)(f)(p) \wedge \overbrace{\bigcap f(w) \subseteq p}^{\forall}$$

$$\text{(ii)}\quad [\![\mathbf{legitimately}]\!] = \lambda M_{\langle s\langle\langle s\langle\langle st\rangle t\rangle\rangle\langle\langle st\rangle t\rangle\rangle\rangle} \lambda w \lambda f_{\langle s\langle\langle st\rangle t\rangle\rangle} \lambda p_{\langle st\rangle} : f \text{ is deontic .}$$

$$M(w)(f)(p) \wedge \overbrace{\bigcap f(w) \cap p \neq \emptyset}^{\exists}$$

The auxiliary *must*, for example, takes a world w, a modal base f, and a proposition p, and it asserts that all worlds in which all propositions in the modal base in w are true are worlds in which p is true. The adverb *obligatorily* is the same as *must*, with two notable exceptions: 1) it takes an additional argument M, a modal auxiliary, which it feeds its w, f, and p arguments, and 2) it imposes a presupposition on the domain of the modal base (here, that it be deontic).

Under this analysis, both modal elements in sentences like (16a) and (16b) assert their own force and flavor, but the adverb 'modifies' the auxiliary in a way that ensures that their independent forces and flavors match, yielding a concord reading. It is through presupposition that the modal adverb ensures that the adverb and auxiliary share the same modal flavor (e.g. *obligatorily* only composes with deontic auxiliaries). An example derivation for the combination of the deontic auxiliary *must* and the deontic adverb *obligatorily* is given in (19), where $[\![\mathbf{must}]\!]$'s contribution is redundant.

(19)   must$_{D,\forall}$ obligatorily$_{D,\forall}$ (concord)

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[7] According to Anand and Brasoveanu (2010), a flavor mismatch allowed when adverb is epistemic, as demonstrated in (i)-(ii).

(i)   a.   John   must$_{E,\forall}$ obligatorily$_{D,\forall}$ be home.   (no concord)

       b.   John definitely$_{E,\forall}$ must$_{D,\forall}$ be home.   (concord)

(ii)   a.   John   might$_{E,\exists}$ allowably$_{D,\exists}$ be home.   (no concord)

       b.   John possibly$_{E,\exists}$ must$_{D,\exists}$ be home.   (concord)

a. $[\lambda M \lambda w \lambda f \lambda p : f$ is deontic $. M(w)(f)(p) \wedge \overbrace{\bigcap f(w) \subseteq p}^{\forall}](\lambda w \lambda f \lambda p. \overbrace{\bigcap f(w) \subseteq p}^{\forall})$

<div align="center">obligatorily   must</div>

b. $\lambda w \lambda f \lambda p : f$ is deontic $. \underbrace{\overbrace{\bigcap f(w) \subseteq p}^{\forall}}_{must} \wedge \overbrace{\bigcap f(w) \subseteq p}^{\forall}$

<div align="center">obligatorily must</div>

$= \lambda w \lambda f \lambda p : f$ is deontic $. \underbrace{\overbrace{\bigcap f(w) \subseteq p}^{\forall}}_{obligatorily\ must}$

Anand and Brasoveanu (2010) claim that agreement in force is required as a result of a non-cancellable $\neg\forall$ implicature generated from $\exists$-force modals.[8] Thus, if a $\exists$-force modal occurs with a $\forall$-force modal, there will be a clash between the latter and the $\neg\forall$-implicature of the former. This is demonstrated in (20) and (21), where the auxiliary and adverb are mismatched in force (for clarity, (b) shows the conflicting implicature in gray).[9]

(20) $\text{must}_{D,\forall}$ $\text{legitimately}_{D,\exists}$ (no concord)

a.   literally: $\underbrace{\overbrace{\bigcap f(w) \subseteq p}^{\forall}}_{must} \wedge \overbrace{\bigcap f(w) \cap p \neq \emptyset}^{\exists}$

<div align="center">legitimately must</div>

b.   w/ implicature: $\underbrace{\overbrace{\bigcap f(w) \subseteq p}^{\forall}}_{must} \wedge \overbrace{\bigcap f(w) \cap p \neq \emptyset}^{\exists} \wedge \overbrace{\neg[\bigcap f(w) \subseteq p]}^{\neg\forall}$

<div align="center">legitimately must</div>

(21) $\text{may}_{D,\exists}$ $\text{obligatorily}_{D,\forall}$ (no concord)

a.   literally: $\underbrace{\overbrace{\bigcap f(w) \cap p \neq \emptyset}^{\exists}}_{may} \wedge \overbrace{\bigcap f(w) \subseteq p}^{\forall}$

<div align="center">obligatorily must</div>

b.   w/ implicature: $\underbrace{\overbrace{\bigcap f(w) \cap p \neq \emptyset}^{\exists} \wedge \overbrace{\neg[\bigcap f(w) \subseteq p]}^{\neg\forall}}_{may} \wedge \overbrace{\bigcap f(w) \subseteq p}^{\forall}$

<div align="center">obligatorily may</div>

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[8]Anand and Brasoveanu (2010) only discuss this implicature within modal adverbs, but presumably it applies to modal auxiliaries as well, (21).

