Intonation, *yes* and *no*[*]

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Abstract

English polar particles *yes* and *no* seem to be interchangeable in response to negative sentences, that is, either can be used to convey both positive and negative responses. While some recent research has been devoted to explaining this phenomenon (Kramer & Rawlins, 2009; Cooper & Ginzburg, 2011; Krifka, 2013b; Roelofsen & Farkas, 2015; Holmberg, 2016), questions remain. Primary among them is whether intonation differs depending on whether the response is positive or negative, and whether intonation can affect the interpretation of polar particle responses. In a series of experiments, we demonstrate that the contradiction contour (Liberman & Sag, 1974) is an intonation that is only produced on positive responses to negative polar questions, and that it influences how hearers interpret bare particle responses. Our experimental results also confirm the phenomenon of interchangeability, and add new evidence regarding speakers' preferences for using *yes* and *no* in response to negative polar questions. We discuss theories of polar particles and intonation, and how the experimental results bear on them, and conclude by considering uses of polar particles that are not easily explained by existing theories.

Keywords: polar particles, yes, no, intonation, prosody, contradiction contour, negative questions

1 Introduction

Recent research has demonstrated that the English polar particles *yes* and *no* are interchangeable in responses to negative *yes*/*no* questions (YNQs), at least when accompanied

[*]This essay was recently submitted for review. It expands substantially on our NELS paper *It's not just what you say, it's how you say it: Intonation,* yes *and* no. Comments are welcome. We can be reached at daniel.goodhue@mail.mcgill.ca.

by a following sentence conveying the intended interpretation (Kramer & Rawlins, 2009; Cooper & Ginzburg, 2011; Krifka, 2013b; Roelofsen & Farkas, 2015; Holmberg, 2016). Intuitions have also been reported that, in response to negative YNQs, a special intonational tune is used on positive responses, and that responses consisting only of *yes* or *no* are most likely to be interpreted as negative. This paper reports on experiments testing these claims, and aims to improve our understanding of the role of intonation. In a series of experiments, we demonstrate that particles in responses to negative YNQs can convey either polarity, even if certain readings of bare particles are available only with the help of certain intonations. We show that the contour most commonly used in responses to polar questions when not using declarative falling intonation is the contradiction contour, and propose an analysis of the contour that can explain the conditions on its use.

2 Polar particles *yes* and *no*

In response to positive *yes/no* questions (YNQs), the choice between *yes* and *no* is often completely determined by what the speaker is trying to convey in her response:

(1) A: Is Jane coming?
   a. B: Yes, Jane is coming.
   b. B: # No, Jane is coming.
   c. B: # Yes, Jane is not coming.
   d. B: No, Jane is not coming.

In (1), *no* is only acceptable if B means to say *Jane is not coming*, and *yes* is only acceptable if B means to say *Jane is coming*. However, in response to negative YNQs where negation is below the subject (low negation), the choice between *yes* and *no* can seem optional.

(2) A: Is Jane not coming?
   a. B: Yes, Jane is coming.
   b. B: No, Jane is coming.

c. B: Yes, Jane is not coming.
d. B: No, Jane is not coming.

We will discuss nuances in the intuitions below, but it is clear that, while (1b) and (1c) are infelicitous responses, all four responses to the negative YNQ in (2) are acceptable. We will refer to this behavior of English polar particles as *interchangeability*.[1] *Yes* and *no* are often interchangeable in responses to negative questions and sentences in the sense that one can swap out *yes* for *no* and vice versa while still conveying the same overall meaning.

Recent analyses of polar particles are mainly concerned with accounting for this interchangeability. Current approaches include ones that view response particles as propositional anaphora (Krifka, 2013b; Westera, 2014), analyses involving syntactic ellipsis (Kramer & Rawlins, 2009; Holmberg, 2016; Wiltschko, 2016), and analyses that involve a combination of both ingredients (Roelofsen & Farkas, 2015).

All of these accounts make concrete claims about the circumstances under which *yes* and *no* are interchangeable, and, beyond interchangeability, about which particle is preferred or more naturally conveys a certain meaning when in principle both are able to convey it. These accounts also make claims about the interpretation of bare particle responses, i.e. in a context in which *no* is preferred for conveying $\neg p$, a bare *no* response is predicted to be interpreted as $\neg p$. They also make predictions about which particle responses are more likely to require an overt following sentence, i.e. in the same context, a speaker using *yes* to convey $\neg p$ is predicted to produce an overt sentence with the meaning $\neg p$.

In much of the prior work on polar particles, it is observed that the interpretation of the particle seems to interact with the intonational tune produced. However there has been little

[1]The phenomenon has been referred to in the literature variously as "ambiguity", "multifunctionality" and "negative neutralization". We want to avoid the term "ambiguity" since the answers in (2) are not ambiguous thanks to the sentences following *yes* and *no*. Moreover, some authors have claimed that bare *yes* and bare *no* responses can only convey a single unambiguous meaning, so it is not even settled whether bare particle responses are ambiguous at all. The term "multifunctionality" similarly already implies a certain interpretation of the facts, since it best fits analyses like Roelofsen & Farkas (2015) in which *yes* and *no* each have two different meanings or 'functions'. The term "negative neutralization" from Kramer & Rawlins (2009) was only meant to apply to negative polarity responses such as (2d) and (2c), so it doesn't capture the full phenomenon.

agreement on the effect of intonation or on the forms of the tunes themselves. This paper aims to elucidate the role of intonation, and also presents new evidence about the use of polar particles that bears on how they should be analyzed. We start out by presenting the different approaches, and outlining how our experiments aim to help further our understanding.

2.1 Krifka (2013b)

Krifka (2013b) proposes that the interchangeability of *yes* and *no* can be explained as a case of anaphor ambiguity resolution. In Krifka's analysis, *yes* and *no* are propositional anaphora that require linguistic antecedents, similar to *that* and *so*. They are different from other propositional anaphora, however, in that they do not just refer to a proposition, they also either assert it (in the case of *yes*) or assert its negation (in the case of *no*). Therefore, while *that* frequently has the syntactic category TP, *yes* and *no* have the syntactic category of speech acts, which Krifka calls ActP. This is why it is not possible to say *Yes surprised me*—the predicate *surprise* requires a TP as its subject, not an ActP.[2]

For Krifka, propositional discourse referents serve as antecedents to polar particles. A positive YNQ as in (3) makes available a discourse referent d anchored to the TP, which denotes the proposition *Jane is coming*:

(3) Is Jane coming?
simplified LF: $[_{TP_{\hookrightarrow d}}$ Jane is coming]

a. Yes = ASSERT(d) [meaning: Jane is coming]
b. No = ASSERT($\neg d$) [meaning: Jane is not coming]

The particle *yes* can only assert d as in (3a). It cannot assert $\neg d$ as there is no antecedent denoting that proposition. Similarly, *no* can only negate d producing $\neg d$ as in (3b) because

[2]And yet it seems that *yes* and *no* can sometimes be embedded under predicates like *believe* (*I believe yes*) or conditionals (*if yes, ...*). In the movie *Pee Wee's Big Holiday*, a character tries to force her way into Pee Wee's room, saying "Let me in, I want to snuggle!" and Pee Wee replies, "I promised your dad no!". This embedding behavior clearly contrasts with the behavior of expressive exclamatives like *bullshit*, which in other ways are quite similar to polar particles: *# I believe bullshit*, and *# if bullshit, ...* An in-depth exploration of this embedding behavior is beyond the scope of this paper.

d is the only antecedent available. To produce d, *no* would need to be able to negate an antecedent that is equivalent to $\neg d$, but there is no such antecedent in (3). Therefore Krifka predicts the non-interchangeability of *yes* and *no* in (1).

Krifka's analysis of the interchangeability of *yes* and *no* in (2) is demonstrated in (4). Under this analysis, interchangeability is caused by negative sentences introducing two propositional discourse referents, d anchored to the TP, and d' anchored to the NegP. d denotes the proposition that *Jane is coming*, and d' that *Jane is not coming*.

(4) Is Jane not coming?
simplified LF: $[_{NegP_{\hookrightarrow d'}}$ not $[_{TP_{\hookrightarrow d}}$ Jane is coming]]

a.	(i)	Yes = ASSERT(d)	[meaning: Jane is coming]
	(ii)	No = ASSERT ($\neg d$)	[meaning: Jane is not coming]
b.	(i)	Yes = ASSERT(d')	[meaning: Jane is not coming]
	(ii)	No = ASSERT ($\neg d'$)	[meaning: Jane is coming]

In (4a), *yes* asserts d, and *no* asserts its negation. In (4b), *yes* asserts d', and *no* asserts its negation. Given the usual properties of negation, $d = \neg d'$ and $d' = \neg d$. Thus Krifka models the interchangeability of English polar particles.

Support for the claim that negative sentences introduce two discourse referents can be found in the behavior of other propositional anaphora responding to negative sentences. In (5), *that* could convey either that B didn't expect Maria to bring the matches or that B didn't expect Maria **not** to bring the matches.

(5) A: Maria didn't bring the matches.
B: I didn't expect that.

The reading in which *that* picks up the discourse referent anchored to the TP rather than the one anchored to the NegP may be more accessible, but pragmatic factors can affect which antecedent is preferred. In (6), chances are that B did not expect to win the jackpot, and the resolution of the anaphor compatible with that reading is readily available in both responses.

In Krifka's terms, this means that *that* in (6a) is interpreted as picking up the NegP discourse referent, while in (6b) it is interpreted as picking up the TP discourse referent.

(6) A: You didn't win the jackpot.
   a. B: I expected that.
   b. B: I didn't expect that.

From (6) we learn that idiosyncratic features of context can affect the interpretation of an anaphor. According to Krifka, more general contextual features conspire to explain the following interpretational preferences. He argues that negative response interpretations of polar particles are preferred over positive response interpretations in general, and that positive interpretations of *yes* and *no* seem to require overt elliptical clauses (e.g., *. . . I did*), and a special intonation that he refers to as a "rejecting accent", though he does not describe what it sounds like.

(7) [Cf. Krifka's (2013b) (50)]
A: Ede didn't steal the cookie.

a.	B: Yes, he did!	Preferred with rejecting accent and elliptical clause.
b.	B: No, he did!	Preferred with rejecting accent and elliptical clause.
c.	B: Yes, he didn't.	Natural, but preferred with clause.
d.	B: No (he didn't).	Natural, clause not necessary.

Krifka hypothesizes two pragmatic markedness principles to explain these preferences. (i) Disagreements with an interlocutor are marked, hence the rejecting accent (indicated with "!") and elliptical clause are required in (7a) and (7b). (ii) Picking up a less salient discourse referent is marked. The relative salience of discourse referents is contextually determined, however the discourse referent anchored to the embedded TP is by default more salient (less marked) than its negative counterpart. This is because, even though the negative sentence is explicitly uttered, it will usually only be uttered in contexts in which the positive sentence is already salient. E.g. "Ede stole the cookie," was likely already salient before A's utterance

in (7). These two pragmatic principles, in (8), are used in the OT tableau in Figure 1 to predict the preference patterns in (7). The decision to rank *DisAgr higher than *NonSal is defended on the grounds that A's utterance is an assertion, which indicates a high degree of commitment to the proposition on the part of A, making disagreement costly.

(8) a. *NonSal: Penalizes reference to less-salient discourse referents.
b. *DisAgr: Penalizes disagreement with the other speaker.

	expression	reference	resulting meaning	*DisAgr	*NonSal	Favorite
a	*yes*	d′	'He did.'	*		((☜))
b	*yes*	d	'He didn't.'		*	(☜)
c	*no*	d′	'He didn't.'			☜
d	*no*	d	'He did.'	*	*	

Figure 1: [From Krifka (2013b), ex. (52)] Calculation of optimal forms in an OT tableau, antecedent in (7).

Since (c) in Figure 1 is the optimal candidate, bare *no* is predicted to be interpreted as *he didn't*. If *no* is intended to convey *he did*, it is therefore necessary to follow up with an elliptical clause. According to Krifka, a bare *yes* is also more likely to be interpreted as *he didn't*, but he writes [p. 13], "as the two interpretations in (a) and (b) differ only slightly, a clarifying elliptical clause is usually required to express these meanings."[3]

To summarize, Krifka's theory explains interchangeability by positing that polar particles are propositional anaphora and that negative sentences introduce two possible antecedents. Preference patterns are theorized to be connected to two pragmatic constraints, *NonSal against picking up less salient discourse referents, and *DisAgr against disagreements. Interpretations that are dispreferred by these constraints are predicted to require following sentences and special intonations. The experimental results we present below will test these

[3]We interpret "differ only slightly" to mean that both (a) and (b) each only incur one violation—which in OT would usually suffice to render one candidate ungrammatical, but maybe other assumptions about constraint aggregation are being made here.

claims.

2.1.1 Westera (2014)

Westera (2014) offers an alternative to Krifka's (2013b) analysis. Given that Krifka appeals to the idea that the positive sentence is usually salient before the negative sentence is uttered to explain why there is generally a preference for picking up positive discourse referents, one might wonder why it should be hypothesized that negative sentences introduce both positive and negative discourse referents at all. That is, why not assume that positive and negative sentences only introduce one propositional discourse referent each, and that the reason for the interchangeability of polar particles in response to negative sentences is that a preceding positive sentence is also salient enough to introduce a discourse referent? This is what Westera (2014) proposes. Under this view, it is unnecessary to posit that *yes* and *no* can pick up an antecedent embedded under negation. (9) demonstrates this hypothesis (cf. Westera's (11)).

(9) A: Did Petra pass the test? [This YNQ may be implicit.]
B: Petra didn't pass the test.
a. S: (Relative to A) Yes, she did / No, she didn't
b. S: (Relative to B) Yes, she didn't / No, she did

If S's response is relative to A, then the responses in (9a) are produced. If relative to B, the (9b) responses are produced. Westera's theory might be preferable to Krifka's in that it makes do without embedded antecedents. However, there is a simple test case that teases the two theories apart. When there is no positive antecedent, Westera's theory predicts *yes* and *no* to lose their interchangeability. Suppose for example that A's YNQ in (9) had been negative. Then the responses in (9a) should be unavailable. Krifka, on the other hand, predicts that such a modified dialogue should still exhibit interchangeability, which seems more in keeping with the intuitions. The dialogue in Krifka (2013b, p. 14) serves as another

test case:[4]

(10) A: Which of the mountains on this list did Reinhold Messner not climb?
B: Well, let's see... He did not climb Mount Cotopaxi in Ecuador.
C: Yes. / No.

The conversation in (10) is one in which the negative sentence *He did not climb Mount Cotopaxi in Ecuador*, is not preceded by a positive sentence. Westera's theory predicts *yes* should unambiguously mean *he didn't*, and *no* should unambiguously mean *he did*. However, it seems intuitively clear that bare *no* with falling intonation can convey *No, he didn't* here. Like in the modified version of (9), the intuitions about (10) seem to favor Krifka's account over Westera's.[5]

As in (7), Krifka predicts that both *yes* and *no* should be most naturally interpreted as meaning *he didn't* in (10). But, whereas *no, he didn't* was identified as least marked in (7), Krifka claims that *yes, he didn't* is least marked in (10). The reason for this is that the positive discourse referent d was most salient in (7), but in (10), the negative discourse referent d' is most salient due to A's negative WH-question. We will return to these intuitions when discussing our experimental results.[6] In sum, it seems to us that Krifka's account of interchangeability in terms of embedded antecedents is more in tune with the intuitions about relevant test cases.

