The prosody of French ambiguous multiple negative sentences.

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Abstract

While it has long been assumed that prosody can help resolve syntactic and semantic ambiguities, empirical evidence has shown that the mapping between prosody and meaning is complex (Hirschberg & Avesani, 2000; Jackendoff, 1972). This paper investigates the prosody of ambiguous French sentences with multiple potentially negative terms that allow two semantically very distinct interpretations—a single negation reading involving so-called negative concord (NC), and a double negative reading (DN) with a positive meaning reflecting a strictly compositional interpretation—with the goal to further research on the role of prosody in ambiguities by examining whether intonation can be recruited by speakers to signal distinct interpretations of these sentences to hearers. Twenty native speakers produced transitive sentences with potentially negative terms embedded in contexts designed to elicit single-negation or double-negation readings. Analysis regarding the F0 and the duration of the utterances revealed distinct prosodic profiles for the two readings, confirming previous evidence that speakers can produce characteristic acoustic cues to signal intended distinctive meanings (Kraljic & Brennan, 2005; Syrett, Simon, & Nisula, 2014). Our results reveal that NC readings feature a focused subject and a deaccented object, in contrast to DN readings where both the subject and the object were independently focused. They do not relate DN to contradiction but link negative meaning with focus on French negative concord items (NCI). The paper discusses the implications of these findings for theoretical approaches to NC and outlines further questions for the syntax-prosody interface of these constructions.

Contents

1. Introduction

Sentences in French like (1) that contain multiple potentially negative terms such as *personne* or *rien* (here dubbed NCI for negative concord items following Watanabe 2004) allow for two distinct readings: the first, interpreted as in (1a), features a single semantic negation and is commonly assumed to be the most accessible one for native speakers. It is known in the literature as the negative concord (henceforth NC) reading. The second reading, paraphrasable as (1b), known as the double negation (henceforth DN) reading, features two semantic negations that cancel each other to a logically positive statement[1].

Cross-linguistically, DN readings are generally considered to be marked, infrequent and hard to process, but in French, they are quite easily accessible to speakers, despite the language being commonly classified as a negative concord one (Corblin, 1995; Déprez, 1997; 2000; de Swart & Sag, 2002; de Swart, 2009; Corblin & Tovena, 2001; 2003). This paper confirms and explores this ambiguity, centrally focusing on the characterization of the prosody of the two interpretations to determine whether they have distinctive features, what these are, and how they can inform theoretical models of these dependencies. We explore these questions experimentally in an elicited production study.

(1) Personne n'aime personne ici

a. Concord: Nobody loves anybody here

b. Double negative: Nobody loves nobody here

∴ Everybody loves someone

With their opposite meanings generated from identical strings, flips between NC and DN readings in (1) offer a linguistic counterpart of the visual ambiguity of the Necker cube, where two opposite geometric perceptions arise from a single visual source to reveal the computational complexity of our visual system. These multiple negative constructions implicate complex interactions between the morpho-syntax, semantics, and pragmatics of NCIs and challenge our understanding of the role of prosody in this computation. Here our experimental work investigates whether speakers can produce robust, identifiable phonetic cues and distinctive prosodic profiles that could reliably help distinguish these readings and illuminate the interactions that their computation involves.

[1] As insightfully discussed in Horn (1989; 1991), the resulting positive statement is not equivalent to the one that would obtain without the presence of the negative terms. See for instance (Larrivée, 2016) for a discussion of the pragmatics of these double negation statements in French.

Much of the discussion in the literature about multiple negative sentences has focused on the NC reading and the compelling puzzle it raises for semantic compositionality (Ladusaw, 1992; Zanuttini, 1991; Laka, 1990; Giannakidou, 2006; Zeijlstra, 2004; de Swart, 2009; Penka, 2011; Tovena, Déprez, & Jayez, 2004). By contrast, the different factors that contribute to the emergence of DN readings have received far less attention[2]. Important disagreements remain as to whether DN readings should be thought of as generated by the grammar in only some of the languages that allow them—so-called DN languages (Zeijlstra, 2004; de Swart & Sag, 2002; de Swart, 2009)—while in others—so-called NC languages—they would be the triggered consequence of special discourse-level pragmatic processes of denial, contradiction or metalinguistic negation, but not be encoded in the grammar (Espinal & Prieto, 2011; Larrivée, 2016). Much controversy also lingers as to whether the privileged access to NC readings in some languages can motivate cross-linguistic macro-parametric distinctions or could be better understood as stemming from the language internal interaction of lexical, morphosyntactic or semantic features and processes. Here, we argue that the interaction of prosodic factors with the morpho-syntax of these constructions can help shed light on these issues for the French constructions.

Not all sequences of multiple negative expressions display comparable ambiguities. In Standard European French, the variety examined here, DN readings are enforced with the sentential negative marker *pas* in a sentence like (2a) or (2b), although judgments vary across dialects.

(2) a. Ils n'aiment pas rien.
They (neg) like neg nothing
They don't like nothing
b. Pas un étudiant (n') a rien dit
neg one student (neg) has nothing said
Not a student said nothing

But as this paper aims to explore the effects of prosody in negative ambiguities, we restrict our attention to sequences where the two readings alternate, particularly constructions where NCIs

[2] For some notable exceptions see (Iordachioaia, 2009; de Swart, 2009; Déprez, Tubau, Cheylus, & Espinal, 2015; Puskás, 2012; Fălăuş, 2007).

interact (i.e.: negative spread), rather than constructions that relate an NCI to sentential negation (i.e.: negative doubling) (Den Besten, 1986)[3].

There is much empirical variability in the accessibility of each of these readings across and within languages and dialects, even in closely analogous constructions. In some languages displaying strict negative concord, like Japanese (Watanabe, 2004), Haitian creole (Déprez, 1999; 1997; 2017), Hungarian (Szabolcsi, 2004), Basque (Etxeberria, Tubau, Deprez, Borràs-Comes, & Espinal, 2018) or Greek (Giannakidou, 2006), sequences of negative expressions like (2) were said to only allow NC readings.

(3) Pèsonn pa di anyen — Haitian Creole (Déprez 1999)

n-person not said n-thing

Nobody said anything

KANENAS *(dhen) ipe TIPOTA. — Greek (Giannakidou 2006:22)

n-person not said.3sg n-thing

'Nobody said anything.'

Likewise, only single negation readings ever arise in a French sentence like (4) (essentially synonymous with (1a)) that combines different negative dependent expressions (i.e. NPIs vs. NCIs), controversially argued to be essentially alike by some authors, e.g.: (Laka, 1990) and fundamentally distinct by others, e.g.: (Zanuttini, 1991).

(4) Personne n'aime quique ce soit ici[4]

Nobody likes anyone here.

The absence of DN in constructions like (3) served to motivate proposals that NCIs lack a negative denotation, though they remain "negative" in some respect, such as bearing "uninterpretable" negative features (Zeijlstra, 2004). By contrast, in other languages like standard English, Dutch, or German, participating expressions are taken to have negative denotation, and sequences of negative expressions like (5) are claimed to only allow DN, even if this reading remains marked (Zeijlstra, 2004).