[9]Note about uncancellability – Anand and Brasoveanu (2010) argue that cancellation in these contexts is not available for a simple assertion (e.g. (i), where generic operator cannot cancel not-all implicature of *most*), but can be accomplished during a subsequent discourse update (e.g. (ii)).

(i)   *Most dolphins are dolphins.   (Anand and Brasoveanu, 2010, p. 25)

(ii)   We can legitimately deny your request. In fact, we have to.   (Anand and Brasoveanu, 2010, p. 25)

3.3 A modal-concord analysis for rising intonation

Returning to rising declarative responses, I aim to determine why (1a) and (1b) can have near-equivalent readings, despite the predictions outlined above in (15).

(1) Amy: What is John's favorite color?
    Ben:
    a. Blue?
    b. Maybe blue?
    c. #Maybe blue.

To do so, I propose a revised analysis of rising intonation. The idea, in brief, is that rising intonation marks the speaker's commitment to the uttered proposition as contingent, which, I propose, is manifested semantically in a way that allows a modal-concord analysis of (1b).

To see how this concord reading is computed, I first assume a denotation of *maybe* parallel to those used by Anand and Brasoveanu (2010), shown in (22). Here, *maybe*, involves existential quantification over epistemically accessible worlds.

(22) $[\![\mathbf{maybe}]\!] = \lambda M \lambda w \lambda f \lambda p : f$ is epistemic $. M(w)(f)(p) \wedge \overbrace{\bigcap f(w) \cap p \neq \emptyset}^{\exists}$

For rising intonation, I follow Gunlogson and assume that it marks a commitment as contingent. I give this a semantic manifestation, shown in (23), where cc marks the proposition p as a contingent commitment in w relative to f.[10] By giving rising intonation modal content like this, it can participate in modal concord.

(23) $[\![?]\!] = \lambda w \lambda f \lambda p.cc(w)(f)(p)$

Using rising intonation as the argument of *maybe*, composition progresses as follows. The modal adverb $[\![\mathbf{maybe}]\!]$ takes $[\![?]\!]$ as an argument, ensuring (via presupposition) that both take an epistemic modal base. $[\![\mathbf{maybe\ ?}]\!]$

$$=[\![\mathbf{maybe}]\!]([\![?]\!]) \tag{i}$$

$$= \underbrace{\left[\lambda M \lambda w \lambda f \lambda p : f \text{ is epist.} M(w)(f)(p) \wedge \bigcap f(w) \cap p \neq \emptyset\right]}_{maybe} \underbrace{(\lambda w \lambda f \lambda p.cc(w)(f)(p))}_{?} \tag{ii}$$

$$= \underbrace{\lambda w \lambda f \lambda p : f \text{ is epist.} \underbrace{cc(w)(f)(p)}_{?} \wedge \bigcap f(w) \cap p \neq \emptyset}_{maybe?} \tag{iii}$$

If *maybe+?* allows modal concord, we expect $[\![?]\!]$ and $[\![\mathbf{maybe\ ?}]\!]$ to be identical, but the above derivation does not yield (23). I assert, however, that if someone is possibly (i.e. contingently) committed to a proposition p, we can assume that they consider p epistemically possible, which I codify in the Epistemic Commitment Principle.[11]

(24) **Epistemic Commitment Principle:** $\diamond_{cs}p \models \diamond_{epist}p$

   If an agent is possibly committed to p, it can be assumed that that agent believes p is possible.

Following the Epistemic Commitment Principle, the contribution of $[\![\mathbf{maybe}]\!]$ is entailed by $[\![?]\!]$, and we can see why (1a) and (1b) give such similar readings: $[\![\mathbf{maybe\ ?}]\!]$ evaluates to $[\![?]\!]$.

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[10]This denotation was written with simplicity in mind, but it is unlikely that contingent commitment is actually an at-issue entailment.

[11]This resembles the epistemic step, by which a speaker can infer *Ben thinks it isn't red* from *Ben doesn't think it's red*. Sauerland (2004) formalizes this as $\neg K\phi \rightarrow K\neg\phi$, where ϕ is a proposition and K is Gazdar (1979)'s epistemic certainty operator. The Epistemic Step (i.e. $\diamond K\phi \rightarrow K \diamond \phi$) allows us to infer *Ben is committed to it possibly being blue* from *Ben is possibly committed to it being blue*.

$$= \lambda w \lambda f \lambda p : f \text{ is epist.} \underbrace{\underbrace{cc(w)(f)(p)}_{?} \wedge \bigcap f(w) \cap p \neq \emptyset}_{maybe?} \tag{iii}$$

$$= \lambda w \lambda f \lambda p : f \text{ is epist.} cc(w)(f)(p) \tag{iv}$$

$$= [\![?]\!] \tag{v}$$

Recall that Anand and Brasoveanu (2010) emphasize the presence of a $\neg\forall$ implicature with existential modals, which they argue explains why concord is not possible between modals that do not match in force. For the derivation above, with the non-universal implicature shown again in gray, the result is $\lambda w \lambda f \lambda p : f$ is epist. $cc(w)(f)(p) \wedge \neg[\bigcap f(w) \subseteq p]$. This is slightly different from $[\![?]\!]$, and while this difference is not important in this example, we will return to it in Section 4.

Note that this Epistemic Commitment Principle applies in other cases of possible commitment. It is not restricted to modal-concord contexts and from utterances like *Blue?* in (1a), we can conclude that the speaker believes that blue is possibly John's favorite color. This is demonstrated in (25), where a continuation contradicting this assumption has a contradictory feel, and a continuation reiterating the assumption has a redundant feel.