[4]We switched from two to three characters in this example so that the speaker of the WHQ and that of the polar particle are distinct individuals. This avoids any confusion that might be caused by having the asker of the WHQ then answer B, in effect suggesting she knew the answer to her own question.

[5]Matthijs Westera (p.c.) has suggested that, if we include an elliptical clause, the location of focus prominence may play a role in acceptability, e.g. "No, he DIDn't" vs. "No, MESSNER didn't". We agree that such an addition seems to affect the interpretation of the polar particles, though it is not clear what the correct explanation is, nor does it explain why the interpretation of bare *no* goes against Westera's prediction.

[6]We note our intuition that the intonation on the polar particles themselves will affect preferred interpretations in (10). In particular, the contradiction contour (a fall rise intonation, to be discussed below) seems to lead to a positive *he did* interpretation, while falling intonation leads to a negative *he didn't* interpretation, for both *yes* and *no*. These intuitions are tested and confirmed in our perception experiment in section 5.

2.2 Holmberg (2016)

Holmberg (2016) theorizes that polar particles *yes* and *no* stand in a syntactic relationship with the following sentence, and that in bare *yes*/*no* responses, the following sentence is elided. More specifically, Holmberg assumes that all sentences have a polarity phrase (PolP) high in the IP domain, above which *yes* and *no* are generated as specifiers of a syntactic focus head. The polarity head can have one of three values, positive, negative and open. Its value in positive polar questions is open. *Yes* and *no* are operators that assign positive and negative values respectively to open polarity heads. If ellipsis occurs, the syntactic and semantic content of the elided PolP complement will be identical to that of the question due to the identity condition on ellipsis, producing an answer with the syntactic structure and meaning of a positive or negative response. An example of responses to a positive YNQ can be seen in (11).

(11) A: Is+[openPol] Jane coming?

a. B: [$_{FocP}$ Yes ~~[$_{PolP}$ [posPol] [$_{TP}$ she is coming]]]~~

b. B: [$_{FocP}$ No ~~[$_{PolP}$ [negPol] [$_{TP}$ she is not coming]]]~~

Note that in order for this account to work, the polarity variables within the elided PolPs need to be able to have a value different from that of the antecedent in the YNQ, hence the identity condition on ellipsis seems to be violated. Holmberg argues that elided pronoun variables can have different interpretations than their antecedents, and he suggests that polarity variables work in the same way.[7]

Holmberg captures the interchangeability of *yes* and *no* in response to negative YNQs by assuming that English has two negations, one high between TP and vP, and one low, as an adjunct to vP/VP. When A asks the question "Is Jane not coming?", B is free to interpret

[7] E.g. *Jane took her car, and Amanda did, too* has an interpretation where Amanda took her own car. It is not immediately clear that the relationship between pronoun variables and their binders is the same as that between polar particles and polarity variables. Moreover, there is still a question as to how the word *not* relates to the negative polarity head, and how it is able to appear in an elided constituent when it is not present in the antecedent, as in (11b).

it as having high or low negation. If negation is low, as in (12a), then the polarity head is open and *yes* and *no* are both free to bind it. *Yes* will produce a negative response (12a-i), while *no* produces a double negative, which reduces to positive (12a-ii). If negation is high, as in (12b), then the polarity head is negative and *yes* requires an unelided clause to change it (12b-i), while *no* forms a negative concord chain with it (12b-ii).[8] Note that high and low negation YNQs are string identical and interpretively indistinguishable in this account. The structural ambiguity between them is what makes *yes* and *no* interchangeable.[9]

(12) *Structures for* "Is Jane not coming?":

a. A: Is+[openPol] Jane [$_{vP}$ not coming]? low negation YNQ
   (i) B: [$_{FocP}$ Yes ~~[$_{PolP}$ [posPol] [$_{TP}$ she is [$_{vP}$ not coming]]]]~~
   (ii) B: [$_{FocP}$ No ~~[$_{PolP}$ [negPol] [$_{TP}$ she is not [$_{vP}$ not coming]]]]~~

b. A: Is Jane not+[negPol] coming? high negation YNQ
   (i) B: [$_{FocP}$ Yes [$_{PolP}$ [posPol] [$_{TP}$ she is ~~[$_{vP}$ coming]]~~]
   (ii) B: [$_{FocP}$ No ~~[$_{PolP}$ [negPol] [$_{TP}$ she is not coming]]~~]

In our opinion, the most interesting difference between Holmberg's and Krifka's accounts is not related to the fact that the former uses ellipsis while the latter uses anaphora, but is instead about the different empirical predictions they make. However, before discussing these differences, we will consider—and ultimately disregard—two reasons that an ellipsis account of polar particles may seem preferable to an anaphor account.

First, the response systems of some languages seem to clearly involve ellipsis, for example Finnish.

(13) [From Holmberg (2016, p. 3)]

[8]This analysis requires Holmberg to claim that there are two separate entries for *no* in English, one with an interpretable negPol feature enabling it to bind the open polarity variable, as in (12a-ii), and one with an uninterpretable negPol feature enabling it to enter into a negative concord chain in (12b-ii).

[9]Wiltschko (2016) builds on Holmberg (2016) by assuming his theory, but adding that polar particles can appear even higher in the syntactic structure, above representations of interlocutors' beliefs and the common ground. She provides support for this claim by introducing interesting new empirical evidence. Our experiments do not touch on these issues, however our discussion in section 8 will, so we will discuss Wiltschko (2016) there.

a. A: Tul-i-vat-ko lapset kotiin?
come-PST-3PL-Q children home
'Did the children come home?'
b. B: Tul-i-vat.
come-PST-3PL
'Yes.'

Holmberg (2016) argues that an ellipsis account of polar particles has the attractive feature of providing a unified account for diverse crosslinguistic facts about responses to YNQs. However, note that in English one can also use elliptical responses without polar particles, e.g. *A: Did the children come home? B: They did.* B's response in (13b) might just as well be translated as "They did." The fact that various languages frequently rely on ellipsis to answer YNQs is not by itself a reason to assume that polar particles also make use of ellipsis. Moreover, unlike English polar particles, Finnish elliptical responses do not give rise to interchangeability (Holmberg, 2016, p. 168-178). An open empirical question is whether elliptical responses in *any* language give rise to interchangeability. If none do, this would be an argument in favor of an analysis of polar particles that is separate from ellipsis. Note that English elliptical responses to the question in (12) do not license interchangeability. E.g. *she is* can only mean that she is coming, and *she isn't* can only mean that she is not coming, but under Holmberg's analysis in (12a) and (12b), it's not clear why they cannot each also give rise to the opposite meanings.

The second reason that an ellipsis account may seem preferable is that it explains the relationship between polar particles and the sentences that can follow them, which seem to specify the meanings of *yes* and *no* more fully. If a following sentence is pronounced, this just means that ellipsis has not happened. The propositional anaphor account has nothing to say about this relationship, other than that the meaning of the particle and what follows it should be coherent in the discourse. Note however that pronouns generally can be followed by an appositive constituent with identical content, cf. (14a). Polar particles with following sentences can plausibly be analyzed as appositive constructions as well, cf. (14b), indeed

this is what Krifka proposes.

(14) a. A: Who called the fire department?
B: Her, the woman.
b. A: Do you want more coffee?
B: No, I don't want more coffee.

Notice also that the relationship between a polar particle and the continuation following it is often not analyzable in terms of ellipsis. Holmberg's account (as well as Roelofsen & Farkas's (2015), see below) requires us to assume that the *no*s in (15a) and (15b) are each followed by an elided constituent that bears no syntactic relation whatsoever to the overt continuation. This is especially striking for (15b), since the elided constituent and the overt continuation have exactly the same propositional content.

(15) a. A: Are you leaving?
B: No, I'm just stepping outside!
b. [Adapted from Holmberg (2013, p. 37)]:
A: Did Jane not pass the exam?
B: No, she failed.

An ellipsis account requires *no* in (15a) to involve an elided *I'm not leaving*. The following sentence *I'm just stepping outside!* has no syntactic or semantic relationship with *no*. Likewise, even though *failed* is semantically equivalent to *did not pass*, *no* in (15b) needs to involve the elided *she did not pass the exam*. The reason is that the sentence *she failed* has positive polarity, but under Holmberg's account *no* must bind a negative polarity feature in the polarity head. Therefore, both an ellipsis account and an anaphor account have to say that in (15b), B is essentially saying, "No (she did not pass the exam), she failed," with the parenthetical sentence represented either as an elided PolP in an ellipsis account, or as the meaning of the pronoun *no* in the anaphor account. Therefore, in such cases an ellipsis account does not offer a better explanation of the relationship between polar particles and continuations than an anaphor account. Consider that even in cases where an elided

constituent would be both syntactically and semantically identical to an overt continuation, there is nothing in an ellipsis account to stop us from analyzing particle-continuation pair from also containing an elided constituent, e.g. *Yes ~~she is coming~~, she is coming.* In fact, it is quite normal for elided constituents to be repeated in an overt continuation, e.g. *She is ~~coming~~, she's coming.* Given these facts, ellipsis and anaphora seem to be on equal footing when explaining the relationship between polar particles and overt continuations.

What distinguishes Holmberg's and Krifka's accounts empirically is ultimately not the fact that one posits syntactic ellipsis whereas the other posits anaphora. For example, we can formulate an ellipsis version of Krifka's theory that, though it makes use of ellipsis, still makes the same predictions as Krifka's proposal. Suppose that *yes* and *no* are high in the CP domain, and they impose requirements on their complement PolPs: *yes* requires its PolP to have identical propositional content and polarity to a salient antecedent, and *no* requires its PolP to have the opposite propositional content and polarity from a salient antecedent.[10] Then, we retain Krifka's assumption that negative sentences introduce two possible antecedents, one corresponding to the NegP, the other to the TP. This ellipsis version of Krifka's theory makes the same predictions as Krifka's anaphor theory, so there is nothing about ellipsis and anaphora *per se* that distinguishes their empirical predictions. Even so, Holmberg's and Krifka's theories *do* make different predictions, which are due to other details about the mechanics, and these differences are what interests us here.

The main empirical differences between Krifka's and Holmberg's proposals derive from how they account for interchangeability. Krifka locates the source of interchangeability in antecedents that make two discourse referents available, while Holmberg locates it in the ambiguity of the antecedent sentence between high and low negation. This leads Holmberg to the distinct prediction that a bare *yes* in response to a negative YNQ is most naturally interpreted as indicating a negative response, since in order to indicate a positive response,

[10]Note, this idea corresponds directly to Roelofsen & Farkas's (2015) relative polarity features, to be discussed below. It nevertheless makes different predictions from their theory since it lacks the absolute polarity features also posited in their account.

an unelided clause is required so that the polarity head can be changed from negative to positive. Holmberg claims the judgments in (16), but one of his reviewers produces the example in (17).

(16) A: Is Jane not coming to the party?
  a. B: # Yes. [meaning: she is]
  b. B: Yes, she is.

(17) A: Is John not coming, then?
  B: Yes, he's just getting his jacket.

Holmberg acknowledges that (17) is problematic for his theory. One solution he suggests is that acceptability may be subject to subtle prosodic cues. Without a special intonation, responses like (16a) and (17) will be infelicitous. Indeed, we believe that whether or not a bare *yes* is naturally interpreted as indicating a positive response to a negative YNQ is highly dependent on the intonation it bears, and our perception experiment in section 5 provides support for this claim. However, we will also see experimental evidence that *yes* is in general preferred with a positive sentence interpretation, counter to the intuition reported in (16), and in contrast to the predictions of Holmberg's account.

2.3 Roelofsen & Farkas (2015)

Like Krifka, Roelofsen & Farkas's (2015) account predicts that polar particle responses are anaphoric to preceding antecedents, and like Holmberg, their analysis makes use of ellipsis. Unlike Krifka, they do not propose that negative sentences introduce two discourse referents, and unlike Holmberg, they do not claim that negative YNQs are ambiguous due to two different syntactic heights for *not*. Roelofsen & Farkas (R&F) attribute the interchangeability of *yes* and *no* to their ability to encode two different types of meanings. The idea behind this account was first introduced by Pope (1972), who proposed that polarity particles in English do double duty: they can either signal the polarity of the answer being given, or they

can signal whether the present response agrees or disagrees with a prior utterance, in other words, they can reflect how the polarity and propositional content of the present response relates to that of the prior utterance.

R&F implement this idea by positing that *yes* and *no* can realize two different types of polarity features, *absolute* and *relative*, which originate in a polarity head in the left periphery. This polarity head takes a (potentially elided) clausal argument, which they refer to as the "prejacent". The *absolute* features [+] and [−] presuppose that the prejacent has positive or negative polarity respectively. The *relative* features [AGREE] and [REVERSE] each introduce two presuppositions relative to a unique most salient antecedent in the discourse: [AGREE] presupposes that the prejacent has the same polarity and identical propositional content to the antecedent, while [REVERSE] presupposes that the prejacent has opposite polarity and complementary propositional content to the antecedent. *Yes* is capable of realizing [+] and [AGREE], while *no* is capable of realizing [−] and [REVERSE]. The fact that the particles can either encode absolute or relative features is the proposed source of interchangeability.

(18) A: Petra passed the test.

a. S: Yes / #No, she did. [AGREE, +]
b. S: #Yes / No, she didn't. [REVERSE, −]

(19) A: Petra didn't pass the test.

a. S: Yes / No, she didn't. [AGREE, −]
b. S: Yes / No, she did. [REVERSE, +]

Since positive responses to positive sentences only meet the presuppositions of the [+] and [AGREE] features, and only *yes* can realize those features, only *yes* is acceptable in (18a). *Mutatis mutandis*, only *no* is acceptable in (18b). In response to negative YNQs, the picture becomes more complicated. Since both the responses in (19a) and (19b) contain features that can be realized by both *yes* and *no*, either particle is licensed in each response. Note that the presence of only one realizable feature is enough to license a polar particle, e.g. in

(19a) *yes* is licensed by the presence of [AGREE] even though [+] is absent and it does not realize [−]. This is how R&F capture the interchangeability of polar particles in English.

R&F conceive of these two sets of polarity features as being universal, and capable of capturing response systems in all languages. Languages vary in which features or feature combinations a particular lexical particle can realize. Additional assumptions are made about the relative markedness of the feature values, which makes additional predictions for preferences in the response patterns. The more marked a feature specification, the greater its need to be realized overtly. R&F argue that [REVERSE] is more marked than [AGREE] since complementation is more marked than identity. [−] is more marked than [+] because negativity is always more marked crosslinguistically (cf. Horn, 1989). Moreover, absolute polarity features are marked in the presence of [REVERSE] since [+] and [−] each necessarily contrast with the polarity of the antecedent when [REVERSE]'s presupposition is met. From these markedness assumptions, R&F derive the following markedness scale from least to most marked for the four possible feature combinations.