(5) Nobody likes nothing

[3] While some accounts do not differentiate between these two types of negative relations, others consider them as fundamentally different (Watanabe, 2004; Déprez, 1997 and following; Labelle & Espinal, 2014).

[4] That NPIs are semantically non-negative expressions is generally agreed upon so that the absence of DN reading in (4) is not unexpected. Yet if as Puskas argued (2012, p. 612), sequences of semantically non-negative NCIs can lead to DN in contradictory contexts involving (agreement with) a verum focus operator or contrastive topics, the question of why DN is not possible for expressions like *quique ce soit* in the same contexts resurfaces. Restricting abstract syntactic features (i.e.: + [uNeg]) to only NCIs seems to name a problem rather than solve it, especially if the distribution of NPIs is constrained by syntax (Linebarger, 1987).

(6) a. Ils (n') aiment pas rien

They (neg) like neg nothing

They don't like nothing

b. Pas un étudiant (n') a rien dit

neg one student (neg) has nothing said

Not a student said nothing

Although NC readings like (1a) are assumed to be the default in French, some factors were shown to favor DN readings for multiple negative constructions of this kind. First, morpho-syntactic factors such as the use of full nominal expressions as opposed to pronominal ones, especially in preverbal position as in (7), favor DN in French as in Spanish, Catalan or Italian, (Acquaviva, 1999; Déprez, 2000; Déprez, Tubau, Cheylus, & Espinal, 2015; Déprez & Yeaton, 2018). DN is also favored when one NCI is syntactically focused as in (8) or (9) (Larrivée, 2016; Puskás, 2012), or occurs in a distinct scope domain as in (10). Moreover, DN is favored in fragment answers to negative questions as in (11) in French or English, although interpretation can vary in Spanish, Catalan or Romanian (Corblin, 1995; Espinal & Tubau, 2016; Fălăuș & Nicolae, 2016).

(7) Aucun enfant ne mange rien. (Déprez 2000)

No child neg eat nothing

' No child eats nothing/anything

(8) Il n'y a personne qui n'aime rien ici

There is nobody who Neg like nothing here

There is nobody who likes nothing here

(9) Il n'y a aucune option que personne n'a considérée

There is no option that nobody considered

(10) Personne ne se fâche pour rien

Nobody gets angry for nothing

(11) Qui n'a rien dit ? Personne.

Who said nothing? Nobody

But with simple ambiguous negative sentences like (1), context and prosody can play a role in influencing interpretation. Regarding context, while no specific pragmatic conditions have

been noted to elicit NC readings, DN has often been observed to be facilitated in contexts that involve the correction or denial of a previously negated proposition (Horn, 1991; Puskás, 2012, p. 613). The question remains, however, whether these pragmatic restrictions are necessary to elicit these readings. We address this question here both in our experimental design and our results and argue that for French, this is not the case. Concerning prosody, while a number of recent experimental studies have been conducted on the prosody of ambiguous negative sentences in a variety of languages including English, Afrikaans, Spanish, and Catalan with variable results and conclusions, there has been, at present, no investigation of French negative sequences like (1). Only impressionistic, often different, intuitions have been offered, e.g.: (Corblin & Tovena, 2001), with little discussion of how prosody interacts with the presumed syntax and semantics of these constructions. Hence one of the central goals of the present work is to fill this gap. In this paper, we present a production experiment designed to thoroughly compare the acoustic and prosodic properties of the two readings to find out whether their intonation profiles are distinct and, if so, how. As our experimental design made use of scripted scenarios to elicit the relevant readings, our study also contributes to exploring the nature and the role of context in this ambiguity. The study furthers the existing literature in several ways. First, we experimentally confirm how widespread the ambiguity of sentences like (1) is for native speakers of French, corroborating the importance of prosody and context in disambiguating them. Second, we provide the first characterization of the acoustic cues recruited for this task. The paper offers detailed acoustic analyses and prosodic descriptions of the French negative sequences and goes on to establish that prosody indeed distinguishes the two readings. We show that beyond individual variability, there are definable acoustic and prosodic correlates to each interpretation. This is interpreted as evidence that they involve distinct prosodic make-ups that can feed different semantic interpretations and/or syntactic structures. The paper also contributes further characterization of the prosody of focus in French as well as the role of focus in negative interpretation. Based on our empirical results, we discuss possible imports that these prosodic distinctions unfold for current theoretical models of negative concord and the mapping between syntax and semantics they propose. Our results are shown to offer a challenge to the assumption that the realization of a contradictory contour and correlative pragmatic processes are required to license double negative readings (Prieto et al., 2013, among others). This invites a reconsideration of the role of syntax/semantics interface and of some of the pragmatic aspects of these negative sequences.

The paper is organized as follows. In Section 2, we start by surveying the current empirical landscape in the literature regarding the accessibility of negative concord and double negation

readings in distinct languages (Section 2.1). Next, we briefly summarize the various theoretical models of NC and examine their predictions with respect to marked DN or NC readings (Section 2.2). We end this part by reviewing the results of the previous prosodic studies that compared the two readings in other languages with the goal of drawing from these works to avoid potential design pitfalls and foster stronger conclusions. We then turn to the discussion of our production experiment with Sections 3 and 4 explaining our experimental design and corresponding analyses. Section 5 reports our results, and Sections 6.1 and 6.2 discuss the prosodic structures they support. Section 6.3 ends the paper by putting our results in theorical perspective, discussing some of the more general outcomes they support and the further questions they raise.

2. Background.

2.1 Negative Concord and Double Negation readings cross-linguistically

When and how speakers access single or double negation readings in multiple negative sequences is a critically relevant issue in the long-standing theoretical debates on the nature of negative dependencies in general, and of negative concord constructions in particular as it bears on the nature of NCIs as negative terms (Zanuttini, 1991; Watanabe, 2004; de Swart & Sag, 2002; de Swart, 2009; Fălăuș & Nicolae, 2016; Déprez, Tubau, Cheylus, & Espinal, 2015). In recent literature, unexpected variation and disagreements have emerged questioning the classic empirical landscape carved by the threefold classification between DN, strict and non-strict NC languages[5]. In some NC languages like French, DN readings in negative spread constructions like (1), have been acknowledged to be quite readily available[6]. In others like Catalan, Spanish, or Italian, they are regarded as rare and marginal (Espinal & Tubau, 2016). Some of these generalizations, based on sometimes conflicting native speaker's intuitions, have been broadly confirmed experimentally. For instance, in an experiment where participants picked the picture best fitting the meaning of ambiguous transitive sentences with multiple NCIs, Déprez et al (2013) and Déprez et al (2015) showed that scenes representing DN readings were chosen at almost 50% in Standard European French, at 30% in Italian (Iacoponi & Déprez, 2017) and at 25% in Catalan (Déprez, Tubau, Cheylus, & Espinal, 2015). These studies revealed DN readings to be far more accessible than previously thought, even in the absence

[5] Although this classic classification has proved useful descriptively, much evidence has been offered that languages manifest mixed systems that challenge its potential theoretical validity (Déprez, 2011; Déprez & Poletto, 2019; Barouni, 2016; Espinal & Tubau, 2016; Szabolcsi, 2018), among others.