(25)   a. #Blue? By the way, it couldn't be blue.   (contradictory, $\diamond blue$ and $\neg \diamond blue$)
        b. #Blue? By the way, it might be blue.   (redundant, $\diamond blue$ and $\diamond blue$)

This same pattern can be seen in other cases of entailment, as demonstrated in (26) where *John has a laptop* entails *John has a computer*.

(26)   a. #John has a laptop. By the way, John doesn't have a computer.   (contradictory)
        b. #John has a laptop. By the way, John has a computer.   (redundant)

Additionally, the Epistemic Commitment Principle can also be seen in Gunlogson's examples of rising declarative questions like *It's raining?* (5b).

(27)   a. #It's raining? By the way, I don't think it could be raining.   (contradictory)
        b. #It's raining? By the way, I do think it could be raining.   (redundant)

So, by formalizing rising intonation as a modal operator and invoking the Epistemic Commitment Principle, we have a modal-concord explanation for the equivalence between (1a) and (1b). Rest assured that this modalization of rising intonation does not change the anaylsis of Gunlogson's original data in any major way, and we will cover several potentially problematic issues in the following sections.

3.4   Rising intonation with other modal adverbs

Below I demonstrate that the analysis above makes correct predictions about the interpretation of rising intonation in combination with other modal adverbs. First, observe that the analysis predicts concord readings with all epistemic possibility adverbs, not just *maybe*. And, as demonstrated in (28), this prediction is met.

(28)   Amy: What is John's favorite color?
        Ben:
        a.   Maybe blue? ($\approx$ Blue?)
        b.   Possibly blue? ($\approx$ Blue?)
        c.   Perhaps blue? ($\approx$ Blue?)

On the other hand, universally-quantifying adverbs like *definitely* are predicted to not lead to modal concord, since an appropriate entailment relation is lacking.[12] While the Epistemic Commitment Principle states that possible commitment entails belief of possibility, possible commitment does not entail belief of necessity, as shown in (29).

(29)   *definitely+?*
         $\diamond_{cs}p \not\models \square_{epist}p$

This prediction holds for other universally-quantifying adverbs like *undoubtedly* and *certainly*. And, as predicted, the concord reading is not attested.

(30)   a.   Definitely blue? ($\not\approx$ Blue?)
         b.   Undoubtedly blue? ($\not\approx$ Blue?)
         c.   Certainly blue? ($\not\approx$ Blue?)

Lack of concord is not the only force contributing to a lack of equivalence in these examples, however, and Section 4.1 will address the different readings rising intonation biases in different contexts.

3.5   Cooperativity and (1c)

We have seen that the near equivalence between (1a) and (1b) can be accounted for through modal concord. The final step in accounting for the data in (1) is to address the infelicity of (1c).

(1)   Amy: What is John's favorite color?
        Ben:
        a.   Blue?
        b.   Maybe blue?   ≈(1a)
        c. #Maybe blue.

In this response Ben is neither answering the question under discussion nor opening the door for anyone else to do so. More precisely, Ben's *cs* contains the proposition that John's favorite color might be blue, which does not directly specify John's favorite color (the question under discussion), and Ben does not provide an opening for anyone to step in as a source for this actually being John's favorite color by using rising intonation. The hearer is left with the impression that Ben, in making such a quick, weak statement that does not invite corroboration, is not putting much effort in to answering the question and is instead dismissing it as quickly as possible.

This uncooperativity disappears, as we have already seen in (1b), if rising intonation is added. This is able contingently commit the speaker to the stronger proposition within the adverb (that John's favorite color is blue), inviting someone else to corroborate this stronger proposition. Additionally, as (31) demonstrates below, this uncooperativity disappears if there is an overt indication that the speaker has put some thought into the response, demonstrating that he is trying to be helpful and give the best answer he can. In (31a), Ben gives a weak answer (*maybe blue*), but he also provides his rationale, making it clear to Amy that he has put effort into answering the question, and by providing his rationale he may even trigger Amy's memory about John, or at least allow her to draw her own conclusion based on the additional facts Ben offers up. In (31b), the rationale is left implicit, but it is still clear that Ben has ruminated over some private knowledge to reach his (albeit weak) conclusion, perhaps even inviting Amy to ask what his private knowledge is.

(31)   Amy: What is John's favorite color?
         Ben:
         a.   You know what? Maybe blue. He always wears blue shirts, and he even painted his front door
              blue, so it would make sense.

---

[12]Or, similarly, according to Anand and Brasoveanu, *definitely*, *absolutely*, etc. are flavor- and force-neutral and act to strengthen the force of the auxiliary (here, rising intonation).

b. Hmmm... Maybe blue.

3.6 Summary

In this section I accounted for the pattern in (1) using modal concord and drawing on Gunlogson (2008)'s analysis of rising intonation. I amended the analysis by treating rising intonation as a modal where contingent commitment to a proposition has semantic content, allowing it to participate in modal concord with epistemic possibility adverbs like *maybe*. I further introduced the Epistemic Commitment Principle to show how, under a concord reading, *maybe* is redundant with rising intonation. This also allowed us to begin to explain the behavior of other adverbs with rising intonation: adverbs like *definitely* have a quantificational force that is too strong to allow them to participate in modal concord with rising intonation. In the next section we will look more closely at predictions generated by this proposal and address the data in (3).