(20) Markedness scale: [AGREE, +] < [REVERSE, −] < [AGREE, −] < [REVERSE, +]

R&F argue that by virtue of both being unmarked, [AGREE] and [+] form a natural class, and [REVERSE] and [−], as the two marked features, form a second natural class. Therefore, [AGREE, +] and [REVERSE, −] are less marked than the other two combinations, with the former the least marked. Of the remaining two combinations, [REVERSE, +] is more marked because [REVERSE] is more marked than [AGREE], and [+] is contrastive in the presence of [REVERSE].

This markedness scale makes two interesting predictions. The first is that [REVERSE, +], being most marked, has high realization needs, which means any language's response system will have to do something special to signal this interpretation. In English, R&F argue that the most natural way to do this is to produce verum focus on the unelided auxiliary verb, e.g. "Yes/No, she DID." Some languages deal with this marked feature combination by having a

third response particle used only for this purpose. E.g. *si* in French, *doch* in German, or *jo* in Swedish. The second prediction is that in [AGREE, −] responses, only one of the features is marked, [−]. Since only *no* realizes this feature, *no* is predicted to be the most natural particle for realizing agreements with preceding negative sentences.

To recap, either *yes* or *no* can be used naturally in [REVERSE, +] responses (e.g. *she did* in response to a negative sentence), but an overt prejacent with verum focus is likely to be needed. Compare to Krifka's OT tableau in Figure 1, which predicts *yes* to be more natural than *no* in such responses. R&F also predict that *no* is most natural in [AGREE, −] responses (e.g. *she didn't* in response to a negative sentence), a prediction shared by Krifka. The results of the experiments reported in sections 4 and 5 will provide data testing these predictions. One other key difference between R&F's and Krifka's accounts is that the latter predicts context sensitivity in the preference patterns for responses to negative sentences, while R&F's markedness scale in (20) is fixed and insensitive to context. We will return to this issue in section 6.

One final note before moving on: as already argued above, the fact that R&F's theory makes use of ellipsis while Krifka's does not is not in itself an interesting difference between the theories, since it is does not by itself make diverging predictions. The more substantive difference between the two theories is that R&F capture interchangeability by proposing more complexity in the polar particles themselves in that they do double duty, while Krifka captures interchangeability by proposing that complexity exists in the preceding sentence, which introduces two antecedents. Krifka's theory makes an interesting prediction: every syntactic constituent that conveys a propositional meaning should introduce a discourse referent that can be picked up by a polar particle. It seems that this prediction is vindicated by (21). Any of C's responses are possible.

(21) A finds B and C arguing about whether John is home, and decides to add her two cents.
A: I know Mary believes John is home.

a. C: No, he isn't.
b. C: No, she doesn't.
c. C: No, you don't.

The responses in (21a)-(21c) are clearly acceptable, and it is clear that *no* does not mean something other than what is expressed in each following clause.[11] Krifka's theory straightforwardly accounts for these interpretations.

In R&F's terms, each of the responses in (21) has the feature bundle [REVERSE, −]. For the presupposition of the [REVERSE] feature to be met in each response, it has to be assumed that each embedded propositional constituent introduces an antecedent, just as in Krifka's account. Given that this assumption has to be made for R&F's account to work, and that other propositional anaphora like *that* are sensitive to propositional antecedents embedded under negation, e.g. (5) and (6), it is no longer clear why we need to posit two different types of features to account for interchangeability in first place. We might just as well analyze interchangeability by assuming simpler meanings for polar particles which pick up antecedents either from matrix or embedded propositional constituents, following Krifka's approach.

In section 8, we will return to this point, by providing evidence that demonstrates that antecedent utterances in fact introduce even more propositional discourse referents than noticed before. Once it is clear that we have to assume that *yes* and *no* can pick up a multiplicity of antecedents, an account that captures the interchangeability of *yes* and *no* with a single meaning for each such as Krifka's account—without the featural ambiguity assumed in R&F's (and Pope's) account—seems more attractive.

2.4 Summary of questions arising from previous research

Below is a list of empirical questions arising from the reviewed literature, which the experimental results reported below will address:

[11] While it is atypical for someone to claim that an interlocutor's knowledge assertion is false, it is nevertheless possible to imagine a felicitous use of (21c).

1. Are English *yes* and *no* indeed non-interchangeable in response to positive polar questions, and interchangeable in response to negative polar questions?

2. Which particles do speakers prefer to use when giving a response with negative polarity? With positive polarity? How are bare polar particle responses interpreted?

3. If the negative sentence that the polar particle responds to is itself responding to a negative sentence, are preference patterns affected, and in particular is *yes* now more acceptably interpreted as a negative response, e.g. "she didn't"?

4. Does a special intonation appear on positive *yes*/*no* responses to negative YNQs? If so, can it affect the interpretation of bare particles?

Previous experimental work in the form of "pen and paper" surveys by Brasoveanu et al. (2013) and Kramer & Rawlins (2012) (discussed in Roelofsen & Farkas (2015)) suggests that the answer to the questions in 1 is yes and yes. Regarding question 2, Brasoveanu et al. found that *no* was preferred over *yes* when giving an agreeing response with a negative sentence, e.g. "No, she didn't." Our naturalness rating results below confirm these findings. Moreover, Kramer & Rawlins (2012) find that bare polar particles are more likely interpreted as agreements with negative sentences, e.g. "she didn't." Within disagreeing responses, e.g. "she did," bare *no* is more readily interpreted this way than bare *yes*.

Our results will partially replicate these findings, but also show that it is crucial to control for intonation when exploring these questions. A running theme in prior work is that at some point in the analysis, reference is made to the role of intonation in interpreting responses to YNQs, but often without committing to a precise characterization of the contours involved. In the following section we discuss the background and suggest one intonational contour which might be particularly relevant. For the first time, our experiments will provide experimental evidence to help resolve question 4.

3 The contradiction contour

We are particularly interested in the role that intonation plays in the interpretation of polar particles. Before running the experiments reported below, our intuition was that a rising tune, the contradiction contour (Liberman & Sag, 1974), would sometimes appear on polar particles that indicate a positive response to a negative question, but not on particles indicating a negative response to a negative question. It turns out that we are not alone in this intuition. Pope (1972, p. 147, ex. (73R2)) identifies a rise-fall-rise tune across the entire utterance of *yes, he is* in response to a negative sentence that we think is the contradiction contour, though she did not identify the intonation as having the meaning that Liberman & Sag propose. If the contradiction contour does have this distribution in yes-no responses, then its presence in ambiguous bare particle responses to negative questions could influence hearer interpretation in a perception task. We will see that our production experiments verify the existence of such an intonation, and our perception experiment demonstrates that the intonation has such an interpretational effect.

Liberman & Sag (pg. 421) write, "This contour is appropriate (although of course optional) just when the speaker is using the utterance that bears it to contradict—he may contradict what has just been said by another, he may contradict some assumption or implication of what has been said or done by another, or he may contradict himself." (22) exhibits a common use of the CC.[12] The image in Figure 2 is a pitch track of B's utterance as produced by a participant made using Praat (Boersma & Weenink, 2016).

(22) A: You're not a friend of Jenny's.
B: No (CC). I'm a friend of Jenny's (CC).

According to Ladd (1980), the CC is a high-falling tone, followed by a low-rise pitch accent on the nuclear or main stress of the sentence. We note that the initial rise is more

[12] "(CC)" following an utterance indicates that the utterance bears a CC tune. There are two CCs in (22). Recordings of numbered examples where intonation is crucial, starting with example (22), can be found at `http://semanticsarchive.net/Archive/GU4M2ZhN/`.

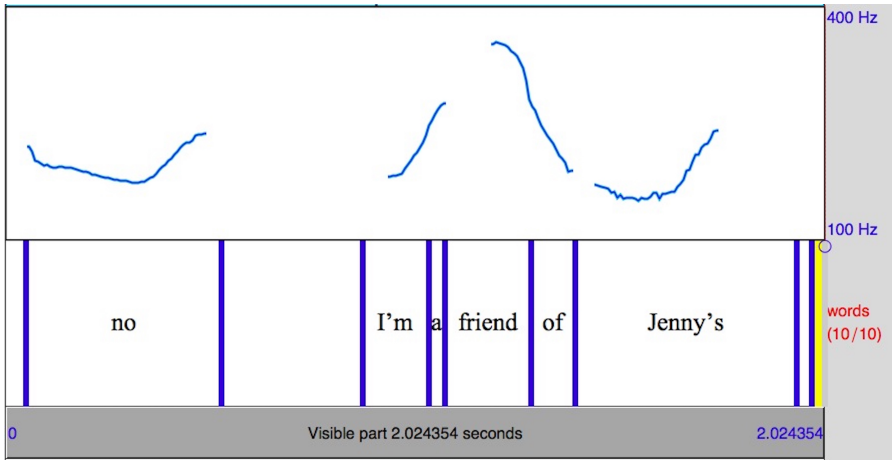

Figure 2: A visual representation of B's utterance in (22).

reliably present when there is more material preceding the nuclear accent. Pierrehumbert & Hirschberg (1990) transcribe the CC in ToBI as L* L-H%, while Constant (2012) transcribes it as L*(+H) L-H%. However, these transcriptions do not accurately capture Ladd's description in that the CC necessarily starts high before reaching the low pitch accent. Thus, we believe a more accurate ToBI transcription might be H+L* L-H%.

Since the CC rises, falls and rises, it can be hard to distinguish from the rise-fall-rise contour (RFR), usually transcribed as L*+H L-H%, when sentence prominence is shifted to the initial position as under subject focus. In fact, Liberman & Sag argue that they are one in the same contour. Ladd (1980) argues that this is not the case. We demonstrate that the CC and the RFR are distinct both phonetically and semantically with the following examples.

(23) A: Jane doesn't like movies.
  a. B: Jane likes movies (CC).
  b. B: JANE likes movies (RFR).

(23a) has the CC with the nuclear stress falling on the object. (23b) has the RFR with subject focus shifting nuclear stress to the subject. The two sound very similar, but only in this particular case where the CC has object prominence while the RFR has subject

prominence and the subject is monosyllabic (cf. Ladd, 1980). If we replace the name *Jane* with a polysyllabic name with stress at least three syllables in, like *Alvarado*, then the phonetic forms of the two contours clearly become distinct.

(24) A: Alvarado doesn't like movies.
   a. B: Alvarado likes movies (CC).
   b. B: ALVARADO likes movies (RFR).

Whereas the contour in (24a) rises and falls utterance initially, in (24b) the contour does not start rising until the third syllable *ra*. This is because RFR locates its initial rise on the stressed syllable of the focussed constituent, whereas the CC has a rise fall preceding the low pitch accent which aligns with the nuclear stress.

The two contours can be seen to be semantically distinct by comparing the asymmetrical intuitions between (24) and (25).

(25) A: Who do we know who likes movies?
   a. B: # Alvarado likes movies (CC).
   b. B: ALVARADO likes movies (RFR).

The meaning of the CC as described by Liberman & Sag requires some element of contradiction. This requirement is clearly met in (24), but not in (25), which is why (24a) is intuitively felicitous while (25a) is not. While the RFR is compatible with contradiction (i.e. (24b) is felicitous), contradiction is not a core part of the RFR's felicity conditions (i.e. (25b) is also felicitous). Ward & Hirschberg (1985) have described RFR as implicating uncertainty relative to some scale. Constant (2012) has argued that RFR indicates that focus alternatives to the present utterance cannot safely be claimed, while Wagner (2012) has argued that it indicates that an alternative utterance is possible. We will not try to settle the meaning of the RFR here. The point is just that, whichever characterization of the meaning of the RFR is correct, it is clearly felicitous in both (24) and (25), whereas the felicity conditions of

the CC are only met in (24), demonstrating that the two are distinct contours with distinct meanings, with only the CC requiring contradiction.

Defining the notion of "contradict" in the quote from Liberman & Sag (1974) above is not trivial, as is anticipated by Liberman & Sag, who allow for contradictions of implications of both verbal and non-verbal actions. If we were to define a contradiction as two assertions in a discourse that aim to add mutually exclusive propositions to the common ground, then we would not predict the use of the contradiction contour in responses to YNQs, e.g. in (26).

(26) It's been a busy day at work. You have ten clients to meet with before your boss gives a presentation at 4 pm that everyone is expected to attend. You are intent on going to the presentation because you have an important question to raise. In your haste to meet with all ten of your clients, you completely lose track of time. Your coworker Thomas knocks at your door. You look at the clock which reads 4:07 pm and you realize you are late for the presentation. Thomas asks:
A: Are you not coming to the presentation? [A's expectation: you are not]
B: No (CC). I'm coming to the presentation (CC).

The apparent antecedent of the CC is not a prior assertion, but the information provided by the context and the question, which at best imply the negative response. E.g. Büring & Gunlogson (2000) (and more recently Krifka (2013a)) argue that negative YNQs implicate that there is contextual evidence for the negative response. Trinh (2014) argues that such YNQs presuppose this contextual evidence. A weaker notion of contradiction is needed.

One possible analysis is that an utterance of p(CC) requires a propositional discourse referent anchored to $\neg p$, and thus involves a propositional anaphor similar to polar particles under Krifka's (2013b) analysis. Analyses of intonational tunes involving propositional anaphora have been proposed in Bartels (1999) and Truckenbrodt (2011). But such an analysis would miss an important difference between polar particles and the CC.

(27) [Like in (26), A has reason to suspect that B is not coming to the presentation, but the context leaves open whether or not B is in fact coming.]
A: Are you coming to the presentation? [A's expectation: you are not]

a. B: I'm coming to the presentation (CC).
b. B: Yes, I am
c. B: No, I'm not
d. B: # Yes, I'm not
e. B: # No, I am

The judgments in (27b) through (27e) are exactly as expected given Krifka's theory of polar particles: Since A asks a positive YNQ, only one discourse referent, *that B is coming to the presentation*, is available for *yes* and *no* to pick up, producing (27b) and (27c). Crucially, there is no discourse referent for the proposition *that B is not coming to the presentation*, hence (27d) and (27e) are unavailable. Note however, that using the CC on a positive response is perfectly acceptable here, e.g. (27a). An analysis that posits a propositional anaphor as part of the meaning of the CC creates the following puzzle then: Why is a negative discourse referent available to the CC, but not the polar particles?

To explain how the CC is licensed, we will make use of the notion of *contextual evidence* introduced by Büring & Gunlogson (2000) for constraints on polar questions. We propose that the CC requires contextually salient evidence against the asserted proposition. We can model evidence as follows:

(28) *Contextual Evidence*: Evidence for p is a change in the context that increases the likelihood that p is true.