[6] Although the availability of DN readings has been experimentally confirmed in Déprez et al (2013; 2014) this does not however mean that such readings are easily found in naturalistic corpora. As Larrivée (2016) discusses, DN readings in corpora are quite rare and require specific contexts most often involving denial or contradiction.

of verbal contradiction-eliciting contexts. By uncovering crosslinguistic and language-internal variations with regard to ease of accessibility of DN readings in comparable conditions among non-strict NC languages, these works offer a more nuanced updated empirical landscape. Furthermore, for strict NC languages claims that DN is unavailable (Giannakidou, 2006) have been confirmed for some languages. For instance, in Basque, pictures representing DN were essentially never chosen by speakers (Etxeberria, Tubau, Deprez, Borràs-Comes, & Espinal, 2018). But for other languages, like Greek (Barouni, 2016), Romanian (Fălăuș, 2007; Iordachioaia, 2009), Mauritian Creole (Déprez & Henri, 2018), or Hungarian (Puskás, 2012) "exceptions" to the no-DN generalization have been repeatedly noted. DN readings were shown to be clearly available for native speakers under a range of conditions that included lexical distinctions among NCIs (Mauritian Creole), the necessary co-presence of interacting NCIs (Romanian), or the use of syntactic focalization (Hungarian). Here again, the empirical picture appears more complex than previously described, with some strict NC languages failing to license DN readings entirely, and others allowing them under distinct conditions. Similarly, while NC readings have long been claimed to be unavailable in standard English, recent experimental evidence has shown that they occur quite readily (Déprez, 2014; Blanchette & Lukyanenko, 2019). These authors argued that NC readings must be part of the grammar of American English, since speakers can assess constraints on their grammaticality independently of whether they acknowledge using them in their own idiolects. Similar controversy arose in German and Dutch where NC readings have been described as rare and marginal in the standard dialects (Zeijlstra, 2004) but are clearly instantiated in substandard dialects (Van der Auwera, De Cuypere, & Neuckermans, 2006; Van der Auwera, 2012). In view of such empirical findings, the status of marked readings (DN in NC languages, NC in DN languages) in the languages that allow them presents a challenge. Should the grammars of NC languages permit DN readings just like the grammars of DN languages do, albeit with possibly distinct constraints? Or on the contrary, should DN readings be considered as largely irrelevant to the grammar of NC languages, if as Espinal & Prieto (2011) have argued, they are pragmatically-triggered non-compositionally inferable outputs of denial mechanisms akin to metalinguistic negation (Horn, 1989)? Related questions also arise about NC readings in DN languages (Zeijlstra, 2010; Blanchette & Lukyanenko, 2019). Answers to these questions bear on the validity of syntactic models of negative dependencies that take DN and NC as consequences of syntactic macro-parametric options, or on the contrary defend the view that they are both language-internal options permitted by the grammar (de Swart & Sag, 2002; de Swart, 2009; Iordachioaia, 2009; Déprez, 2000; 2011).

Clearly, even if DN readings are marked, the fact that they can emerge at all is useful to probe what distinguishes negative dependencies that allow them from those that never do. The mere possibility of DN readings is one of the most solid empirical facts distinguishing negative concord constructions from other negative dependencies (Giannakidou, 2000; Zanuttini, 1997; Déprez, 2000; Déprez, 2011; de Swart, 2009). No amount of prosodic emphasis, contradictory contour, or context has ever been observed to license DN readings in sentences featuring interacting NPIs, an NPI and its licensing negation or even an NPI with an NCI. As such, a better understanding of the factors governing the availability of DN readings and the role that prosody can play as one of these factors appears to be central to inform empirically sharper and theoretically deeper accounts of negative concord and of negative dependencies generally.

2.2 The theoretical landscape of negative concord

A glance at the current theoretical landscape of negative concord dependencies reveals that there are three broad families of accounts predominantly distinguished by the semantic and morpho-syntactic representations assumed for NCIs, and sometimes the status of the sentential negative markers (Zeijlstra, 2004, and following). These do not make equivalent predictions as to the possible availability of DN readings in NCI sequences.

In the first family of accounts, NC is conceived as a type of agreement relation between dependent NCIs, assumed to be non-negative expressions with [uNeg] features with existential (~∃x) (or universal (∀x~) (Giannakidou, 2000)) denotations, and a unique (sometimes unpronounced) negative operator whose role is to license these NCIs both semantically and syntactically through a feature agreement relation. Such a model has been proposed for French by (Zeijlstra, 2004; 2008; 2010). Languages are taken to differ parametrically as to whether they allow negative agreement relations and feature or an overt or covert [+Neg] licensing negative marker. Strictly speaking the predictions of these approaches are that DN readings in sequences of NCIs are essentially not allowed by the grammar or the semantics of the Neg-agreeing languages. DN must emerge through special processes that condition the emergence of an additional abstract negative operator, possibly triggered by pragmatic denial (Puskás, 2012) or particular constraints on elliptic conditions (Fălăuș & Nicolae, 2016).

In the second family, NCIs are semantically negative expressions and concord readings result from a semantic process of resumptive quantification (May, 1990). On this view, sequences of NCIs, though not NCIs themselves, are predicted to be semantically ambiguous and to naturally derive either NC or DN readings depending on whether negative quantifier sequences are interpreted through scopal interaction (DN) or resumptive polyadic quantification (NC). Such

315 approaches proposed for French by Déprez (2000), De Swart and Sag (2002), and De Swart
316 (2009) do not include parametric distinctions between languages and predict that DN and NC
317 readings should also surface in languages like English or German. The challenge here is to
318 account for how languages differ in their NC/DN distribution and to understand how speakers
319 resolve the choice between scopal and polyadic quantification. For De Swart (2009), access to
320 NC and DN is regulated cross-linguistically through optimality-based language-specific
321 grammars and constraint reranking. This approach, however, does not deal with language-
322 internal variation.