(3) Amy: What is John's favorite color?
     Ben:
     a. It's blue?
     b. It's maybe blue? $\napprox$(3a)
     c. #It's maybe blue.

4 Concord in a range of rising configurations

The analysis I develop in this paper has assumed that fragment responses, like those in (1), were declarative.

(1) Amy: What is John's favorite color?
     Ben:
     a. Blue?
     b. Maybe blue? $\approx$(1a)
     c. #Maybe blue.

These responses, however, can be ambiguous between declarative and interrogative fragments, as shown by the paraphrases in (32).

(32) Amy: What is John's favorite color?
      Ben:
      a. Blue?
          =   It's blue?
          =   Is it blue?
      b. Maybe blue?
          =   It's maybe blue?
          =   Is it maybe blue?

   Furthermore, recall that in Section 1 I introduced (3), repeated below, and we noted that (3a) and (3b) do not seem similar as their fragment counterparts in (1a) and (1b).

(3) Amy: What is John's favorite color?
     Ben:
     a. %It's blue?
     b. %It's maybe blue? $\napprox$(3a)
     c. #It's maybe blue.

The lack of equivalence between (3a) and (3b) might suggest that rising intonation in full declaratives does not participate in modal concord, an exception unexplained in the current analysis. Additionally, if the fragments in (1) are underlyingly declarative, it is unexpected that they should pattern differently from the

full declaratives in (3), casting doubt on the assumption that these fragments are, as I have tacitly assumed, declarative.

In this section, we will examine rising intonation in a variety of configurations, some of which will show an ostensible lack of concord reading between rising intonation and *maybe*, as in (3b). This will be shown to be an artifact of 1) mismatched uncertainty readings, or 2) infelicitous pragmatic weakening. We will conclude by returning to question of whether these fragments are declarative or interrogative.

4.1 Different uncertainty readings

At first blush, the lack of equivalence between (3a) and (3b) suggests a lack of concord in (3b). I argue that (3b) in principle allows a concord reading, and that a perceived lack of equivalence with (3a) is due primarily to (3a) and (3b) each favoring a different uncertainty reading.

To see the two different uncertainty readings mentioned above, observe that the fragment response in (33a) and full-sentence responses in (33b) and (33c), where you may find the similarity between (33a) and (33c) to be stronger than the similarity between (33a) and (33b).

(33)   Amy: What is John's favorite color?
        Ben:

    a.   Blue? (p)
    b.   It's blue? $\not\approx$(33a)   (QUD)
    c.   Is it blue? $\approx$(33a) (p)

The difference, I propose, is that the rising intonation in (33a) and (33c) favors what I term an 'uncertain-p' reading, where the speaker's uncertainty is with respect to the truth of the proposition expressed (here, the speaker is not certain that blue is John's favorite color). On the other hand, the rising intonation in (33b) favors what I term an 'uncertain-QUD' reading, where the speaker's uncertainty is with respect to the identity of the question under discussion, or *QUD* (here, e.g., Ben is not sure that Amy is asking what John's favorite color, perhaps because Ben believes that Amy already knows John's favorite color).[13]

(34)   a.   **Uncertain-p reading:**
              Reading where a speaker's uncertainty is with respect to the truth of the expressed proposition
        b.   **Uncertain-QUD reading:**
              Reading where a speaker's uncertainty is with respect to the identity of the question under discussion

To see the difference between these two reading more clearly, consider the dialog in (35).

(35)   Amy:What's John's favorite color?
        Ben:Maybe blue? (p)
        Amy:And what's John's favorite color?
        Ben:Maybe blue?   (QUD)
              Are you sure you don't mean Mary?

In Ben's first response, he may use rising intonation to mark his uncertainty about the identity of John's favorite color. In his second response, he knows that Amy knows that he has already suggested blue as John's favorite color and uses rising intonation here to indicate that he's not sure he's answering the question Amy intends to ask.

In the analysis I am building, these uncertainty readings translate to reasons for contingent commitment and are not directly represented in the semantics.[14] Where relevant, I notate rising intonation's preferred

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[13]There are other possible uncertainty readings, but for simplicity I focus on the two described here.

[14]The intonation contour used for these two types of uncertainty need not be the same, but I assume they always map to (23).

uncertainty reading to the right of each example, though keep in mind that another reading can always be coerced, especially with a rich enough context.

Observe that when *maybe* is present, fragment, full-declarative, and full-interrogative responses seem comparable, all preferring an uncertain-p reading.

(36)   Amy: What is John's favorite color?
Ben:

    a.   Maybe blue? (p)
    b.   It's maybe blue? ≈(36a) (p)
    c.   Is it maybe blue? ≈(36a) (p)

On the other hand, when *definitely* is present, an uncertain-QUD reading is biased, though not for full-sentence interrogatives.

(37)   Amy: What is John's favorite color?
Ben:

    a.   Definitely blue?   (QUD)
    b.   It's definitely blue? ≈(37a)   (QUD)
    c.   Is it definitely blue? ≉(37a) (p)

These readings in out-of-the-blue contexts are summarized in (38), though, again, keep in mind that these are only tendencies and that rising intonation in declaratives can in principle take either reading.