As Büring & Gunlogson note, contextual evidence needs to be publicly available. We further note that contextual evidence can come from any kind of perceptual experience or from interlocutors' actions, including speech acts. Moreover, contextual evidence does not necessarily affect the speaker's (private) expectations about p. For example, the contextual evidence for p in (29a) and (29b) does not seem to affect S's commitment to $\neg p$:

(29) a. S is an experienced animal tracker who knows that mountain lions no longer live in these parts. S sees some mountain lion scat, and says to herself.
S: There aren't any mountain lions around here (CC).
b. H: There are mountain lions around here.
S: There aren't any mountain lions around here (CC).

Using p as a label for the proposition that *there are mountain lions around here*, we take (29a) and (29b) to both be contexts in which there is contextual evidence for p by our definition in (28). In (29a) evidence for p is in the form of S's perception of scat (combined with S's expertise and assumptions), and in (29b) the evidence for p is in the form of H's assertion of p. In both cases S asserts $\neg p$ despite the evidence for p. This presumably means that S's beliefs or epistemic state has not been altered with respect to p by the new evidence. So, while evidence for p increases the likelihood that p is true, it needn't necessarily cause S to change her own expectations about the likelihood of p.

This notion of evidence can be motivated based on broad principles of question answering. Suppose that questions denote sets of alternative propositions (Hamblin, 1973). Then we can characterize a necessary condition on responses to questions as follows:

(30) *Answer Constraint*: A response to a question has to be a discourse contribution that provides evidence for or against one or more of the propositions denoted by the question.

This answer constraint is broad enough to be compatible even with very indirect responses to questions, which seems desirable:[13]

(31) A: Who will come to the reading group meeting today?
B: Jane's mother is in town.
$\rightsquigarrow$ Jane is unlikely to come to the meeting.

While B does not respond directly to A's question, it is nevertheless a valid response since, when combined with world knowledge about visiting mothers, it provides evidence for the proposition that *Jane will not come to the meeting* by our definition of evidence in (28).

[13](30) may be related to question-answer congruence, however this latter notion has usually been formulated in stricter terms to constrain the range of possible responses further for independent reasons (cf. Groenendijk & Stokhof, 1984; Rooth, 1992). We note that the strong conditions often proposed to explain prosodic QA-congruence might be unnecessarily strict (cf. discussion in Wagner, 2005). Conditions on QA-congruence will hopefully follow from some more general pragmatic principle, which will have as a corollary the condition in (30).

Since this proposition is the negation of an answer to A's question, B's response counts as providing evidence against an answer, and (30) is met.

The notion of contextual evidence in (28) is further motivated by its use in Büring & Gunlogson (2000) and Trinh (2014) to state generalizations about the felicity of different types of questions:

(32) a. rising declaratives: Require contextual evidence for p.
b. low negation YNQs: Require contextual evidence for $\neg p$.[14]

We use the notion of contextual evidence to formulate the meaning of the CC:[15]

(33) $[\![CC]\!]^c = \lambda p_{\langle s,t\rangle}$: There is evidence for $\neg p$ in C. p

The denotation in (33) treats the CC as a partial identity function. It is the tension between presupposing contextual evidence against p and being true iff p is true that creates the signal of disagreement that the CC is known for.[16] Both the CC on our analysis and polar particles on Krifka's are dependent on previous context, but they differ in that polar particles require a discourse referent denoting a certain proposition, while the CC merely requires contextual evidence for a certain proposition.

[14]Importantly, *evidence* and *bias* should not be confounded. High negation YNQs require a previous commitment to p (i.e. Romero & Han's 2004 positive bias), but they also seem to frequently require evidence for $\neg p$.

[15]Portes & Reyle (2014) provide a QUD account of French "implication" contour (IRF), which the authors claim primarily encodes a contradiction. Therefore, one might wonder whether such an account could also be applied to the CC. Note however that there are empirical differences in the distributions of the two contours. E.g. Portes & Reyle's example (3), in which IRF is acceptable, would be unacceptable with the CC in English, but acceptable with a contrastive accent on *curtains*:

(i) A: There aren't any shutters here.
a. B: # Yeah (CC). There are curtains (CC).
b. B: Yeah (Contrastive). There are CURtains (Contrastive).

Therefore, IRF may be more similar to English contrastive accents than to the CC.

[16]As Ladd (1980) notes, the CC cannot be embedded. This suggests that the CC might actually be an operator over speech acts, similar to Wagner's (2012) proposal for the RFR contour. Another possibility is that the CC contributes a conventional implicature, as in the analysis of expressive meaning in Potts (2005).

4 Production Experiments

Now that we have discussed the theoretical backgrounds of the two main linguistic phenomena under consideration, polar particles and intonation (in particular, the contradiction contour), we will describe and discuss the results of five separate experiments: (i) A production experiment that gathers intonations and naturalness ratings for the polar particles *yes* and *no* in response to both positive and negative polar questions (YNQs) in which inversion has taken place and the auxiliary is fronted (section 4.1); (ii) A production experiment testing *yeah* and *no* in response to negative rising declaratives, that is, questions with declarative word order that have a rising intonation typically associated with YNQs (Gunlogson, 2001; Nilsenovà, 2006) (section 4.2); (iii) A perception experiment that tests participants' interpretations of bare *yes*/*no* responses to negative YNQs, controlling for intonation (section 5); (iv) & (v) constitute two rating experiments that are intended to rule out alternative interpretations of our results, and to increase comparability to the results in Meijer et al. (2015) (section 6). These experiments received ethics approval from the McGill Research Ethics Board under file number 401-0409. Overall, the results of these experiments contribute toward answers to the empirical questions arising from theoretical research discussed in section 2.4.

4.1 Experiment (i): Responses to positive and negative YNQs

4.1.1 Methods

The methods of production experiments (i) and (ii) are similar, so we describe those for (i) in detail here, and we will note the differences between them in section 4.2. Each trial involved a silently read context story similar to the one in (26), followed by a dialogue between a pre-recorded questioner and the participant. Experiment (i) had three factors: QUESTION, whether the questioner asked a positive or a negative question; PARTICLE, whether the participant used the polar particle *yes* or *no*; and ANSWER, whether the participant gave a

positive answer (*yes/no, I am*) or a negative answer (*yes/no, I'm not*).

Each level of the factor ANSWER required a different context story. A story that sets up a positive answer (e.g. *yes/no, I'm coming to the presentation*) was illustrated in (26). The context in (34) exemplifies a set-up for a negative answer:

(34) It's been a busy day at work. You have ten clients to meet with before your boss gives a presentation at 4 pm that everyone is expected to attend. You've been to hundreds of your boss's presentations, and you think they are boring and keep you from doing important work. You plan to meet with your clients, and if you can't finish meeting with all ten by 4 pm, then you'll just have to miss the presentation since clients come first. Your coworker Thomas knocks at your door at 4:07 pm. He asks:
A: Are you not coming to the presentation? (A's expectation: you are not)
B: No ___ I'm not coming to the presentation

Both contexts were designed to make contextual evidence for the negative response salient. When a negative polar question was used, it reinforced the contextual evidence, at least if the analysis of negative polar questions in (32b) is correct.[17] There were eight context pairs total (eight items). Responses were always complete sentences, but we will refer to them as "(Yes/No) I am" and "(Yes/No) I'm not" for brevity. We instructed participants to pause at "___" to maximize unique intonations on polar particles themselves. This made annotations of intonations easier, and also enabled us to use participants' polar particle productions in the perception experiment. Participants were not made aware that the experiment was about intonation.

After recording each trial, we asked for the participant's naturalness judgments: "Please indicate how natural this response seems on a scale of 1 to 5 (1=least natural, and 5=most natural)."

The three factors were crossed, $2 \times 2 \times 2$, making eight conditions. Each participant saw each condition for each item in eight randomly ordered blocks of trials with one con-

[17] A NELS reviewer notes "...that in recent work [Trinh (2014)] has argued that positive polar questions are incongruent with contextual evidence towards not-phi." While Trinh's examples seem to support this claim, we believe that positive YNQs are acceptable in our experimental contexts which feature contextual evidence toward not-phi. Further work on the licensing conditions of positive YNQs is needed.

dition from each item. If need be, this enables a latin-square analysis by looking at only the first quarter of trials. We ran 30 native speakers of North American English (mostly McGill undergraduates), but had to exclude 7 due to technical difficulties, making for 1,472 observations total.

To facilitate analysis, we split the results between the levels of the factor QUESTION. I.e., we analyzed the results of responses to negative questions and positive questions separately, each as a 2×2 design with the two factors PARTICLE and ANSWER.

4.1.2 Naturalness Results

First we examine participants' naturalness ratings of the responses they were asked to say.

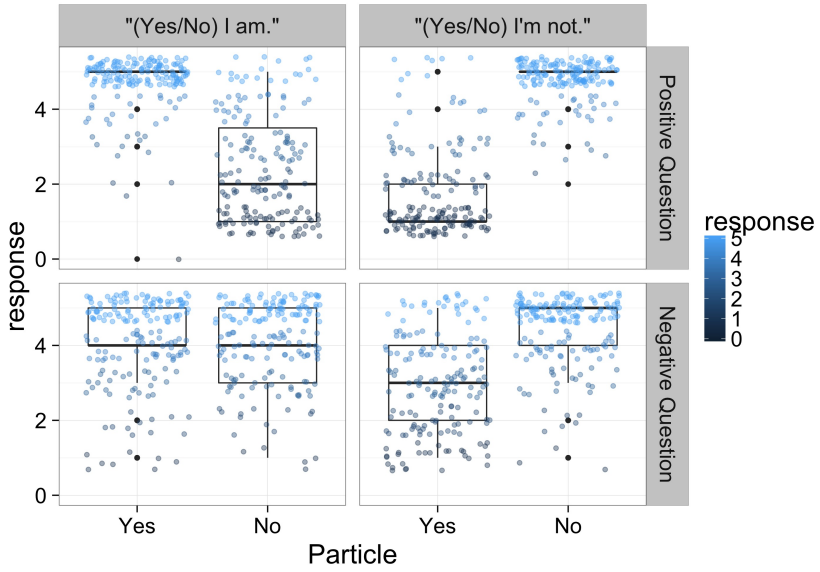

Figure 3: Naturalness ratings for responses to experiment (i).

The top half of the plot in Figure 3 shows how participants rated *yes*/*no* responses to positive YNQs. As expected, when indicating a positive response to a positive YNQ, *yes* is rated as highly natural and *no* is rated as unnatural, and vice-versa in negative responses. *Yes* and *no* are therefore indeed not interchangeable in response to positive YNQs, although *No, I am* is rated as somewhat more natural than *Yes, I'm not*.

The bottom row shows how participants rated responses to negative YNQs. As suggested in response to question 1 in section 2.4, we observe that both *yes* and *no* are overall acceptable in both positive and negative responses, indicating a high degree of interchangeability of the particles when used in response to negative questions. We fitted a cumulative link mixed model regression for responses to negative questions, with random intercepts and slopes for participant and item. We found a significant main effect of ANSWER, a significant main effect of PARTICLE, and a significant interaction (see Table 1).

	β	SE
Particle	-1.27	$(0.15)^{***}$
AnswerPolarity	0.57	$(0.15)^{***}$
Particle:AnswerPolarity	2.59	$(0.30)^{***}$

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 1: Cumulative link mixed model for naturalness ratings in response to negative YNQs

The interaction, which is the largest effect, is due to the fact that in positive answers, both *yes* and *no* are equally acceptable, while in negative answers, *yes* is rated as significantly less natural than *no*. The two main effects reveal that *no* responses are rated more natural than *yes* responses, and positive responses are rated more natural than negative responses. These effects are driven by the fact that *no* is more acceptable than *yes* when the answer polarity is negative. *Yes* is not less acceptable than *no* in general.

How do the theories of polar particles proposed in Krifka (2013b) and Roelofsen & Farkas (2015, R&F) compare in light of these results?[18] The main result of our naturalness ratings is that *no* is more natural when agreeing with a negative question than *yes*. Both theories capture this result. According to R&F, *no* is more natural when agreeing than *yes* because the features spelled out are [AGREE, $-$], the latter is more marked than the former meaning its realization needs are higher, and *no* meets that need by realizing [$-$]. For Krifka, *no* is more natural than *yes* in agreeing responses because it picks up the most salient discourse

[18]Holmberg (2016) is left out here since the theory doesn't make strong predictions about naturalness ratings beyond predicting interchangeability in response to negative YNQs.

referent, the positive one, and negates it, while *yes* incurs a violation for picking up the less salient negative discourse referent.

One prediction of Krifka's that is not borne out in this data is that *no, I am* responses are predicted to be the least natural (see the OT tableau in Figure 1). This does not match our participants' judgments. R&F predict *yes* and *no* to be equally natural when indicating a positive response to a negative YNQ, and they predict *no* to be more natural than *yes* when indicating a negative agreeing response, which does seem to match our participants' judgments. We will return to different predictions about preferences when interpreting the results of our perception experiment below.

4.1.3 Intonation results

The recorded responses were annotated for intonational contour by an RA. A contour can appear on *yes* and *no* themselves, on the sentence following them, or across both. We therefore annotated contours on polar particles and their following sentences separately, using three intonational categories (declarative fall, contradiction contour (CC), and rise fall). Intonations were marked "unclear/other" if it did not fit any of these categories, and "problematic" in case of disfluencies, recording errors, etc. Polar particles were marked as "none" when the participant produced a single contour over the whole utterance.

Cooper & Ginzburg (2011) have claimed that when *no* is used to convey a positive response to a negative YNQ, it will bear a distinct rise fall tune. We believe that our rise fall category overlaps with their observation, though we found that rise falls appear negligibly on polar particles themselves in responses to negative YNQs (3 observations total (.2%), 1 on *no* meaning *I'm not*, 1 each on *yes* and *no* meaning *I am*), and when they appear on the following sentences, it is roughly the same amount of the time in both positive and negative responses (25 observations on positive responses (8%), 13 on sentences following *yes*, and 18 observations on negative responses (5%), 7 on sentences following *yes*). Moreover, we think this category has some overlap with what Roelofsen & Farkas (2015) call "stress," though

from personal correspondence, loudness (intensity), and not intonation, may be the defining characteristic of their category. In the literature on intonational meaning, our category rise fall can likely be identified with VERUM focus (Höhle, 1992; Richter, 1993; Romero & Han, 2004; Gutzmann & Castroviejo Miró, 2011). This would explain why rise falls are felicitous in both positive and negative responses to negative YNQs, since VERUM can emphasize the truth of an assertion regardless of whether it has the same or opposite polarity of the question. We will not discuss rise fall further here due to its rare use and roughly equal distribution across conditions.