323 Finally, for the third family, NCIs are ambiguous expressions sometimes semantically
324 negative, and sometimes not. The ambiguity of NCIs is approached differently in different
325 models and can be assumed to be either lexical (Herburger, 2001; Surányi, 2006);
326 morphological, with varying compositions of arbitrarily assigned interpretable or
327 uninterpretable negative features (Espinal & Tubau, 2016); or structural (Déprez, 2000). Yet
328 another type of ambiguity-based account views the shifting behavior of negative expressions
329 as due to a combination of NCI-internal binary or unary Neg features and a movement
330 operation (Neg-raising) that leads negative features to either semantically cancel one another
331 (-+- =+) or be interpreted (Collins & Postal, 2014). In a distinct perspective, Déprez (2011;
332 2018) proposes that the semantic interpretability of negative features is determined by a
333 dynamic computation that depends on the internal structure of NCIs and the structural position
334 they occupy. The general principle is that negative features can be semantically interpretable
335 only when they occur at phase edges where they become accessible to a higher domain of
336 computation. How negative features dynamically reach phase edge—both in the internal
337 structure of NCIs (internal phase) and in their sentence position (external phase)—matters for
338 the computation and can micro-parametrically vary across and within languages, although the
339 principle of negative interpretability at phase edge remains unchanged. Hence NC and DN
340 readings are subject to internal and external morpho-syntactic and structural conditions that
341 can vary both cross-linguistically and language-internally[7].

[7] Déprez's (2018) dynamic model allows for given NCIs to be semantically negative in some positions (i.e. when their Neg features occur at phrase edge through possible DP-internal or -external movement), or semantically non-negative in other positions (i.e.: when their Neg features remain buried inside a particular domain of computation). Empirical evidence in a variety of languages and dialects that manifest an internal mix between strict and non-strict NC confirms this possibility (Déprez, 2018; Déprez & Poletto, 2019). See also (Szabolcsi, 2018) for a distinct account of a related type of language-internal variation in Hungarian.

2.3 Previous studies on the intonation of double negative sentences

As with other linguistic ambiguities, intonation has been assumed to play an important role in favoring particular interpretations in negative sequences. Various suggestions as to how intonation affects the interpretation of sentences like (1) in French have been offered in the literature. Corblin (1996, p. 15) suggests that "If one of the negative quantifiers is stressed, the bi-negative reading is highly favored", while Corblin and Tovena (2003, p. 24) consider, more specifically, that DN readings arise if the first *personne* is emphasized. A similar intuition is reported in an early Linguist List post (1999) (Query Linguist list 10.1587 Negation in French) that informally surveyed French speakers on the interpretation of sentences like (1) and their relation to prosody. While a few speakers indeed felt that emphasis on the second syllable of the first *personne* was what governed their access to the double negation, others reported differing intuitions. For one speaker, emphasis on the first *personne* triggered a double negation reading featuring a purely existential interpretation of the NCI (someone loves someone). For yet others, it was the NC interpretation that stood out prosodically: it required a "symmetrical emphasis" on both NCIs. Finally, some speakers found that a DN reading required emphasis on the second NCI rather than on the first. In sum, and perhaps unsurprisingly, the post revealed interesting variability among French speakers' intuitions with respect to either the interpretation of these sentences or the relation they entertained with their prosody.

Remarkably, despite the numerous theoretical discussions of French multiple negative constructions in the literature (Muller, 1991; de Swart & Sag, 2002; de Swart, 2009; Corblin, Déprez, De Swart, & Tovena, 2004; Giannakidou, 2006; 2020for a recent survey and references cited therein) there has, as of yet, been no systematic investigation of their prosody and of the role that prosody could play in disambiguating or influencing their interpretation. This absence stands in notable contrast to studies on the intonation of multiple negative sentences recently conducted in other languages like English (Blanchette, Nadeu, Yeaton, & Deprez, 2018), Dutch (de Swart & Fonville, 2014), Afrikaans (Huddlestone K. M., 2010), Catalan, or Spanish (Espinal & Prieto, 2011; Prieto, Borràs-Comes, Tubau, & Espinal, 2013). Using various experimental methods, these works all provide evidence that prosody influences the interpretation of NCIs sequences or of isolated NCIs in fragment answers to negative questions. Generally, they highlight the conclusion that DN readings correlate with a special prosody, even if, at present, points of convergence regarding the characteristic features of this prosody remain elusive.

Four perception studies (Huddlestone (2010) and Huddlestone and De Swart (2014) for Afrikaans, Espinal et al (2016) for Spanish, and Espinal & Prieto (2011) for Catalan) associate DN readings with what they term a "contradictory contour". This contradictory contour is described as a sequence of H*L*L-H% for Huddlestone and a sequence of L+H* LM% (namely a rising pitch accent L+H* on the accented syllable followed by a complex boundary fall-rise pitch movement at the end) for Espinal and Prieto (2011) following Prieto et al (2013). Interestingly, these contradictory contours share similarities across the languages studied, particularly regarding the end of the contour. In most cases, the contradictory contour involved the combination of a low tone followed by a rising or fall-rise final boundary tone. These results suggest that in NC languages, a marked "contradictory contour" ending in a low tone followed by a high boundary tone succeeds in triggering DN rather consistently. Hence, the mapping of a contradictory contour to a DN interpretation appears likely, though not necessary. On the basis of their prosodic findings, Espinal & Prieto (2011) argue that DN readings in NC languages like Catalan and Spanish do not reflect the classic compositional computation of two semantic negations, but rather, the output of an inferential process of denial (Geurts, 1998). Utterance of an NCI with a corrective or contradictory contour conveys the rejection of a negative presupposition and yields a corrective positive reading as a conversational implicature. For instance, in the question-answer dialogue in figure 1, the NCI with the contradictory contour L+H* L!H% leads to a DN reading signifying that everyone ate dessert, because the negative presupposition of the question (someone did not eat dessert) is challenged and corrected by the speaker, hence deriving a positive interpretation through a denial mechanism (Geurts, 1998).

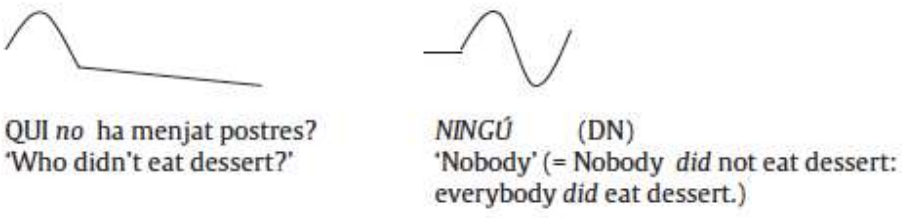

Figure 1: Schematized contradictory contour for the DN reading of a negative answer to a negative question in Catalan (Espinal & Prieto, 2011, example 11)

By the term "contradictory intonation contour" the author refers to the production of a contour used to deny a discourse-accessible proposition (Goodhue & Wagner, 2018). But as a contradictory contour is not unique to double negation sentences and can be used to deny

sentences of any polarity, this leads Espinal and Prieto to claim that DN readings are not encoded in the syntax or semantics of the NC languages they study.