(38)   Uncertainty readings from (33)-(37)

modifier	sentence form	favored interpretation
–	fragment	uncertain-p
–	full declarative	uncertain-QUD
–	full interrogative	uncertain-p
maybe	fragment	uncertain-p
maybe	full declarative	uncertain-p
maybe	full interrogative	uncertain-p
definitely	fragment	uncertain-QUD
definitely	full declarative	uncertain-QUD
definitely	full interrogative	uncertain-p

So, while rising intonation can have either uncertainty reading, interrogative structure seems to force an uncertain-p reading. Fragments appear to bias an uncertain-p reading, while full declaratives bias an uncertain-QUD reading[15]. Additionally, weak epistemic adverbs (e.g. *maybe*) appear to bias an uncertain-p reading, while strong epistemic adverbs (e.g. *definitely*) bias an uncertain-QUD reading. In this way, fragments and full-declarative responses pattern alike in their interactions with epistemic adverbs, unlike full interrogatives.

In support of this, notice that when fragment *Blue?* and full-declarative *It's blue?* occur in a context that strongly biases a particular reading, they appear equivalent. We see this first in (39), where the context establishes that Ben does not know John's favorite color, biasing an uncertain-p reading of the rising intonation.

(39)   [Uncertain-p context: As part of a party game, Ben is answering trivia questions about John. He doesn't know John very well but is trying his best.]
Amy: What is John's favorite color?
Ben:

    a.   Blue? (p)

---

[15]This uncertain-QUD may be biased in full-declarative responses since they can be seen as a repetition of the perceived QUD (*It/John's favorite color is X*). Fragment responses, on the other hand, provide no such repetition.

b. It's blue? ≈(39a)   (p)

c. Is it blue? ≈(39a)   (p)

d. It's maybe blue? ≈(39a)   (p)

In this context, now (39a) and (39b) appear equivalent. Note that (39d) is also equivalent to (39a) (and (39b)), indicating that full declaratives allow a concord reading between *maybe* and rising intonation.

A similar pattern can be seen in (40), where the context establishes that Amy is aware that Ben knows John's favorite color (ruling out an uncertain-p reading), biasing an uncertain-QUD reading of the rising intonation.

(40)   [Uncertain-QUD context: Amy and Ben were recently discussing John's favorite color and established that they are both sure that it is blue.]
        Amy: What is John's favorite color?
        Ben:

    a.   Blue?   (QUD)

    b.   It's blue? ≈(40a)   (QUD)

    c. #Is it blue? ≉(40a)   (p)

    d. #It's maybe blue? ≉(40a)   (QUD)

In this context, now (40a) and (40b) appear equivalent. As mentioned above, however, interrogative structure forces an uncertain-p reading, and this uncertain-p reading is incompatible with the context where Ben knows what John's favorite color is, so (40c) is infelicitous under its uncertain-p reading.

To see why (40d) remains infelicitous under an uncertain-QUD reading, recall that, as discussed in Section 3, $[\![\mathbf{maybe}]\!]$ contributes a $\neg\forall$ implicature ($[\![\mathbf{maybe\ ?}]\!] = \lambda w\lambda f\lambda p : f$ is epist.$cc(w)(f)(p) \wedge \neg[\bigcap f(w) \subseteq p]$), and in this context the $\neg\forall$ implicature conflicts with Ben's certainty about the truth of the proposition, leading to infelicity. To see this more clearly, consider that, under a concord reading, Ben contingently commits to blue being John's favorite color, and he asserts that blue might be John's favorite color, just as in the derivation in Section 3.3. This assertion, under the Epistemic Commitment Principle, is redundant with the contingent commitment. In this context, however, Ben is certain what John's favorite color is, and his uncertainty is regarding whether he has understood the question correctly. Therefore, this $\neg\forall$ implicature leads to infelicity in this context.

We are now in a position to give a full explanation of (3), repeated below, and its lack of concord reading.

(3)   Amy: What is John's favorite color?
        Ben:

    a. %It's blue?   (QUD)

    b. %It's maybe blue? ≉(3a)   (p)

    c. #It's maybe blue.

In a neutral context without an epistemic adverb, full declaratives appear to bias an uncertain-QUD reading in (3a). With *maybe*, an uncertain-p reading is generally preferred, so (3b) may receive an uncertain-p reading. Importantly, even if (3b) may not appear to be equivalent to (3a), (3b) can still give a concord reading. We saw this already in (39), where we used a context that biases an uncertain-p reading in the full-sentence declarative. Furthermore, note that (3b), while it may feel quite different from (3a), is near-equivalent to the fragment *Blue?* (e.g. (1a)), which likewise favors an uncertain-p reading.

Thus we see that modal concord is available between rising intonation and *maybe* so long as rising intonation receives an uncertain-p reading. Lack of equivalence between responses like *Maybe it's blue?* and its *maybe*-less counterpart *It's blue?* does not indicate lack of concord so much as a difference in uncertainty readings in various contexts.

4.2 Pragmatic weakening

Another case in which concord readings appear to be absent arises when we consider rising declarative questions. Consider the example in (41) (adapted from Gunlogson, 2008, p. 104), where, counter to our prediction, a concord reading does not appear to be available.