Counts and percentages of intonations used in response to both positive and negative YNQs are summarized in Table 2.[19]

Contour	n contours on particles	n contours on sentences
Declarative Fall	1137 (77%)	1022 (69%)
Contradiction Contour (CC)	150 (10%)	241 (16%)
Other/Unclear	23 (2%)	140 (10%)
None	98 (7%)	n/a
Problematic	64 (4%)	69 (5%)

Table 2: Annotation counts and percentages

A first observation based on the overall distribution summarized in Table 2 is that the contour used most often when speakers didn't use the declarative contour was the contradiction contour. This suggests that the CC is indeed the most important intonational tune other than the declarative tune in responses to polar questions. Figure 4 below shows the proportion of CC produced by participants on particles (top panel) or the following sentences (bottom panel) depending on the particle used (*yes* vs. *no*). Positive sentence answers are in red, negative in blue. For instance, CC was produced in 47% of trials in which positive sentences followed the particle *no*, but only in 1% of trials in which negative sentences followed the particle *no*.

[19] A category for question rises was included in the annotation, but was only used 3 times total. Question rise and rise fall annotations are included in the "other/unclear" row of Table 2.

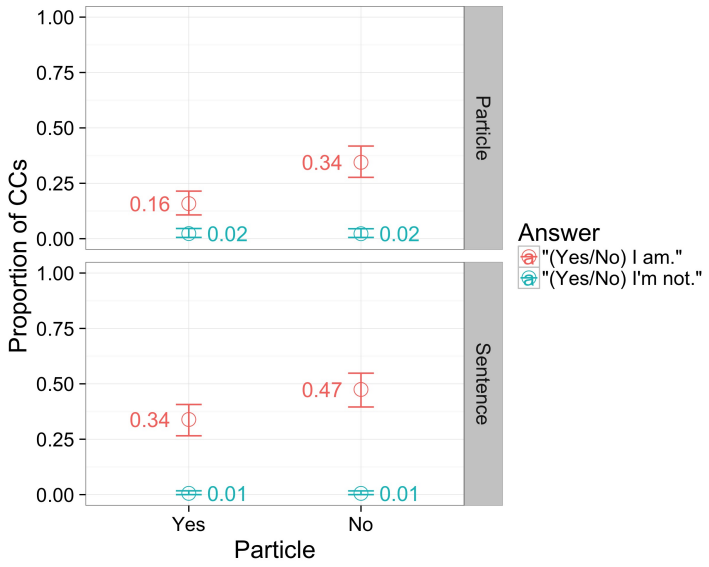

Figure 4: Negative YNQ: "Are you not coming to the presentation?" (experiment (i)).

We fitted a mixed effects logistic regression with random intercepts and slopes for participant and item (for discussion on the advantages of mixed effects regressions, see Baayen, 2008; Barr et al., 2013; Jaeger, 2008). The dependent variable was whether or not the CC was produced. We used Helmert coding to code two contrasts. The first is between positive and negative responses (ANSWER), and the second compares *yes* vs. *no* within the positive responses. We didn't test whether PARTICLE had an effect in negative responses since negligible amounts of CC were produced in negative responses (see data points in blue in Figure 4). We found that there is a significant effect of answer polarity in that a special intonation appears exclusively on positive *yes* and *no* responses to negative YNQs and their following sentences (see Table 3). Therefore, question 4 from section 2.4, "Does a special intonation appear on positive *yes*/*no* responses to negative YNQs?", is answered: yes, the CC, appears on positive *yes*/*no* responses to negative YNQs. This result confirms theoretical accounts in which all authors predict some sort of special intonation to appear only in positive responses to negative sentences. However, our result is surprising since no author predicted the intonation to be the rising contradiction contour. This is significant since, now that we know that this intonation plays a crucial role in these contexts, we can test experimentally

whether it has a significant impact on the interpretation of bare polar particles (discussed in section 5).

We also found a significant effect of the choice of particle: the CC was more likely on *no* particles and their following sentences (see Table 3) than on *yes particles*, which is not predicted by any of the existing accounts. One possible explanation is that *no* is generally more likely to be used in disagreements than *yes*, and therefore is more likely to appear with the CC. This correlation affects speakers' choices even in cases where in principle the CC would be licensed on *yes*.

	β	SE
(Intercept)	1.70	$(0.42)^{***}$
noPos.vs.yesPos	-1.21	$(0.44)^{**}$
negSent.vs.posSent	4.20	$(0.28)^{***}$

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 3: Logistic regression mixed model for intonation annotations in responses to negative YNQs

The preceding results could be taken to show one of two things. Either the CC requires a linguistic antecedent with opposite polarity, or it merely requires contextual evidence for that proposition, as we claimed in section 3. We can determine which is the case by looking at responses to positive YNQs in contexts that supply evidence for the negative answer before the question is asked. If the former view is correct, then the contextual evidence shouldn't matter and the CC should only appear on negative responses. If the latter is correct, then the polarity of the YNQ shouldn't matter and the CC should appear on positive responses. The results in Figure 5 support the latter conclusion.

We found that there is a significant effect of answer polarity in that the CC appears exclusively on positive *yes*/*no* responses to positive YNQs and their following sentences (see Table 4). The evidence for the negative answer provided by the context sufficed to license the CC, even if at a lower rate than in response to negative YNQs. In previous theoretical research on polar particle responses, researchers do not consider the possibility of special

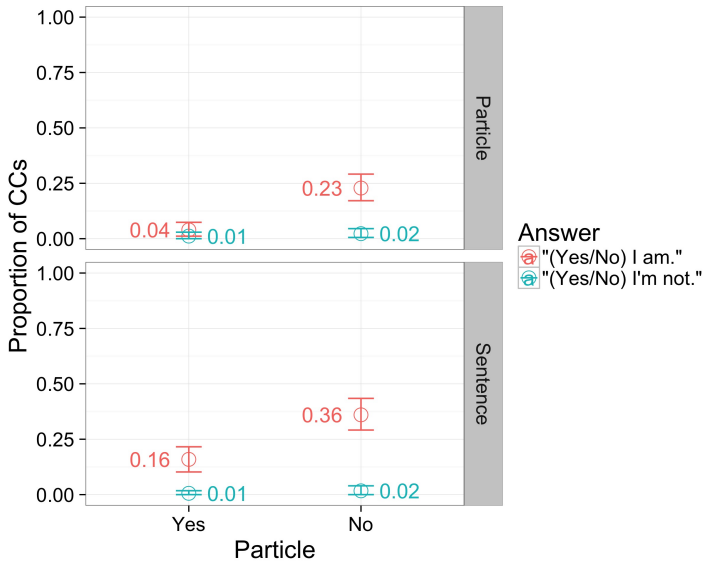

Figure 5: Positive YNQ: "Are you coming to the presentation?" (experiment (i)).

"reverse" prosody appearing in responses to positive YNQs. We demonstrate here that an intonation like the CC is not reserved just for identifying positive polar particle responses to negative YNQs, but that it is sensitive more generally to contextual evidence for a proposition that is opposite from the proposition that the speaker asserts.

	β	SE
(Intercept)	2.70	$(0.51)^{***}$
noPos.vs.yesPos	-1.91	$(0.36)^{***}$
negSent.vs.posSent	3.57	$(0.32)^{***}$

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 4: Logistic regression mixed model for intonation annotations in responses to positive YNQs

4.2 Experiment (ii): Responses to negative rising declaratives

4.2.1 Methods

Experiment (ii) tested responses to negative rising declaratives, e.g. *You're not coming to the presentation?*, instead of negative YNQs as in experiment (i). Moreover, instead of using

yes, *yeah* was used. Otherwise, the design was the same, crossing the two two-level factors, PARTICLE and ANSWER, 2×2. There were six items and four conditions.[20] There were 22 participants, all native speakers of North American English, who were mostly undergraduate students. There were hence 528 observations total. The trials were pseudo-randomized so that participants never saw the same condition twice in a row, and trials from the same item were organized into different blocks to maximize their distance.

4.2.2 Naturalness Results

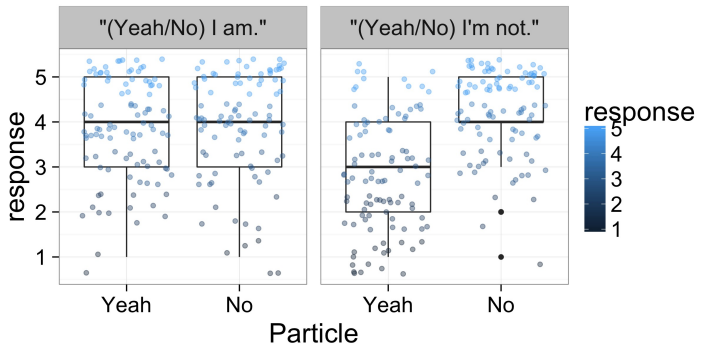

Figure 6: Naturalness ratings for responses to negative rising declaratives (experiment (ii)).

Figure 6 shows how participants rated *yeah*/*no* responses to negative rising declaratives in experiment (ii). The results replicate the pattern from experiment (i) (bottom half of Figure 3). *Yeah* and *no* appear to be interchangeable when giving a positive response to a negative question. While *no* is highly acceptable as a negative response, *yeah* is less acceptable. We fitted a cumulative link mixed model regression for responses to negative rising declaratives, with random intercepts and slopes for participant and item. We found a significant main effect of ANSWER, a significant main effect of PARTICLE, and a significant interaction (see Table 5). As in experiment (i), we believe that the interaction effect is of primary interest.

[20] In fact, there were six conditions, four test-conditions with negative rising declaratives, and two additional conditions testing responses to positive YNQs. In these two latter conditions in experiment (ii), we did not fully cross the two factors, PARTICLE and ANSWER, since we took it as given that *yes, I'm not* and *no, I am* are infelicitous in response to a positive YNQ. We will only report on the subset of the data with

	β	SE
Particle	−1.26	(0.20)***
AnswerPolarity	0.66	(0.19)***
Particle:AnswerPolarity	2.21	(0.39)***

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 5: Cumulative link mixed model for naturalness ratings in response to negative rising declaratives

We used *yeah* in experiment (ii) because we had the intuition that it would be more acceptable in negative, agreeing responses. Roelofsen & Farkas report this same intuition in a footnote, and suggested more empirical work is needed. We were therefore surprised that negative agreeing responses were dispreferred with *yeah* in this experiment, just like *yes* was in experiment (i). It is an open question whether systematically varying *yes* and *yeah* in the same experiment might nevertheless produce preferences for the latter in the negative response level of the ANSWER condition.

We ran a follow up experiment to experiment (ii) with the exact same design, except that participants were only asked to produce the particles *yeah* and *no* themselves, with stage directions indicating the meaning of the response. E.g. if the question was "You're not coming to the presentation?", the participant might have been given the following as their response: Yeah (You want to convey: I'm coming to the presentation). There were 33 participants. Naturalness ratings can be seen in Figure 7.

The qualitative pattern of the naturalness ratings are somewhat different from those of experiments (i) and (ii). Negative *yeah* responses are still rated as less natural than negative *no* responses, however now positive responses appear to be less natural than negative responses in general. We fitted a cumulative link mixed model regression for responses to negative rising declaratives, with random intercepts and slopes for participant and item. There is a main effect of answer polarity in this experiment (see Table 6). Therefore, the answer to question 2 from section 2.4, "Which particles do speakers prefer to use when

negative rising declaratives, since experiment (i) captures responses to positive YNQs more fully.

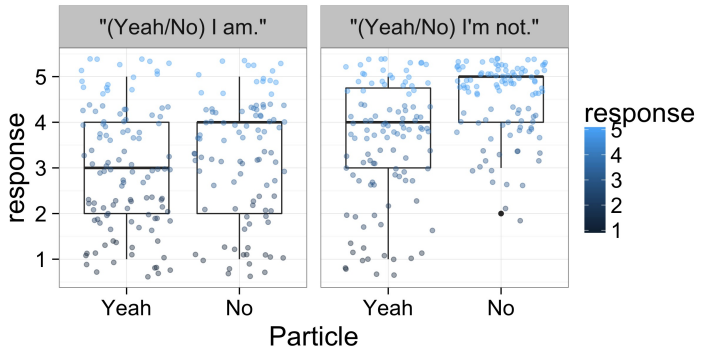

Figure 7: Naturalness ratings for bare particle responses to negative rising declaratives.

giving a response with positive polarity?", is somewhat different for bare particle responses: speakers don't really like giving bare particle responses *at all* when conveying a positive response to a negative YNQ.

	β	SE
Particle	-1.28	$(0.14)^{***}$
AnswerPolarity	-1.40	$(0.14)^{***}$
Particle:AnswerPolarity	1.50	$(0.27)^{***}$

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 6: Cumulative link mixed model for naturalness ratings of bare particles in response to negative rising declaratives

Both Krifka and Roelofsen & Farkas predict this result in that both predict that positive sentence polar particle responses to negative utterances require overt following sentences, and that such responses are less natural with bare particles. Holmberg predicts bare *yeah* to be less natural when conveying a positive response since it requires an unelided elliptical clause to change the polarity from negative to positive. However, the correspondingly low rating of bare *no* indicating a positive response is not predicted by Holmberg. Interestingly, the results of the perception experiment in section 5 below will not be the same as these naturalness ratings by our speakers. That is, the way hearers interpret bare particles differs from the preferences suggested by the ratings observed in production.

4.2.3 Intonation Results

The intonational results of experiment (ii) can be seen in Figure 8.

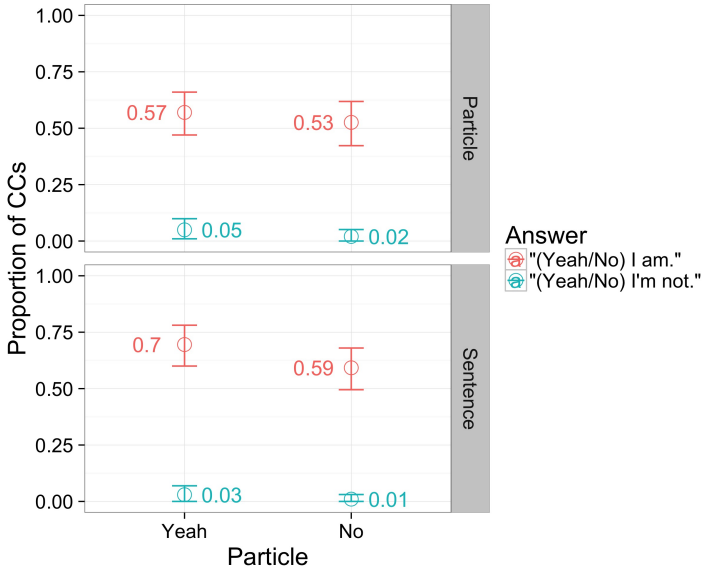

Figure 8: Negative rising declarative: "You're not coming to the presentation?" (experiment (ii)).

Again, we fitted a logistic regression mixed model, with random intercepts and slopes for participant and item, and again we found that there is a significant effect of answer polarity in that a special intonation appears exclusively on positive *yeah* and *no* responses to negative YNQs and their following sentences (see Table 7).