In the perception studies reviewed here, no consistent mapping between NC interpretation and a particular contour was observed. More neutral contour perceptions were associated with greater speaker hesitation and variability both in Huddlestone (2010) and in Espinal and Prieto (2011). Likewise, in the production studies of Fonville (2013) and De Swart and Fonville (2014) in Dutch, the mapping between a particular pair of tones, i.e.: pitch accents on each of the NCIs in a binary sequence[8] and a given interpretation was not always constant. Although de Swart and Fonville identified a pair of tones that uniquely mapped to DN readings, namely (H* L*), they also found many DN readings that did not map to this tone pair. Concerning NC readings, no pairs of tones were found to uniquely map to this reading, although one (H*,-) was more frequently used than others. Although these studies offered a prosodic ToBI-based characterization of the stimuli, only one (Espinal and Prieto (2011)) provided a parallel phonetic/acoustic analysis to ground it. Additionally, the stimuli that participants evaluated were not always produced in naturalistic settings. The perception studies by Huddlestone (2010) used stimuli recorded by two speakers asked to produce distinct contours in absence of guiding verbal contexts, hence their stimuli reflect what the speakers thought constituted DN/ NC contours, not spontaneous elicitations. The production study of de Swart & Fonville (2014) embedded the tested sentences in verbal contexts designed to elicit NC or DN readings, yet the success of these contexts in eliciting the intended interpretations was not controlled for. Consequently, some of the variability in their results could well have arisen from a mismatch between the context and the speakers' actual interpretation that went unnoticed.

3 Research questions and Experimental design

The preceding sections observed that the prosody of acknowledged ambiguous French multiple negative sentences, has not yet been experimentally investigated. Moreover, at the outset of previous studies, whether and how distinctive acoustic or prosodic cues could be reliably identified or characterized for each reading remains inconclusive. The perception stimuli or the production realizations were rarely analyzed acoustically. Espinal & Prieto (2011) investigated prosodically marked question-answer pairs (as opposed to simple propositions), and fragment answers which are unambiguous in French (Corblin, 1994; 1995). When disambiguation

[8] This measure--not standard for intonation studies—delivered only a partial picture of the facts.

contexts were used, a description of their discourse characteristics was not provided, nor was their influence on interpretation verified. Our experimental design sought to address and avoid these potential issues which may have impacted these previous studies. In this section, we lay out the precise research questions our study means to answer, and the design of our production experiment intended to investigate them. Our central research questions were the following:

1. In French ambiguous sequences of NCI like (1), can the two possible readings—NC and DN—be distinguished acoustically and prosodically?

If so:

2. How do the two readings differ? More specifically,
    a. What are the acoustic/prosodic properties that characterize the NC reading?
    b. What are the acoustic/prosodic properties that characterize the DN reading?
3. What do the acoustic profiles reveal about the prosodic structure and its interactions with the syntax, the semantics, or the pragmatics of these ambiguous sentences?

To address these questions, we designed a carefully controlled production experiment in which participants were recorded reading aloud simple ambiguous transitive sentences that featured two NCIs—*personne* and *rien*—respectively in subject and object positions. The sentences were embedded in contexts manipulated to elicit the distinct interpretations.

3.1 Elicitation paradigm: Context-guided production

Thirty-two experimental context-target pairs were created with eight items in each of four experimental conditions (DN, NC, NegSub, NegOb):

1. NC: transitive sentences with two NCIs presented in a negative concord targeted context
2. DN: transitive sentences with two NCIs presented in a double negative targeted context
3. NegSub: transitive sentences with one NCI in subject position, and a non-negative object
4. NegOb: transitive sentences with one NCI in object position, and a non-negative subject

An additional eight fillers were included to serve as behavioral controls that did not feature any NCIs (see appendix for the complete list of stimuli). In the DN and NC conditions, the target sentences were constructed to be maximally ambiguous by featuring two pronominal NCIs with simple highly frequent transitive predicates. Their ambiguity was previously confirmed in a picture choice task (Déprez, Cheylus, & Larrivée, 2013) showing that sentences with two pronominal NCIs mapped to DN and NC interpretations almost evenly, while sentences with

more complex NCI DPs (e.g.: *aucun enfant* – no child), favored DN, and were avoided in this experiment. Identical target sentences were used in both the DN and NC conditions to maximize comparability at the phonetic and acoustic level, with only minor changes to sentence-final prepositional phrases.

To ensure that participants accessed the interpretation directed by a given context, we introduced a meaning control task. Each experimental item was followed by a verification statement that participants judged as true or false. They served to verify the speaker's interpretation and corresponding produced prosody. They also evaluated the extent to which the contexts were successful in guiding the interpretation.

To illustrate, consider the NC context in (12a). Here, if the interpretation of the target sentence (12c) matches the NC context intention (12a), the verification statement (13) "they don't drink alcohol" is expected to be true, since everyone in the family is allergic to alcohol. By contrast, judging (13) as false would signal a DN interpretation ("no one fails to drink at parties") of the target sentence (12c) as expected in the context (12b) which states that the consumption of alcohol among the youth has reached frightening levels.

(12) (a) NC context:
Dans notre famille, on est tous allergique à l'alcool
My whole family is allergic to alcohol
(b) DN Context:
Chez les jeunes, la consommation d'alcool est effrayante
Among young people, alcohol consumption is alarming
(c) Target sentence:
Personne ne boit rien dans les soirées
Nobody drinks nothing/anything in parties
For both 12(a) and 12(b), the verification statement was 13.
(13) Ils ne boivent pas d'alcool
They don't drink alcohol

In the NegSub (14a) and NegOb (14b) conditions, the verification statement kept task homogeneity and controlled for participants' interpretations of unambiguous sentences. They further provided a prosodic baseline to compare the production of NCIs in a single negative condition against the potentially more complex multiple negative NC and DN conditions. True and false responses were counterbalanced within each condition.

(14) NegSub Condition
(a) Dans ce bar, il y a de l'ambiance et on consomme beaucoup d'alcool :
In this bar, the atmosphere is vibrant, and people drink a lot of alcohol

Personne ne boit d'eau ici.
No one drinks water here.

NegOb Condition
(b) Quand on sort, il faut un chauffeur sobre :
When we are going out, we need a sober driver
Raoul ne boit rien aujourd'hui.
Raoul drinks nothing today.

3.2 The Verbal stimuli: prosodic properties

In all the critical conditions and fillers, the target sentence featured at least seven syllables: two for the subject, one for the pre-verbal *ne* particle, one for the verb, one for the object, and between two and five syllables for a sentence-final prepositional phrase. This sentence-final PP was included to keep the object NCI tone separate from the sentence final boundary tone to avoid masking other relevant prosodic signals. Wherever possible, sonorant use was maximized to facilitate F0 measurements. The same eight high-frequency monosyllabic verbs were used in the present tense across all four experimental conditions to maintain canonical SVO word order.

In the NegSub condition, the subject was the same pronominal NCI as in the DN and NC conditions and the object was a non-negative monosyllabic DP (e.g.: *l'eau* – water) or pronoun (e.g.: *ça* – this) to keep syllable count constant across conditions. In the NegOb condition, all subjects were bisyllabic DPs to maintain syllable count for comparison across conditions.