(41)   [Robin is sitting in a windowless computer room when another person enters. The newcomer is wearing a wet raincoat and boots.] Robin to the newcomer:

    a. It's raining?
    b. #It's maybe raining? $\not\approx$(41a)

The questions in (41a) and (41b) are not equivalent, but this time it is not due to a discrepancy between uncertain-p and uncertain-QUD readings[16]. The utterance in (41b) sounds more like a suggestion than a question and is relatively bizarre out of the blue, particularly directed at someone who just came in from outside and knows whether or not it is raining.

To see why (41b) is infelicitous, first consider the case where (41b) receives a cumulative (i.e. non-concord) reading. Here the speaker contingently commits to the proposition that it is possible that it is raining. The speaker has adequate evidence for this, but the speaker has adequate evidence for the stronger proposition *It's raining*, so it is somewhat strange for him to have chosen the weaker proposition. This is even stranger given that the addressee is in a position to make the stronger commitment (that it is or is not raining) as well. So, assuming cooperative conversationalists, (41b) is infelicitous.[17]

Note that the felicity improves in a context where the addressee is not authoritative with respect to whether or not it is raining, but is authoritative with respect to whether or not it **might** be raining. For example, if, instead of arriving from outdoors, the addressee just checked the weather report in the paper and saw the probability of rain for the present time of day, (41b) is felicitous.

Given that a cumulative reading is infelicitous, why can't a concord reading rescue (41b)? I propose that a concord reading of (41b) is infelicitous due to the pragmatic effect of concord. As Zeijlstra (2008) describes it, to achieve a single-modal reading, only a single modal item is necessary, so the presence of a second modal item in modal concord contexts is pragmatically marked (cf. Grice's Maxim of Manner, specifically "Be brief", (Grice, 1975)) and gives an emphatic effect. When two possibility modals are used where only one is needed, this leads to a weakening effect (more remote possibility). So, just as (42b) is weaker than (42a), the single-modal *It's maybe raining?* in (41b) is weaker than its single-modal counterpart *It's raining?* in (41a), even under a concord reading.

(42)   a. John might be home by curfew.
       b. John might possibly be home by curfew.

This emphatic effect has been explored in depth for emphatic double negation, where an emphatic reading of multiple negation can occur when Negative Concord is not obligatory (Zeijlstra, 2008), as in (43).

(43)   a. Dat heb ik nooit neit gezien   (Dutch)   (van der Wouden, 1994, p. 147)
           that have I never not seen
           'I never saw that'
       b. Sij is nooit nie beskikbaar nie   (Afrikaans)   (Zeijlstra, 2008, p. 322)
           she is n-ever neg available neg
           'She is never ever available'

---

[16]Note that uncertain-QUD readings should not be at play here, since Robin is introducing the QUD.

[17]Note that if only possibility is relevant, i.e. *It's maybe raining* is at the right level of informativity, (41b) is still not felicitous because the rain gear alone is sufficient to conclude that rain is possible, obviating rising intonation, cf. (i).

(i)   [Robin is sitting in a windowless computer room with no information about current weather conditions when another person enters from outdoors.] Robin to newcomer:

    a. #There's evidence pointing toward it being rainy right now?
    b.   There's evidence pointing toward it being rainy right now.

A similar emphatic effect can be seen in (44), where redundant 'strong' expressions (e.g. *very, often*) lead to a strengthening effect, and redundant 'weak' expressions (e.g. *occasionally, sort of*) lead to a weakening effect.

(44) a. Miss Tox was <u>often</u> <u>in the habit</u> of assuring...   (Fowler and Fowler, 1906, p. 342)
      b. We are <u>very</u>, <u>very</u> happy with the result.   (van der Wouden, 1994, p. 145)
      c. Lord Roseberry has not budged from his position–splendid, no doubt–of <u>lonely</u> <u>isolation</u>.
                                                           (Fowler and Fowler, 1906, p. 342)
      d. Klein huisje   (Dutch)   (van der Wouden, 1994, p. 145)
         <u>small</u> house-<u>DIM</u>
         'Small little house'
      e. Ben <u>sometimes</u> <u>occasionally</u> attended mass.
      f. David was <u>somewhat</u> <u>slightly</u> annoyed.

Returning to a concord reading of (41b), the use of two uncertainty markers where only one is required leads to pragmatic weakening, here marking heightened uncertainty. This heightened certainty implies that the speaker does not have adequate evidence for the commitment they are making (e.g. they do not realize the correlation between rain and wet raingear). And if the speaker does not have adequate evidence, they cannot felicitously make the commitment. Thus (41b) is infelicitous under a concord reading due to an inference of lack of Speaker Evidence.

Now we see that modal concord readings may be technically possible for rising declarative questions like (41b), but they express a heightened lack of certainty incompatible with the use of a declarative. Note that this contrasts with rising declarative responses, as in (45).

(45) Amy: What's the weather like right now?
      Ben:
      a. It's raining?
      b. It's maybe raining?   ≈ (45a)

There the speaker faces pressure to provide an answer to the current QUD, making a declarative felicitous though the speaker's evidence may not be sufficient. In (41), the speaker faces no pressure to assert that it's raining. And while concord is infelicitous with rising declarative questions like (41), this does not reflect a failure in the theory proposed above but rather a conflict between the pragmatic effect of concord and the requirement of declaratives that speakers have adequate evidence for their commitments.