	β SE
(Intercept)	0.37 (0.45)
noPos.vs.yesPos	0.53 (0.69)
negSent.vs.posSent	5.75 (0.43)***

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 7: Logistic regression mixed model for intonation annotations in responses to negative rising declaratives

This result replicates those of experiment (i) with two relevant differences. First, the overall proportion of CC responses appears to be higher. One possible reason for this that

seems intuitively plausible is that a speaker who uses a negative rising declarative suggests more strongly that the available evidence supports $\neg p$ than one who uses a negative YNQ. The expression of stronger evidence for $\neg p$ may more frequently license the use of an intonation reserved for disagreement (i.e. the CC) by an interlocutor who wants to assert p. This result may therefore be taken to show that a theory of the evidence required to license different kinds of negative questions should predict that negative rising declaratives require more or stronger evidence for $\neg p$ than negative YNQs, which means that a questioner using a rising declarative conveys that they believe the evidence to be quite strong. Cf. Trinh (2014), who predicts that negative rising declaratives and negative YNQs require exactly the same amount of evidence for $\neg p$.

The second difference between the results of experiment (ii) and experiment (i) is that the particle used has no effect on the rate at which the CC was observed in experiment (ii) (see Table 7), whereas in experiment (i) there was an effect of particle with more CC observations in *no* responses. One possible reason is that experiment (ii) used *yeah* whereas *yes* was used in experiment (i). For a reason that remains unknown, it may be the case that *yeah* more readily admits CC intonation than *yes*.

4.3 Summary of Production Results

To recap, the results of production experiments (i) and (ii) shed light on several of our research questions from section 2.4: Question 1, "Are English yes and no indeed non-interchangeable in response to positive polar questions, and interchangeable in response to negative polar questions?" The answer to these questions is yes, confirming the results of earlier work by Brasoveanu et al. (2013) and Kramer & Rawlins (2012).

Question 2, "Which particles do speakers prefer to use when giving a response with negative polarity? With positive polarity? How are bare polar particle responses interpreted?" Our participants prefer to use *no* to convey a negative polarity response to a negative YNQ, which is predicted by both Krifka (2013b) and Roelofsen & Farkas (2015). Our participants

are equally happy using *yes* or *no* to convey a positive polarity response, which is predicted by Roelofsen & Farkas (2015), but not by Krifka (2013b). Data on how bare particle responses are interpreted will be explored in the next section, however we did find that speakers dis-prefer using bare particles to convey a positive response, which is predicted by both Krifka (2013b) and Roelofsen & Farkas (2015), and which is predicted for *yes*/*yeah*, but not for *no*, by Holmberg (2016).

Question 4, "Does a special intonation appear on positive yes/no responses to negative YNQs? If so, can it affect the interpretation of bare particles?" We found that there is a special intonation used on positive yes/no responses to negative YNQs, confirming intuitions reported in previous research (Cooper & Ginzburg, 2011; Krifka, 2013b; Roelofsen & Farkas, 2015; Holmberg, 2016). However, what is not predicted in previous research is that the intonation is the contradiction contour. We are now in a position to test whether its use affects the interpretation of bare particles.

5 Perception Experiment

The experiment in this section will address the following aspects of questions 2 and 4 from section 2.4: How are bare polar particle responses interpreted? Does the contradiction contour (CC) affect the interpretation of bare particles? While Roelofsen & Farkas (2015) predict bare particles to be ambiguous, they also say that they are more likely to be used to convey a negative response to negative YNQs. Krifka (2013b) predicts that bare *no* will unambiguously convey a negative response. Holmberg (2016) predicts that bare *yes* will unambiguously convey a negative response. Given our finding that *yes* and *no* themselves can carry the CC, we wondered whether its presence affects a listener's interpretation. Here is a sketch of how the CC might affect the interpretation of a bare particle: In response to "Are you not coming to the presentation?" a polar particle can either convey a positive disagreeing response (*I am*), or a negative agreeing response (*I'm not*). Therefore, it may

be unclear to the hearer which interpretation was intended. Intonation can provide a clue, however: If the particle bears the CC, the speaker conveys that the response disagrees with some contextually salient evidence. The negative question requires that there is contextually salient evidence in favor of the negative response (Büring & Gunlogson, 2000; Trinh, 2014). If this is the evidence the CC signals disagreement with, then the particle must indicate the positive response. On the other hand, the choice not to use the CC in a context in which there is negative evidence might lead a listener to conclude that the speaker does not disagree with the evidence, leading to a negative interpretation. We conducted a perception experiment to test whether the interpretation of bare polar particles was indeed affected by intonation in this way.

5.1 Methods

Participants were presented with a context story on a computer screen. The experiment's contexts were similar to those in the production experiments, except that now they crucially leave open whether the character will give a positive or negative response:

(35) **Context**: Taylor and Mark are coworkers. Their boss is giving a presentation at 4 pm that they are both supposed to attend. Mark is running a bit late, and on his way to the presentation at 4:05, he notices Taylor is on the phone and hasn't gone to the presentation yet either. The following dialogue ensues:
Mark [Heard through headphones]: Are you not coming to the presentation?
Taylor [Heard through headphones]: Yes

The question recordings came directly from production experiment (i). The responses were extracted from the recordings of the same production experiment. These responses varied along three dimensions: (i) PARTICLE: whether the word uttered is *yes* or *no*. (ii) INTONATION: whether the intonation used was the CC or a declarative fall (Dec). (iii) ORIGIN: whether the polar particle answer came from a trial in the production study in which the participant said a negative sentence or a positive sentence. On each trial, participants first

silently read the context and the dialogue, then pressed a key to hear the dialogue. Afterwards, the participants were asked how they interpreted the response:

(36) **Question**: Based on Taylor's response, which of the following is true:
1. Taylor is coming to the presentation.
2. Taylor is not coming to the presentation.

The participants were 25 North American English speakers, mostly undergraduate students. There were eight different dialogues (items), and the experiment was run so that each participant saw all conditions in all items, therefore 1,536 observations total.[21] The trials were randomized so that participants never saw the same condition twice in a row, and trials from the same item were organized into different blocks to maximize their distance, and to allow for a latin-square analysis of a subset of the trials if needed, as in the production study.

5.2 Results and Discussion

The results are summarized in Figure 9. We fitted a logistic mixed effects regression, which included particle, intonation, origin, and two-way interactions between origin and the other predictors as fixed effects, and random effects for participant and item that included as many predictors as possible for the model to converge.[22]

We found a significant effect of intonation (see Table 8). Particles bearing the CC were significantly more likely to be interpreted as a positive sentence, e.g. *I am coming to the presentation* (26% positive interpretation with Dec, 65% with CC). Neither Krifka (2013b) nor Roelofsen & Farkas (2015) nor Holmberg (2016) specifically discuss predictions for the interpretations of bare polar particles that have different intonations. The theory of Krifka (2013b) predicts that in order to convey a positive response to negative YNQs, *no* must be followed by an overt sentence, and this prediction is contradicted here. Holmberg (2016)

[21] One participant was removed for completing less than 50% of trials, and 10 observations were removed due to participants choosing neither possible answer.

[22] We did not include an interaction between particle and intonation because it is clear from exploratory data analysis that there is no interaction effect.

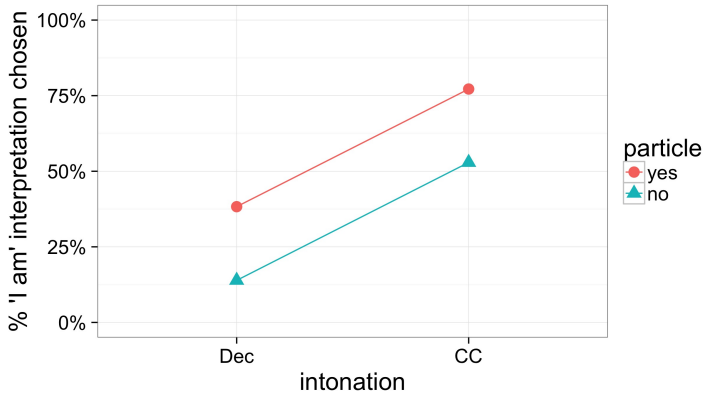

Figure 9: Interpretation of *yes*/*no* response to: "Are you not coming to the presentation?".

makes the same prediction for *yes*, which is also contradicted. Roelofsen & Farkas (2015) predict negative interpretations of bare particles to be preferred, other things being equal. One might read this as meaning that a systematic manipulation of intonation could alter the expected interpretation. On the other hand, R&F claim that positive interpretations of polar particles will require an overt following clause, and that prediction is contradicted here. However, these previous accounts of polar particles do suggest, even if in vague terms, that intonation could have some effect, and that positive responses to negative questions in particular would bear a special intonation. Our results lend support to this intuition, and add to it by identifying for the first time that this unique intonation is the CC, and by demonstrating empirically that the CC much more so than Dec leads to positive interpretations of bare polar particles responding to negative questions.

	β SE
(Intercept)	-0.55 $(0.13)^{***}$
particle.yes	-1.43 $(0.32)^{***}$
origin.rev	0.23 (0.24)
intonation.Dec	2.14 $(0.29)^{***}$
particle.yes:origin.rev	0.97 $(0.30)^{**}$
origin.rev:intonation.Dec	-0.29 (0.34)

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 8: Logistic regression mixed model for participant interpretations of bare polar particles

Given our proposed meaning for the CC, one could ask why positive interpretations are not at 100% when the CC is present. One might expect this since low negation questions $?\neg p$ give rise to evidence for $\neg p$, so in order for the requirement introduced by the CC to be met, the speaker must be asserting p. But note that using the CC on a negative response to a negative question is possible in principle, if there is also positive contextual evidence (in addition to the negative evidence necessary to license the negative question). This was just not the case in our production study, which is why we found almost no negative responses with the CC. However, the contexts in our perception experiment may have been open enough to leave some room for listeners to posit that there may have been such evidence. Sometimes, even raising a question of the form *not p?* can suggest that the speaker considers there to be some evidence for p (in addition to evidence for *not p*), and license the CC on a negative response. The following question (adapted from examples by Trinh, 2014) both suggests contextual evidence that B is not left-handed (antecedent for CC in (37a)), and given the lower odds of being left-handed the formulation of the question suggests a prior belief of A that B is left-handed, which B can take as positive evidence (antecedent for CC in (37b)):

(37) A always thought B was left-handed, but now sees B writing with her right hand.
A: Are you not left-handed?
a. B: I'm left-handed (CC).
b. B: I'm not left-handed (CC).

There was also an effect of the choice of particle (see Table 8). *Yes* responses were significantly more likely to be interpreted as conveying a positive sentence response, e.g. *I'm coming to the presentation* (30% for *no*, 53% for *yes*). Viewed through the lens of Krifka's theory, this is expected since a pragmatic constraint is in effect, *NonSal: being anaphoric to a less salient discourse referent is dispreferred. Since the negative discourse referent is typically less salient, both *yes* and *no* prefer picking up the inner, positive discourse referent, which results in a positive response interpretation for *yes* and a negative interpretation for

no. F&R also predict *no* to be more frequently interpreted as a negative response, since it realizes the [−] feature of the [AGREE, −] response. However, they predict positive responses to the be the most marked, thereby requiring an overt following clause, so they predict that bare particles will more likely be interpreted as negative responses in general. This latter prediction does not fit with the effect we found here. Holmberg predicts bare *yes* should only be interpreted negatively, which is exactly the opposite of the main effect of PARTICLE in our experiment.

Since this main effect of particle is more simply and completely explained by Krifka's theory, we might reasonably conclude that that theory is on the right track on this point. But now we have a question: if the positive antecedent is preferred, why is *yes* with declarative intonation only interpreted as positive in under 50% of observations? This can be explained if there is a preference to use the CC whenever possible. Failing to use the CC in a context where there is negative evidence (such as in response to negative YNQs) then licenses the inference that the speaker must agree with the negative evidence. The absence of the CC is a cue in favor of the outer, negative antecedent.[23]

Kramer & Rawlins (2012) report results from a written truth-value judgment study on the interpretation of bare polar particles that diverge from ours. They found that when trying to convey a positive response (*I am*), bare *yes* is mostly judged false, while *no* is judged more ambivalently. In our experiment, *yes* was more likely than *no* to be interpreted as conveying a positive response. The discrepancy might be due to the fact that Kramer & Rawlins did not control for intonation. Our participants were more likely to produce the CC on *no* than on *yes* (production experiment (i)), and bare particles carrying the CC are more likely to be interpreted as positive (perception experiment). It is plausible then that Kramer & Rawlins's participants imagined more *no* responses with the CC when silently reading the dialogues, leading to more positive interpretations, while *yes* was imagined with more Dec intonation, leading to more negative interpretations, and therefore judgments of

[23]It could be that this inference by the listeners is an artifact of our experiment, since utterances with and without the CC were juxtaposed across trials—in a more natural situation, this effect might be smaller.

falsity when meant to convey a positive response.

Whether an utterance was originally uttered in an agreeing response or a disagreeing response (our factor ORIGIN) did not significantly affect interpretation ($p>0.32$), nor did ORIGIN interact with the INTONATION ($p>0.39$). This gives our intonational annotation some validation—it could have been that our categorization missed some crucial prosodic cues revealing the intent of the speaker that is not captured by annotating whether they used the CC or not, or maybe what we annotated as CC could have been quite different depending on which type of utterance it occurred in. But there is no evidence for either of these conceivable problems with the way we annotated the data.

On the other hand, ORIGIN did have a significant interaction with PARTICLE (see Table 8). Participants were more likely to interpret *no* responses as agreements with the negative question when the *no* sound file came from an agreement utterance in experiment (i) than when it came from a disagreement utterance. There is a difficulty in interpreting this effect. In this experiment, 75% of *no* responses with a negative sentence origin had falling intonation, while only the remaining 25% were CC, compared to a 50-50 balance between falling intonation and CC in *no*-positive responses. Therefore, it is possible this interaction effect is actually the result of the INTONATION factor (CC vs. Dec) rather than some other prosodic differences. This lack of balance was unavoidable since only three CCs were produced on *no*-negative responses in experiment (i). Still, those three *no*-negative origin CCs compared to the positive origin ones have lower overall pitch values (max, min and mean) than other CCs. It might be interesting to run a follow up experiment comparing the interpretation of CC-*no* responses to negative YNQs, while systematically controlling for the f0 level manually.

5.3 Summary of Perception Results

To recap, the results of the perception experiment sheds light on the following questions from section 2.4: Question 2, "How are bare polar particle responses interpreted?" Bare *yes* is interpreted as a positive response in 53% of trials, while bare *no* is interpreted as

positive in 30% of trials. Particle choice does not interact with the intonation used. This result is predicted by Krifka (2013b), but not by Roelofsen & Farkas (2015) or Holmberg (2016). Therefore, while the naturalness ratings from the production experiments were best predicted by Roelofsen & Farkas (2015), especially the fact that *yes* and *no* were rated equally natural when conveying a positive response, the main effect of PARTICLE in the perception experiment just cited is best predicted by Krifka (2013b). This difference in results will be discussed further in section 7.

Question 4, "Does the contradiction contour (CC) affect the interpretation of bare particles?" Yes, particles bearing the CC are interpreted as positive in 65% of trials, while particles bearing Dec are interpreted as positive in only 26% of trials. Intonation has a large effect on how hearers interpret bare particle responses (see Table 8). This result is not clearly anticipated by previous research (see discussion in section 5.2).