3.3 Context design

While the contexts in the NegSub and NegOb conditions simply set up a situation where the target sentences were natural continuations, the contexts in the DN and NC conditions were manipulated to guide the interpretation of the ambiguous target.

As many authors have observed (Horn, 1985; Puskás, 2012; Larrivée, 2016), DN readings are notably facilitated in contexts that trigger the contradiction or denial of a previous negative utterance or presupposition. Moreover, such facilitation effects obtain in DN languages like English or Dutch, as well as in NC languages like Hungarian, Spanish , Catalan or French (Horn, 1991; Puskás, 2012; Szabolcsi, 2018; Déprez, Tubau, Cheylus, & Espinal, 2015; Larrivée, 2016). spanning across the classic DN and NC language divide. Due to their crosslinguistic effects then, contradictory contexts do not offer very useful grounds to help

understand the potential contribution of morpho-syntax or semantics in allowing access to DN readings. We hence chose to steer away from pragmatic contradiction in designing our DN elicitation contexts to avoid potentially confounding effects. Our DN contexts did not use any negative propositions, or statements or presuppositions that would have led speakers to interpret the target sentences as corrective or contradictory with respect to the contexts. They presented simple assertive statements that described situations compatible with a DN reading for our target sentences, offering contingent generalizations that would come to be reinforced by a DN reading. Consider (15).

(15) a. Dans notre école, les profs veulent tous donner leurs avis.
At our school, the teachers all want to express their opinions
b. Personne ne dit rien pendant les réunions.
Nobody says nothing/anything during meetings

In this example, a generalization is stated about the teachers of a given school, asserting that they are highly opiniated people eager to express their viewpoint. This sets up a situation where they are unlikely to remain silent. The question under discussion (QUD) relevant to (15b) is: Who says what in meetings. Coherence with the context guides an interpretation that discourages alternatives in which someone remains silent, i.e.: says nothing. (15b) strengthens this by asserting that nobody did. In contrast, (15b) under a single negative NC reading (asserting people were silent) clashes with the situation set up in this DN context. Our DN contexts were all designed in this way, with the particular goal of gauging whether French speakers could access DN readings without the help of the peculiar pragmatic facilitation that a contradictory reading sets up. The absence of contradictions also allows us to examine whether a DN prosodic contour could differ from the contradiction contour discussed in previous literature (Liberman & Sag (1974), Ladd (1979, p. 150), Pierrehumbert & Hirschberg (1990)), in particular for metalinguistic negation (Puskás, 2012; Portes & Reyle, 2014).

3.4 Pseudorandomization

To avoid ordering effects and the priming effects the interpretation of one sequence could have on another, the items were pseudorandomized in blocks with a different list order for each participant. In the blocks, no two items from the same condition appear consecutively, and the contrastive DN/NC pair for a given target sentence (as in 14(a) and 14(b)) were never part of the same block. All participants saw all 40 items.

3.5 Recording procedure

Recordings took place in a quiet office at the Institute for Cognitive Sciences at the University of Lyon, France. Participants received a written informed consent approved by the Institutional Review Board of Rutgers University and were seated comfortably in front of a computer monitor wearing an Asus Orion PRO gaming headset with a noise filtering microphone used for the recordings.

Participants were instructed to first read silently the context and target sentences to ensure good understanding of their meaning (Figure 2, A). Then, they pressed the space bar to begin recording the items read aloud in their entirety, as though they were talking to a child, to encourage lively and naturalistic rendering (B). Once satisfied with their recording, the participant pressed the space bar to stop (C) and proceed to the verification statement judged by pressing either the V or F key (French for Vrai (true) or Faux (false)) on an AZERTY (French layout) keyboard. Their response triggered the next trial. Participants received two practice trials, to familiarize themselves with the paradigm, followed by the 40 experimental items. Finally, they filled out a short demographic questionnaire and were debriefed. The whole session lasted about 20 minutes from start to finish.

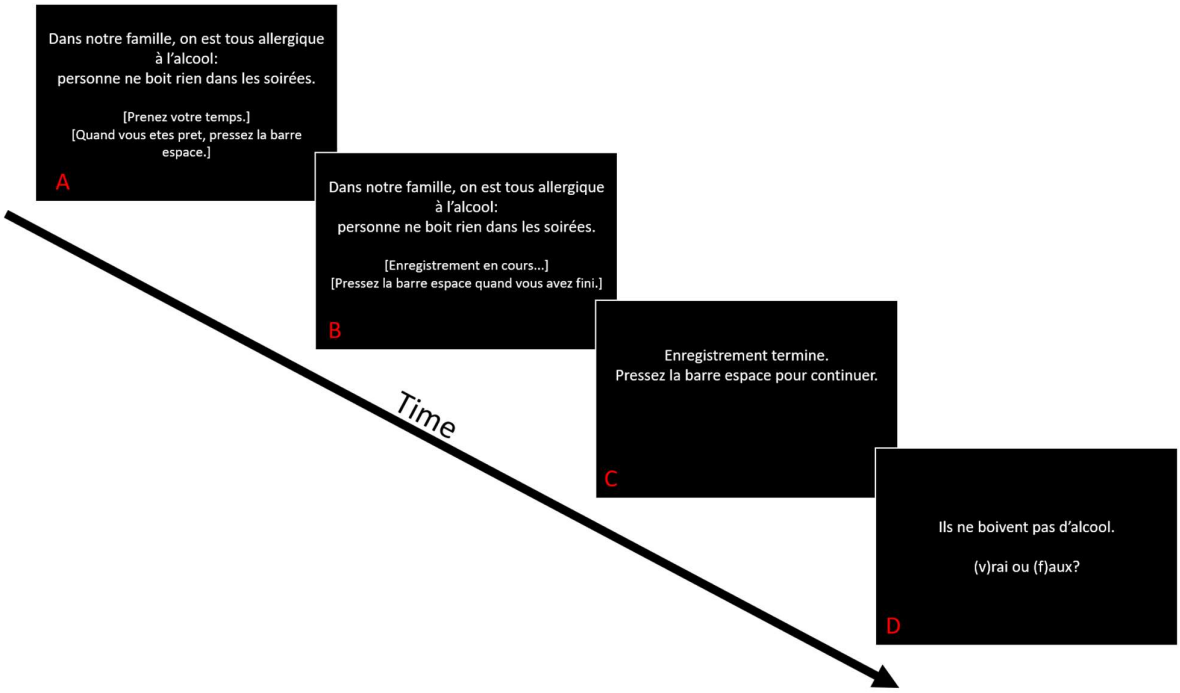

Figure 2. Single trial schematic for production experiment. A) Participants read the context and target silently, then pressed the space bar to begin recording. B) Participant recorded context and target read aloud and C) pressed the space bar to end recording. D) They judged the verification statement by pressing V or F.

3.6 Participants

28 monolingual native speakers of continental French—from various regions but residing in Lyon—participated in the experiment (18F, aged 18-45). They were compensated 10 EUR for their time.