4.3 Summary

Beyond the cases of concord as in (1), we have seen cases in which no concord is predicted as in (2), and in this section we have now seen cases where concord readings appear to be unexpectedly absent. These surprising cases, however, were shown to be due to differences in uncertainty readings and pragmatic weakness, which are orthogonal to and compatible with the analysis developed in Section 3.

5 Conclusion

By implementing Gunlogson (2008)'s analysis of rising intonation, we were able to explain the pattern of data in (1) through modal concord (such that (1a) is nearly equivalent to (1b)) and cooperativity (such that falling intonation on an underinformative statement like (1c) is uncooperative).

(1) Amy: What is John's favorite color?
     Ben:
     a. Blue?
     b. Maybe blue?   ≈ (1a)

c. #Maybe blue.

The lack of equivalence between (2a) and (2b), where a stronger epistemic adverb appears, is due to the clash in strengths between the adverb (necessity) and rising intonation (possibility), which blocks modal concord.

(2) Amy: What is John's favorite color?
     Ben:
     a. Blue?
     b. Definitely blue? $\not\approx$ (2a)
     c. Definitely blue.

The lack of equivalence between the full-sentence responses in (3a) and (3b) was due to conflicting uncertainty readings, where (3a) biases an uncertain-QUD reading, while (3b) (and (1a) and (1b)) biases an uncertain-p reading.

(3) Amy: What is John's favorite color?
     Ben:
     a. %It's blue?
     b. %It's maybe blue? $\not\approx$ (3a)
     c. #It's maybe blue.

A number of innovations were introduced in explaining these patterns, which we will briefly revisit. First, allowing modal concord between adverbs required giving semantic content to intonation. This is perhaps unconventional, but it allows an explanation for the data puzzles examined in this paper via modal concord. Another mechanism that provides the proper scope between the rising intonation and the proposition surface-modified by the epistemic adverb (as opposed to the proposition *containing* the adverb) may work just as well. One such approach may be to propose a separate *maybe* hedge that acts as a wide-scope speech-act modifier, outside of the scope of rising intonation, though much work would be required to flesh out such an approach.

While this modal analysis remains largely consistent with Gunlogson (2008), she cautions against linking rising intonation directly with epistemic states. Her worry seems to be with respect to cases like counterfactuals, where a speaker's current (temporary) commitment set may contradict with their epistemic commitments (Gunlogson, 2001, p. 43, fn. 4). An example of such a context is given in (46)-(47), where Ben adds the proposition that the moon is made of cheese to his commitment set without actually believing that the moon is made of cheese.

(46) Amy: We both know the moon isn't made of cheese, but let pretend that it is for a moment.
      Ben: Okay, the moon is made of cheese.

(47) Amy: We both know the moon isn't made of cheese, but let pretend that it is for a moment. Now ask me if the moon is made of cheese.
      Ben: Is the moon is made of cheese?
      Amy: Yes.
      Ben: Okay.

It is clear, however, that this commitment is separate from any earlier *cs*s (otherwise their *cs*s would be set since this new commitment conflicts with the earlier commitment that they know the moon is not made of cheese) and will not last beyond the scope of the hypothetical. Why, then, should we not have separate temporary epistemic states as well? Such states seem necessary in an exchange like (48), where Ben is referring to his separate temporary set of beliefs (without which, he would be forced to reply to Amy's question in the negative).

(48) Amy: I know the moon isn't made of cheese, but let pretend that it is for a moment. Now, do you believe the moon is made of cheese?

Ben: Of course, everyone knows that.

Gunlogson's fear, then, appear unnecessary, so long as epistemic commitments are given the same treatment as discourse commitments in these contexts.

A consequence of attributing modal semantic content to rising intonation is that accomplishing concord between adverbs and rising intonation requires a semantic configuration like that in (49), where the adverb composes directly with rising intonation. While epistemic adverbs are generally considered to appear in a high position, it seems questionable to have them appear at the same level as an illocutionary element. However, there are many argued-for cases of interaction between semantics and intonation (e.g. comma intonation and restrictive vs. non-restrictive relative clauses), so while the particular configuration in (49) may not ultimately be correct, another may be able to provide the attested readings under an appropriately modified analysis.

(49)

maybe   ?   is John's favorite color   blue
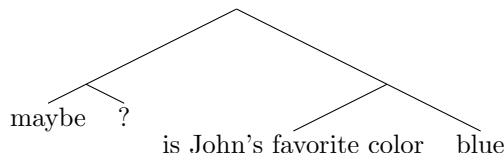
Finally, given this discussion, it may be interesting to note the interaction between rising intonation and different approximators.

(50)   Amy: How old is Chris?
        Ben:
        a.   Ten?
        b.   About ten? $\approx$ (50a)
        c.   Approximately ten? $\not\approx$ (50a)

Here, *about* appears to give rise to a concord reading, whereas *approximately* does not. A similar pattern can be seen in (51), where *about* appears to give a concord reading with *might*, but *approximately* does not.

(51)   a.   John might be about six feet tall.
              'John is somewhere in the ballpark of six feet'
        b.   John might be approximately six feet tall.
              'It is possible that John is approximately six feet tall'

This suggests that approximators like *about* have a modal component that can participate in modal concord with other modal possibility markers like *might* and rising intonation, which then further supports our treatment of rising intonation as a modal possibility marker.