6 Reading Experiments

The following reading experiments were designed to address question 3 from section 2.4: "If the negative sentence that the polar particle responds to is itself responding to a negative sentence, are preference patterns affected, and in particular is *yes* now more acceptably interpreted as a negative response?"

Meijer et al. (2015) attempt to answer this question for German, and they note that Krifka (2013b) and Roelofsen & Farkas (2015, R&F) make different predictions with respect to these questions. Krifka argues that negative sentences, like B's sentence in (38) below, are usually uttered in a context in which the positive response is already salient. E.g. usually when someone says "He did not climb Mount Cotopaxi in Ecuador," the proposition that *he did climb Mount Cotopaxi* is already salient, perhaps because someone else claimed it, implied it, asked about it, etc. Then, when the negative sentence is uttered, it introduces two discourse referents, one anchored to the embedded TP, and one anchored to the NegP.

Krifka hypothesizes that the TP discourse referent is more salient than the NegP one thanks to preceding context, and that there is a pragmatic constraint against picking up non salient discourse referents, *NonSal. This means *yes* is more likely to pick up and assert the positive discourse referent, making a negative interpretation of a *yes* response dispreferred. However, these preferences are context sensitive. In (38), B's negative sentence is preceded by A's negative sentence, which Krifka argues makes the negative discourse referent anchored to the NegP more salient. Therefore polar particles should be more likely to pick it up, which affects hearers' preferred interpretations of bare responses.

(38) A: Which of the mountains on this list did Reinhold Messner not climb?
B: Well, let's see... He did not climb Mount Cotopaxi in Ecuador.
C: Yes. / No.

According to Krifka, *yes* is most naturally interpreted as meaning "he didn't climb it," since *yes* picks up the more salient negative discourse referent. *No* is also predicted to be most naturally interpreted as meaning "he didn't climb it," since, even though this would require picking up the less salient positive discourse referent, *DisAgr is more highly ranked than *NonSal when responding to an assertion (see the OT tableau in Figure 1). Finally *yes* is predicted to be preferred over *no* when indicating a negative response, since *DisAgr plays no role when the response agrees, and *yes* picks up the more salient discourse referent. This all holds for German *ja* and *nein* as well, with the difference that *doch* is preferred for indicating a positive response to a negative sentence.

On the other hand, R&F do not predict shifts in context—like whether the negative sentence is preceded by a positive or negative sentence—to have any effect on preference patterns in polar particle responses. The reason for this is that R&F claim that an antecedent utterance introduces only one propositional discourse referent, and they hypothesize that the interchangeable behavior of *yes* and *no* is due to the existence of both relative and absolute polarity features. For R&F, both *yes* and *no* in (38) can be interpreted as either an [agree,

−] response or a [REVERSE, +] response. In general, [REVERSE, +] interpretations for bare particles are dispreferred since it is the most highly marked feature combination, which is usually signaled in English with an overt elliptical clause with verum focus, e.g. "Yes/No, he DID". However, when it comes to giving an [AGREE, −] response, [−] is more marked than [AGREE], and *no* spells out the former, so *no* is predicted to be more naturally interpreted as an [AGREE, −] response than *yes* is regardless of context. Like Krifka, this all holds for German *ja* and *nein*, with the exception that *doch* is a special particle that indicates a [REVERSE, +] response.[24, 25]

Meijer et al.'s (2015) results do not favor either theory. They found that *ja* was preferred over *nein* when indicating a negative, affirming response, which runs counter to R&F's predictions. This preference held regardless of whether the context WH-question was positive or negative, counter to Krifka's predictions. We wondered whether these results would be different in English. One interesting feature of Meijer et al.'s (2015) experimental paradigm is that participants were asked to verify follow up sentences to make sure they were paying attention. E.g. participants were shown a sentence like "A, B and C are talking about mountain climbing," and they were asked to say if they thought the sentence was "richtig" ('right'/'correct') or "falsch" ('wrong'/'false'). Before testing whether a systematic manipulation of the polarity of the sentence preceding the question affected preference patterns (results in section 6.2), we wanted to test whether the addition of a verification question could, by itself, have an unintended effect (results in section 6.1). In particular, we wondered if these follow up questions may make participants find *ja* or *yes* more natural as an affirmation of a negative sentence.

[24]In English, R&F's claims leave open the question of how bare *yes* responses to negative sentences will be interpreted. On the one hand, there is pressure for it be interpreted as a negative response, since the more marked positive response should be accompanied by an elliptical prejacent. On the other hand, *no* is preferred when giving a negative response, since it spells out the more marked [−] feature. So it is not clear which interpretation R&F predict for bare *yes*, or if they predict one at all, since infelicity is a valid option.

[25]Meijer et al. (2015) do not discuss the predictions of Holmberg (2016). We believe that his theory, like R&F's, does not predict context sensitivity to preceding sentences.

6.1 First reading experiment – verification question

This experiment was identical to our first production experiment in section 4, except for two differences. First, we did not ask participants to say responses aloud, and second we asked participants to say whether a follow up sentence about the context was true or false, e.g. "The boss's presentation is at noon. (True, False)". Since the contexts and dialogues were identical to the first production experiment, if there were any difference in participants' naturalness ratings, it would have to be due to one of these two changes.

As before, the experiment was run within participant so that each participant saw each condition in each item. We ran 12 native speakers of North American English (mostly McGill undergraduates), and one participant is missing one trial, making for 767 observations total.

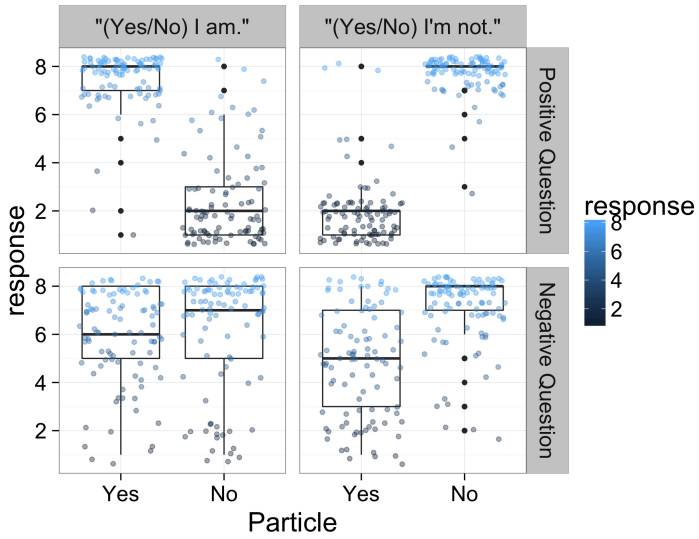

Figure 10: Naturalness ratings with the addition of a verification question.

The pattern of naturalness ratings in Figure 10 is qualitatively almost identical to that of the first production experiment. In response to positive questions, *yes* and *no* are not interchangeable. In response to negative questions, they are interchangeable, however *yes, I'm not* responses are somewhat degraded. We fitted a cumulative link mixed model regression for the ratings of responses to a negative question, with random intercepts and slopes for participant and item (see Table 9). We found a significant main effect of PARTICLE, and a

significant interaction effect, but no main effect of ANSWER (p>0.49). The interaction effect is unsurprising since *no* responses are rated more naturally in both positive and negative responses, but the difference between *yes* and *no* is even greater in negative responses.

	β	SE
Particle	−1.47	(0.20)***
AnswerPolarity	0.13	(0.19)
Particle:AnswerPolarity	1.76	(0.39)***

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 9: Cumulative link mixed model for naturalness ratings when indicating whether the response was "true" or "false"

This demonstrates that (i) whether or not the participant actually takes part in the dialogue by saying the yes/no response aloud has no effect on the qualitative patterns observed in the naturalness ratings, and (ii) asking participants to verify a follow up question does not seem to affect naturalness ratings. So it seems we have no reason to worry that Meijer et al.'s (2015) methodology might be causing German speakers to behave radically different from English speakers. Instead, the different behavior seems more likely to be caused by some more interesting difference between the speakers of the two languages.

6.2 Second reading experiment – Manipulating the context

With the worry that the verification question could be having an unwanted effect out of the way, we wanted to see if making the smallest changes possible to our original stimuli to fit them into the experimental paradigm of Meijer et al. (2015) would change participant naturalness ratings, either in the way predicted by Krifka, or to be more like the results of Meijer et al. for German.

Note that we need to make an assumption, so far left implicit, that will enable us to compare our results to the predictions made by R&F and Krifka. Above we described these authors' predictions for the preferred interpretations of bare particle responses. In this experimental paradigm, we present participants with polar particles followed by full clauses,

and ask them to rate naturalness. We assume (and we think that the theorists we have been discussing also assume) that the hypotheses about preference patterns are meant to explain both the interpretations that hearers are likely to assign to bare responses *and* the perceived naturalness of certain particle-clause combinations. So Krifka predicts that *yes* followed by a response with negative polarity will be judged less natural when the positive discourse referent is more salient, but more natural when the negative discourse referent is more salient. R&F predict that *no* will always sound more natural than *yes* when followed by a negative clause in an [AGREE, −] response.

6.2.1 Methods

This experiment has three two-level factors, $2 \times 2 \times 2$. Two are identical to the first set of production experiments, the PARTICLE used (*yes* vs. *no*), and the polarity of the ANSWER (positive vs. negative). In all conditions, these responses are made to a negative declarative antecedent. The third factor was manipulating the polarity of the CONTEXT sentence preceding the antecedent. The goal was to stay as similar to our original stimuli as possible while mirroring the experimental paradigm of Meijer et al. (2015). Participants were asked to rate the naturalness of the responses, and they were asked a follow up verification question. Here is an example stimulus.

(39) **Setup**: You and your coworker Harley are closing down the restaurant for the night. Harley is trying to determine ...
Positive context: ... which tasks have been done already.
Negative context: ... which tasks haven't been done yet.
Antecedent: You didn't take the trash out.
Positive, disagreeing response: Yes/No, I took the trash out.
Negative, agreeing response: Yes/No, I didn't take the trash out.

The participants were 12 North American English speakers (mostly McGill undergraduates), making for 768 observations total. The trials were randomized so that participants never saw the same condition twice in a row, and trials from the same item were organized into

different blocks to maximize their distance, and to allow for a latin-square analysis of a subset of the trials if needed, as in the previous experiments.

6.2.2 Results

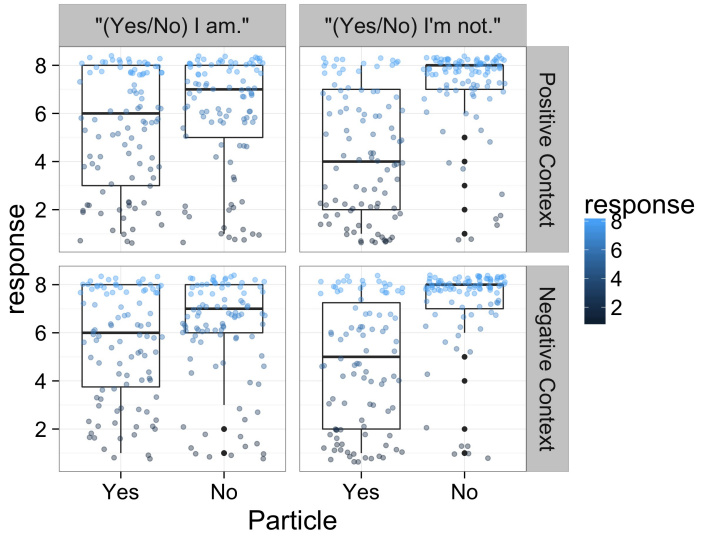

Figure 11: Naturalness ratings with context factor.

From Figure 11, we expect there to be an interaction between PARTICLE and ANSWER as we saw in the production experiments above. It appears as if the polarity of the context preceding the antecedent is unlikely to have any effect, except perhaps on *yes, I'm not* responses, which appear to be rated slightly more natural in negative contexts (median 5 in negative contexts to median 4 in positive contexts). If this result is significant, it would lend support to Krifka's hypothesis that preceding context polarity modulates naturalness ratings.

We fitted a cumulative link mixed model regression with all three factors and all possible interactions, with random intercepts and slopes for participant and item (see Table 10). We found a significant main effect of PARTICLE, as well as a significant main effect of ANSWER, and a significant interaction effect, as expected and like in the other production experiments. We did not find a significant three way interaction (p>0.67), nor were any other factors

significant. A likelihood ratio test revealed no difference between this model and one with only PARTICLE, ANSWER and their interaction (p>0.57).

	β SE
Particle	-1.62 (0.15)***
AnswerPolarity	-0.50 (0.14)***
Context Polarity	-0.19 (0.14)
Particle:AnswerPolarity	2.26 (0.28)***
Particle:ContextPolarity	0.09 (0.27)
Answer:ContextPolarity	0.31 (0.27)
Particle:AnswerPolarity:ContextPolarity	-0.23 (0.55)

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 10: Cumulative link mixed model for naturalness ratings when controlling for the polarity of a preceding context sentence

Therefore, the polarity of sentences in the context preceding the antecedent of the polar particle response does not have an effect on naturalness ratings. *No, I'm not* responses are always rated more natural than their *yes* counterparts which seems to confirm Roelofsen & Farkas's hypothesis. However, we note that, according to Meijer et al.'s (2015) results, context polarity had no effect on naturalness in German either, yet the result contradicted R&F's predictions. Therefore, when taking our results together with Meijer et al.'s, the results of both experiments demonstrate that controlling for the polarity of a preceding context sentence has no effect on preference patterns in either English or German, at least not in this experimental paradigm. The results contradict Krifka's preference pattern predictions, and they confirm R&F's predictions, but only for English, not German.

Nevertheless, we think there is some merit to the intuition that in a context like (38), *yes* more naturally indicates a negative, agreeing response, whether as a bare particle or with a following overt sentence. In future work, we would like to see other experimental designs used to test whether context can affect preference patterns. If, after further testing, *yes*-negative responses remain dispreferred, then it may likely be that a theory like R&F's that predicts preference patterns to be insensitive to contextual factors is on the right track.

6.3 Summary of Reading Results

To recap, the results of the reading experiments shed light on the following question from section 2.4: Question 3, "If the negative sentence that the polar particle responds to is itself responding to a negative sentence, are preference patterns affected, and in particular is *yes* now more acceptably interpreted as a negative response?" No, naturalness ratings of particle responses appear to be insensitive to systematic manipulation of the polarity of context sentences, which is predicted by Roelofsen & Farkas (2015).

7 General discussion

In section 2.4, we posed four research questions, reprinted below.

1. Are English *yes* and *no* indeed non-interchangeable in response to positive polar questions, and interchangeable in response to negative polar questions?

2. Which particles do speakers prefer to use when giving a response with negative polarity? With positive polarity? How are bare polar particle responses interpreted?

3. If the negative sentence that the polar particle responds to is itself responding to a negative sentence, are preference patterns affected, and in particular is *yes* now more acceptably interpreted as a negative response?