3.7 Exclusion Criteria for the prosodic analysis

To accurately characterize the prosodic features of the DN and NC readings, we needed to be certain a) that the productions reflected the contextually intended meaning, and b) that the participants had access to both the DN and NC interpretations, as participants unable to access both are unlikely to produce a distinguishing prosody.

For a), assessment of T/F responses to verification sentences revealed that contexts were quite successful in guiding the DN/NC interpretation. Context-congruent responses were given in 79.9% of DN & NC trials (see Figure 3), confirming the strong ambiguity of these sentences for French speakers. The influence of context was slightly higher in the NC condition (mean = 87.05%, $t = 10.439$, $df = 27$, $p = 5.608e\text{-}11$) than in the DN one (mean = 72.77%, $t = 4.0083$, $df = 27$, $p = 0.0004329$), but was significantly above chance in both cases.

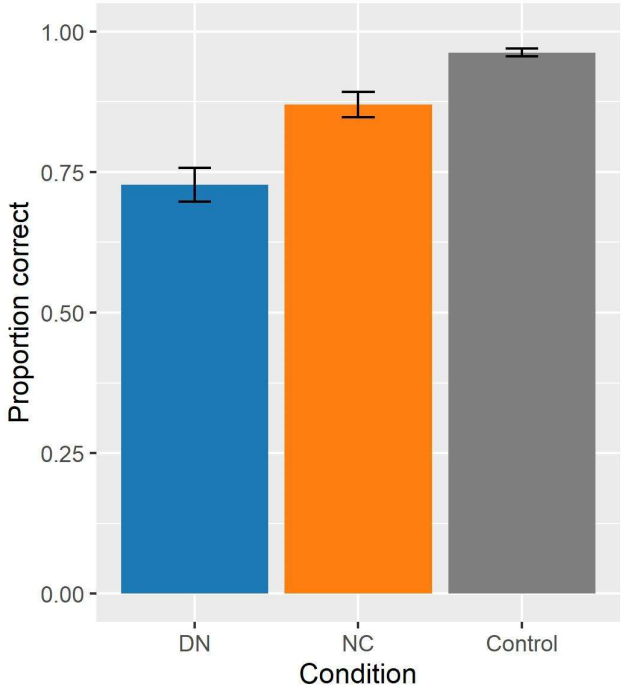

Figure 3: Percent context-matching responses by condition. Participants performed at ceiling for the single negative controls and filler items. Error bars represent 95% confidence interval.

We used the results of these verification statement responses to select participants regularly accessing both readings. Eight participants who did not were excluded from our acoustic analysis (see supplementary materials for details on the exclusion procedure). From the productions of the remaining 20 participants, our acoustic analysis included only items with context-matching interpretations (excluded n = 65; see Table 1 for a breakdown). The acoustic analysis hence included 277 and 298 recordings in the critical and control conditions respectively, for a total of 575 productions.

Table 1: Number of items per condition used in prosodic analyses. The numbers here are each out of a possible 160 (20 participants × 8 items per condition).

Condition	**Structure**	**Abbreviation**	**n**
Double Negation	NCI-NCI	DN	137
Negative Concord	NCI-NCI	NC	140
Subtotal Criticals			277
Single Negative Object	DP-NCI	NegOb	149
Single Negative Subject	NCI-DP	NegSub	149
Total			575

4 Analyses

4.1 Acoustic Analysis

The target sentences were excised from the context using Audacity 2.0.6 and time-aligned, matching phonemes and syllables to the waveform in Praat (Boersma & Weenink, 2009) using EasyAlign (Goldman, 2011). The Praat plugin ProsodyPro (Xu, 2013) was then used to extract fundamental frequency (F0) values, and syllable duration.

4.2 Variables under consideration

For each syllable, ten time-normalized (i.e., uniformly sampled over the duration of the syllable) F0 values, as well as a maximum and minimum F0 were extracted. Syllable duration was z-score transformed. The time-normalized F0 values were z-score transformed and used as the baseline to z-score the maximum and minimum F0 values. Z-score absolute values ≥3.0 for the syllable duration and time-normalized F0 data, and ≥5.0 for the syllable maximum and minimum values were excluded. Two additional measures were calculated on these data: syllable range (max F0 minus min F0), and a "drop" or down step value, calculated as the maximum F0 of syllable *n* minus the minimum F0 of syllable *n*+1.We set two a priori windows of interest for the analysis: 1) the first six syllables and 2) the last two syllables of the target sentence. Window 1 comprised the subject (2 syllables), the French *ne* particle (one syllable), the verb (one syllable), the object (one syllable), and the first syllable of the sentence-final prepositional phrase. Window 2 comprised the final two syllables[9] making up the sentence final contour. The time-normalized F0 values were meaned by participant and condition in each of our two windows of interest to create a characteristic contour for each condition.

4.3 Planned tests

For each time point in window 1, a t-test was performed comparing the means of the DN and NC conditions (6 syllables * 10 time-normalized values per syllable = 60 tests). These t-tests employed a false discovery rate (FDR) correction with a threshold of 0.05, to correct for multiple comparisons (Benjamini & Hochberg, 1995). The same comparison was employed for the sentence-final window. In addition to this overall comparison, we used t-tests to

[9] In some items (n = 3), the first syllable of the prepositional phrase was also the penultimate syllable, and therefore would appear in both windows of interest.

compare the duration, max F0 and min F0 values, as well as the range and "drop" values for the NC and DN conditions at each syllable in the first window.

4.4 Exploratory tests

Once the data were known, we conducted equivalence tests (Lakens, 2017; Lakens, Scheel, & Isager, 2018) at each point in the object syllable and the first syllable of the prepositional phrase (20 points), pairwise comparing each condition to the other three to determine at what points the conditions were statistically equivalent to one another. The threshold for the equivalence tests was set to +/- 0.25, with an alpha of 0.05.

We now turn to the results of our production study.

5 Results

The goal of our experiment is to uncover whether acoustic and prosodic cues are consistently employed to distinguish between our experimental conditions, most critically DN and NC. This section first describes and compares the F0 contours that characterize the DN and NC conditions across the whole sentence (cf. Section 4.2). Next, the regions where our statistical analysis revealed significant differences between DN and NC are discussed, followed by a more detailed analysis mostly on duration. Finally, the DN and NC conditions are compared to the NegSub and NegOb control conditions.

5.1 Overall F0 contour: Comparison between DN & NC

A representative sample rendering of two distinct productions of the same sentence by the same speaker, one with a DN interpretation and the other in an NC interpretation is given in Figure 4.