6   Acknowledgments

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A   Testing for different types of uncertainty

Above, I claimed that there is more than one reason why a speaker may contingently commit to a proposition, and that this is reflected in multiple possible uncertainty readings that rising intonation can receive. While context has a huge influence, I claimed that generally: 1) *maybe* biases a uncertain-p reading, 2) *definitely* biases an uncertain-QUD reading, 3) fragments bias an uncertain-p reading, 4) full sentences bias an uncertain-QUD reading, and 5) interrogatives require an uncertain-p reading.

Therefore, I should predict that if participants are asked to rate their p- and QUD-certainty, the ratings for the forms that I claim bias/require uncertain-p readings should differ from the ratings for the forms that I claim bias uncertain-QUD. Specifically, the former should have overall lower p-certainty ratings and higher QUD-uncertainty ratings than the latter.

This prediction was tested using Amazon Mechanical Turk. 26 Participants were asked to read 36 short dialogs between two speakers, A and B, and to evaluate B's confidence on both i) the truth of the propositional content of B's utterance (p-certainty) and ii) that B understood A's question (QUD-certainty). Evaluations were made on a scale from 1 (very inappropriate/odd) to 7 (very appropriate). Rising and falling intonation were represented, as in this paper with *?* and *.* respectively, though this correspondence was not made explicit in the instructions.

Each participant saw 9 filler items with falling intonation and 27 test items. The test items were fully crossed for modifier (none, *maybe*, *definitely*) and syntax (fragment, full declarative, full interrogative), with three items per condition. An example item is shown in Figure 1.

In principle, either uncertainty reading is possible in these test items, especially since this task provides minimal context. The difference that I claim holds generally between full declaratives (uncertain-QUD bias), fragments (uncertain-p bias), and interrogatives (uncertain-p requirement), however, predicts a main effect of syntax. Similarly, the difference between *maybe* (uncertain-p bias) and *definitely* (uncertain-p bias) predicts a main effect of modifier, and the overlap of these two predicts a syntax x modifier interaction.

Results for the test items are show in Figure 2. QUD-certainty ratings appear to be at ceiling, so below I analyze the p-certainty data only. A 3x3 within-subjects ANOVA on p-certainty rating shows, as predicted, a main effect of modifier ($F(2, 50) = 4.1932, p = 0.003$), a main effect of syntax ($F(2, 50) = 9.1448, p < 0.001$), and an interaction ($F(4, 100) = 2.9313, p = 0.004$), (R Core Team, 2014; Bates et al., 2014a,b).

The relative lack of variation in QUD-certainty ratings was not expected. It may be that the prompt was too confusing or that the dialogs provided were not sufficient to support the particular uncertain-QUD reading I presented for rating. While these results do not demonstrate show any evidence of the uncertain-QUD reading, its existence is uncontroversial in examples like (35).

Dialogue:

> A: What is John's favorite color?
> B: Blue?

Rate B's confidence on the following:

S_1: John's favorite color is blue.

- 1 (B is not at all confident that S_1 is true)
- 2
- 3
- 4
- 5
- 6
- 7 (B is very confident that S_1 is true)

S_2: B understands A's question.

- 1 (B is not at all confident that S_2 is true)
- 2
- 3
- 4
- 5
- 6
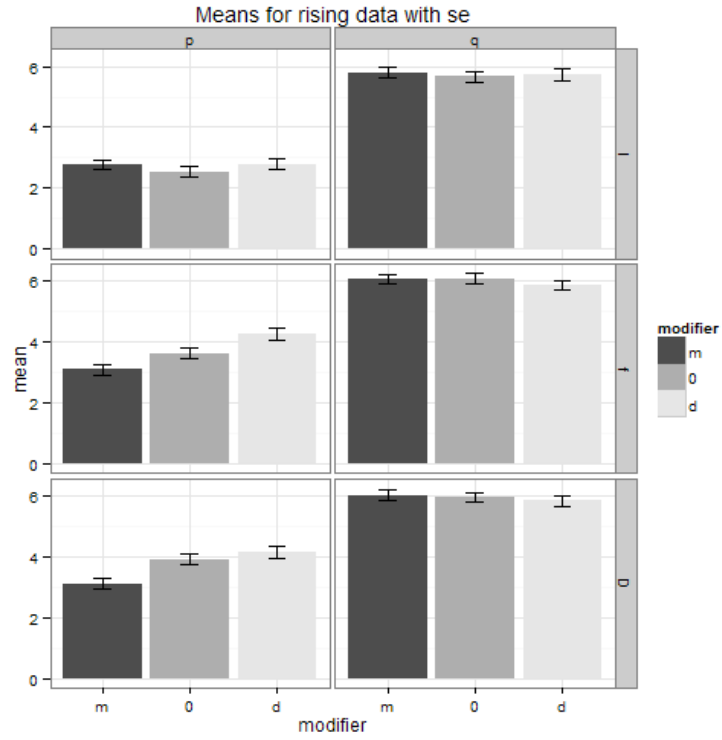- 7 (B is very confident that S_2 is true)

Figure 1: An example item

Figure 2: Mean *p*- and QUD-certainty ratings, with SE, for I(nterrogative), f(ragment), and D(eclarative) responses with m(*aybe*), 0(-no modifier-), and d(*efinitely*).