4. Does a special intonation appear on positive *yes*/*no* responses to negative YNQs? If so, can it affect the interpretation of bare particles?

We begin with question 4 since our results are the first we know of to address it. As discussed in the introduction, various researchers working on polar particle responses have shared the intuition that a special intonation may appear in positive responses to negative utterances, and that this intonation may have an effect on the interpretation of polar particles. However there has been disagreement over the form that the intonation takes, and no

quantitative data has been presented in support of any particular claim. The main finding of our work is that there is indeed a particular intonation that is produced in positive responses to negative utterances, and that intonation is a fall rise that we identify as the contradiction contour (Liberman & Sag, 1974). The CC is the only intonation we found that is systematically produced in positive responses that disagree with the negative bias inherent in contexts that license negative YNQs, while not in appearing in negative, agreeing responses.

The results of our perception experiment demonstrate that this intonation has a strong effect on how hearers interpret bare polar particle responses to negative utterances: participants are much more likely to interpret a bare *yes* or *no* as indicating a positive response when it bears the CC than when it bears falling intonation. Building off of Liberman & Sag, we have argued that the CC, when used on an assertion of p, conveys that there is contextual evidence for $\neg p$. This hypothesis accounts for why it is used almost exclusively on positive responses, given that our contexts made evidence in favor of the negated proposition very salient. Prior to viewing the results of this experiment, it would have been hard to guess how sensitive to intonation naïve participants are. Perhaps the most surprising result of this work is that hearers' interpretations of bare *yes*/*no* responses appear to be strongly influenced by the intonation appearing on these monosyllables.

Regarding question 1, both the production and perception results demonstrate that *yes* and *no* are interchangeable in response to negative sentences, and the production results demonstrate that they are not interchangeable in response to positive sentences. This confirms the intuitions reported by Krifka (2013b); Roelofsen & Farkas (2015); Holmberg (2016) and others, and replicates earlier experimental findings reported in Brasoveanu et al. (2013) and Kramer & Rawlins (2012).

Regarding question 2, one clear finding from the naturalness ratings, again replicating a finding from Brasoveanu et al. (2013), is that *no* is more acceptable than *yes* when giving a negative, agreeing response to a negative sentence. Both Roelofsen & Farkas's (2015) and Krifka's (2013b) theories account for this preference, as discussed above, while Holmberg's

(2016) does not. Holmberg argues that speakers who disprefer such *yes* responses do so because they interpret the preceding negative YNQ as having a syntactically high negation between TP and vP. Those who interpret the YNQ as having a low negation, adjunct to vP/VP, are predicted to find such negative *yes* responses to be completely natural. Therefore, this view predicts that such responses should be rated by individual participants either as completely natural or completely unnatural, but should not receive in between ratings. However this is not what we found. Instead, negative *yes* responses are consistently rated as somewhat degraded (median rating of 3) relative to all other response combinations by most of our participants.

Besides this result, the production naturalness ratings and the perception results clearly bear on question 2 in other ways, however determining exactly how the results bear on previous theoretical claims about preference patterns is complex. The reason is that in the discussion of preference patterns from the literature, no attempt is made to distinguish between preferences regarding the *use* of polar particles from preferences regarding the *interpretation* of bare particle responses. Moreover, the data on preferences provided by our experiments come in two different forms: (i) naturalness ratings by the producers of polar particles with complete, overt following sentences,[26] and (ii) forced choice interpretations of bare particle responses in a perception experiment. The results in form (i) and form (ii) do not perfectly align with one another, and could be argued to support the predictions of two different theories.

The results in form (i) reveal that participants find producing *no* followed by a positive sentence and *yes* followed by a positive sentence to be equally acceptable. This result runs counter Krifka's (2013b) theory, which clearly predicts that positive *no* responses should be less natural than positive *yes* responses, regardless of previous context (see the OT tableau in Figure 1). Roelofsen & Farkas (2015), on the other hand, predict that both *yes* and *no* should be equally acceptable when indicating positive responses, which is what we found in

[26]With the exception of the follow up to experiment (ii) discussed in section 4.2, which provided naturalness ratings of bare particle responses.

the naturalness ratings of the production study.

The results in form (ii) reveal that participants are more likely to interpret bare *no* as conveying a negative response than bare *yes*, regardless of the intonation used on the bare particle. While the result from the preceding paragraph contradicted the predictions of Krifka (2013b), those very same predictions are confirmed by this result. Since positive *no* responses are predicted to be less natural, it makes sense that we would find that bare *no* responses are more likely to be interpreted as negative than bare *yes* responses (again, see the predictions in Figure 1). Roelofsen & Farkas's (2015) theory predicts both bare *yes* and bare *no* to be more likely interpreted as negative. In order to be interpreted as positive, R&F claim that they need to be followed by an overt clause like *he DID*. The idea that this overt clause is obligatory in such positive, disagreeing responses and that therefore negative interpretations of both bare *yes* and bare *no* are more likely, is incompatible with the finding that bare *yes* is more likely to be interpreted as positive. Finally, Holmberg's (2016) theory also has trouble explaining this result, since it makes the strong prediction that bare *yes* in English cannot be interpreted as a positive response to a negative utterance, but instead must be followed by an overt positive clause. While our experimental results support his suggestion that bare *yes* responses are more likely to be interpreted as positive with special prosody, this does not explain the fact that we found a main effect of polar particle choice with bare *yes* more likely to be interpreted as positive than bare *no*, independent of intonation.

Therefore, the results for question 2 and how they bear on existing theories of polar particles are somewhat mixed. More testing may be needed, and the theories making predictions about preference patterns may need to be tightened. In particular, a theory of polar particles that makes distinct predictions for preferences related to *use* as opposed to *interpretation* may be needed.

Regarding question 3, the experimental results from section 6 reveal that, so far, no experimental paradigm has successfully demonstrated that manipulating the polarity of preceding context sentences affects the result that negative *yes* responses are dispreferred. This

result contradicts the predictions of Krifka (2013b), and supports those of any theory that predicts preference patterns to be context insensitive, such as Roelofsen & Farkas (2015) and Holmberg (2016). However, as we said in the conclusion of section 6, we are hesitant to draw strong conclusions from this result. For starters, the same experimental paradigm manipulating context sentences failed to have an effect on German preference patterns (see Meijer et al., 2015), but their result went against the predictions of both Krifka (2013b) and Roelofsen & Farkas (2015). Moreover, we share Krifka's intuition that the context manipulations of examples like (38) do have an effect, making negative *yes* responses seem more natural. We believe more experimental testing using different paradigms is needed to settle definitively the question of whether preceding context manipulations affect preference patterns. If they do not, then the context sensitivity built into Krifka's pragmatic constraint *NonSal may need to be rethought.

Our experiments have several limitations. For one, we only used contexts which convey negative contextual evidence. We did not vary evidence in order to keep the complexity of the experiments under control. As noted in footnote 17, there are theoretical questions about whether it is even felicitous to use a positive YNQ in the presence of negative contextual evidence. We believe our experimental contexts do license the use of both positive and negative YNQs, but this raises the question of why. Is it because theories that predict this to be impossible are wrong, or is it because our contexts were complex enough that they could be taken to have both positive and negative evidence? If it is the latter, then why was the CC only produced on positive responses, regardless of whether the YNQ was positive or negative? If evidence can be manipulated between purely negative and purely positive in a production experiment, we predict it to have an effect on the distribution of the CC, with CC appearing on negative responses in the presence of positive evidence and on positive responses in the presence of negative evidence.

Another limitation is that the perception experiment only tested CC against falling intonation. We noted that rise-fall verum focus intonation was distributed relatively evenly

across conditions in the production experiment. However it may nevertheless be interesting to run a perception experiment with rise-fall intonation on the polar particles to see how it affects interpretation.

8 Other uses of *yes* and *no*?

Wiltschko (2016) notices uses of polar particles that seem to fall out of the reach of analyses such as Krifka's. For example, *yes* can be used to respond to WH-questions, as demonstrated in examples uncovered in the corpus of American soap operas by Wiltschko:[27]

(40) Katie: Why would you do something like that?
Brooke: Yes. That is the right question.

Yes in (40) does not answer Katie's question. As Wiltschko puts it, the polar particle seems to be used to agree with the question. Another way of putting it is that Brooke uses *yes* to second the question. Wiltschko argues *yes* and *no* can encode two types of meanings by appearing in one of two syntactic positions. She assumes that that there is structure above the CP that includes information about the common ground and interlocutors' beliefs. When polar particles are below this structure, they signal the polarity of their complement proposition by interacting with "polarity features". Here, she adopts Holmberg's (2016) theory, including his explanation for interchangeability. When polar particles are above this structure, they indicate agreement or disagreement with a speech act by interacting with "coincidence features". The idea is that a positive coincidence feature indicates that the speaker has the same speech act (in (40), the same question) as their interlocutor, while a negative coincidence feature indicates they do not have the same speech act.[28]

[27]We altered the following example slightly.

[28]Intuitively, we think that the primary meaning of Brooke's *yes* response in (40) is that she agrees that Katie should ask that question, not that she actually has the same question as Katie. After all, Brooke probably already knows the answer to the question, and thus does not have the same question. Note however that Wiltschko's theory only derives the former, primary meaning from the latter meaning, i.e. *yes* indicates agreement with the question only as a secondary inference derived from the literal meaning of *yes* which is

Krifka (2013b) briefly discusses some similar examples. He observes that *yes* can be used to express compliance with an interlocutor's speech act. He argues one component of assertions is the event of the speaker adding the proposition to the common ground (CG), which introduces a discourse referent. While in (41a), *yes* picks up a propositional discourse referent and asserts it in the usual way, in (41b), B uses *yes* to comply with A's attempt to add a proposition to the common ground, but B does not reassert the proposition herself. Cf. (41c) which similarly signals that a proposition has been added to the CG without asserting that proposition.

(41) [Cf. Krifka (2013b) exs. (45) and (46)]
A: [$_{ActP}$ CG$_{\rightarrow d'}$ [$_{TP \rightarrow d''}$ Edith stole the cookie]]

a. B: Yes, she did. (picks up d'')
b. B: Yes. (picks up d')
c. B: Okay. (picks up d')

The claim is that *yes* and *no* can be anaphoric to either d' or d'', and hence convey rather different contributions even when the same proposition is involved. But is d' a propositional discourse referent or a speech act discourse referent? Krifka first says that it is the latter, and that *okay* and *right* are speech act anaphora, which can pick up d' but not d''. This explains why they do not give rise to interchangeability in response to negative sentences, unlike polar particles. But in order to explain (41b), Krifka changes his position and claims that d' is indeed a propositional discourse referent, and the clean explanation of *okay* and *right* is lost. The alternative would be to claim that polar particles are ambiguous between propositional discourse referents and speech act discourse referents, but this adds extra complexity to a theory of polar particles that is primarily attractive for its simplicity.

We think that a simpler proposal can capture the preceding examples while retaining Krifka's (2013b) idea that polar particles are propositional anaphora only. The idea is that

that Brooke has the same question. This would seem to be undersirable for examples like (40). Perhaps an auxiliary assumption could be made that Brooke assumes Katie's perspective in indicating that she has the same question.

implications of various kinds convey propositional meanings, and as such they introduce propositional discourse referents that *yes* and *no* can pick up as antecedents. Implications are generally less salient than overt, linguistically represented at-issue content, therefore we would expect bare particles to be more likely to be interpreted as referring to the latter (cf. the a. examples below). Nevertheless, when followed by overt sentences, it seems clear that polar particles can refer to most kinds of standard inferences (cf. the b. examples):

(42) Presupposition
A: Amelia stopped smoking.
$\rightsquigarrow$ Amelia was smoking before.
a. B: No. (She still smokes.)
b. B: No, she never smoked before.

(43) Conversational Implicature
A tells B and C that she is out of gas.
B: There's a gas station around the corner.
$\rightsquigarrow$ The gas station is not closed.
a. C: No. (There isn't a gas station around the corner.)
b. C: No, it's closed.

(44) Scalar Implicature
A: Edith stole some of the cookies.
$\rightsquigarrow$ Edith did not steal all of the cookies.
a. B: No. (She didn't steal any of the cookies.)
b. B: No, she stole all of them.

This approach straightforwardly explains uses of polar particles like in (40) and (41). From Katie's interrogative speech act in (40), we draw the inference that the question is relevant and appropriate at this time. Brooke's *yes* seems to agree with this implication because it picks up the discourse referent introduced by it and asserts it. From A's assertive speech act in (41), we draw the inference that the speaker adds the proposition to the common ground. B's *yes* in (41b) picks up the discourse referent introduced by this implication and asserts it.

Another advantage of this approach is that it easily captures the hitherto mysterious response *yeah no* (cf. Farkas & Bruce, 2010; Roelofsen & Farkas, 2015). We claim that the two particles are anaphoric to different discourse referents.

(45) Danielle is a chemistry teacher talking to her student, Mark, after class.
Danielle: Chemical bonds are what hold the physical world together, what hold us together.
Mark: Yeah no, I got it.

Yeah picks up the discourse referent anchored to the TP of Danielle's utterance and asserts it, which produces the effect of agreement. Danielle's assertion also gives rise to the inference that Mark does not yet know what she is telling him. *No* picks up this inference and negates it. Therefore, *yeah no* in (45) can be paraphrased as, "I agree, chemical bonds *are* what hold the world and us together, and you don't need to tell me, I already know it."[29]

One problem with this account is that it is relatively unconstrained. There are in fact some cases where a polar particle response to a standard inference does not sound natural, such as the response to the presupposition in (46).

(46) A: Jane solved the problem too.
$\rightsquigarrow$ Someone else solved the problem.
B: # No, no one else solved it.

A thorough discussion of which types of inferences introduce antecedents for *yes* and *no*

[29]There is a different use of *yeah no* which has a unique prosody. It starts off sounding as if *yeah* is going to pick up and agree with the discourse referent introduced by the TP of the preceding utterance, and then ends by simply negating it with *no*, e.g.:

(i) A: Can you drive us to Rhode Island?
B: Yeah, no.

Yeah is pronounced with a higher, even tone, potentially long in duration, while *no* has a lower tone, and may optionally be shorter in duration. The speaker sounds as if she changes her mind mid-utterance, or as if she was misleading the hearer with the *yeah* before switching to *no*. The effect is generally comedic, but the phenomenon is less theoretically interesting, since both *yeah* and *no* pick up the discourse referent introduced by their interlocutor's TP.

goes beyond what we can do in this paper, but would be necessary to explore whether our proposal for how to account for these (apparent) other uses of *yes* and *no* is constrained enough.

9 Conclusion

In this paper, we have provided experimental evidence that (i) polar particles *yes* and *no* are interchangeable in response to negative YNQs but not in response to positive YNQs, (ii) that there is a special intonation, the CC, that appears on positive responses that disagree with negative contextual evidence, and (iii) that bare polar particles responding to negative YNQs are not necessarily likely to convey a negative response, contrary to earlier claims in the literature. Instead, interpretation is impacted by the contour present on the particle.

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