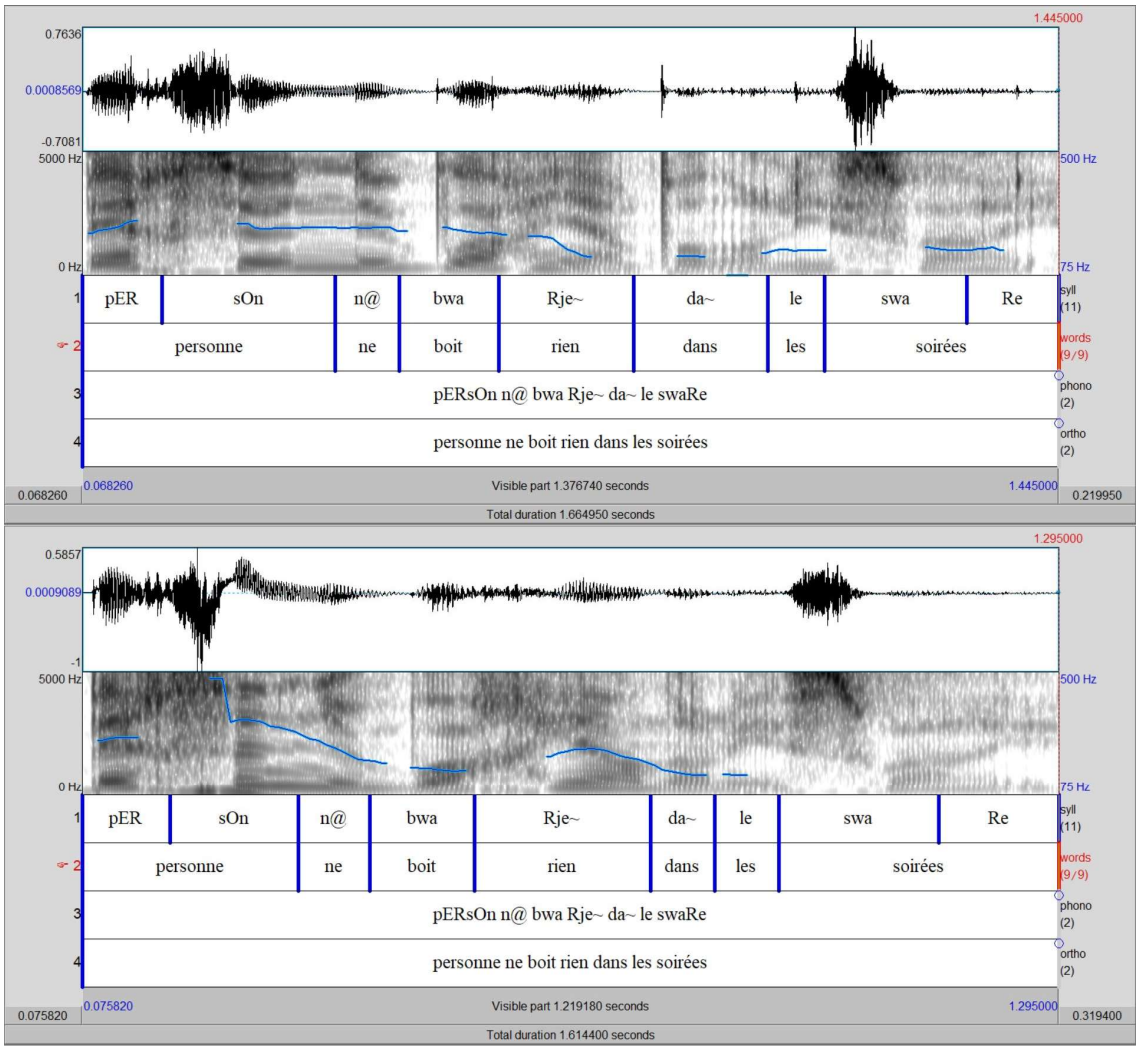

Figure 4. Praat images of representative NC (top) and DN (bottom) productions by the same speaker. Note the blue curve plotted over the spectrogram indicating F0.

DN and NC present essentially the same overall melodic contour characterized by two peaks on the final syllable of each of the NCIs and a falling tone after each, with an overall falling final tone (L%) and a general falling baseline. Characteristically, in the DN rendering, the two peaks appear far more pronounced and higher. These distinctions and overall melodic curve are confirmed when an averaged contour is computed over the entire set of speakers' productions included in this acoustic analysis (Figure 5).

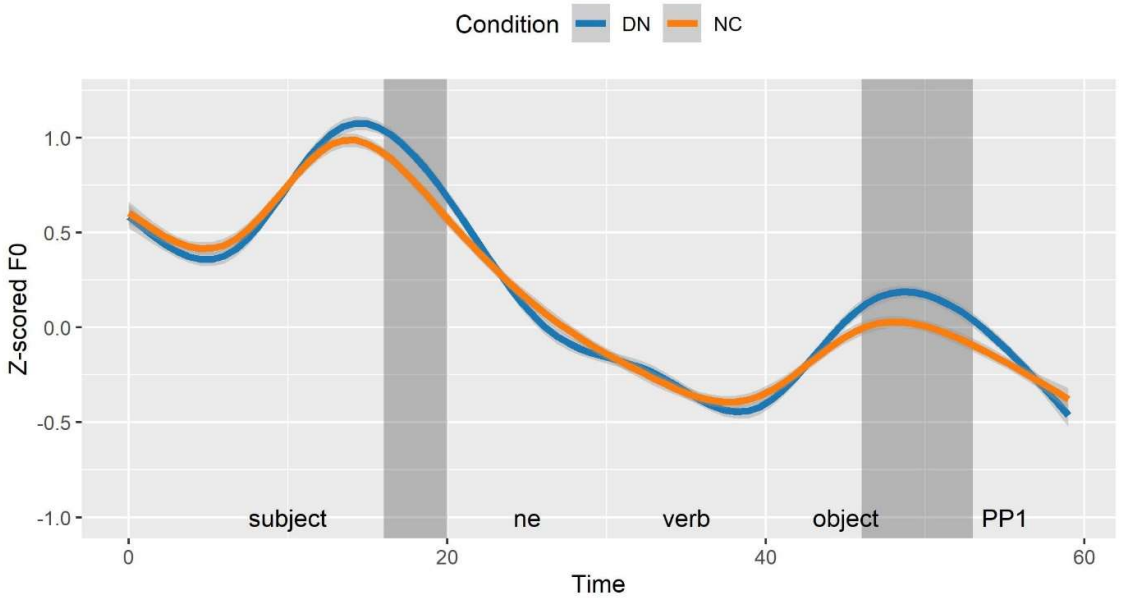

Figure 5: Prosodic contours in the critical conditions. Shaded bars indicate regions where the conditions differ significantly. The x-axis is in normalized time points (10 per syllable).

This averaged contour shows that both the DN and NC conditions follow largely the same melodic form: an overall falling contour with two strong peaks—the first on the second syllable of the subject NCI and the second on the main syllable of the object NCI—with the second lower than the first. As this melodic shape parallels that of our single negative control sentences, as well as the contour of simple transitive affirmative statements as schematized in Vaissière and Michaud (2006) reproduced in Figure 6, it is insufficient to distinctively characterize our ambiguous multiple negative sentences.

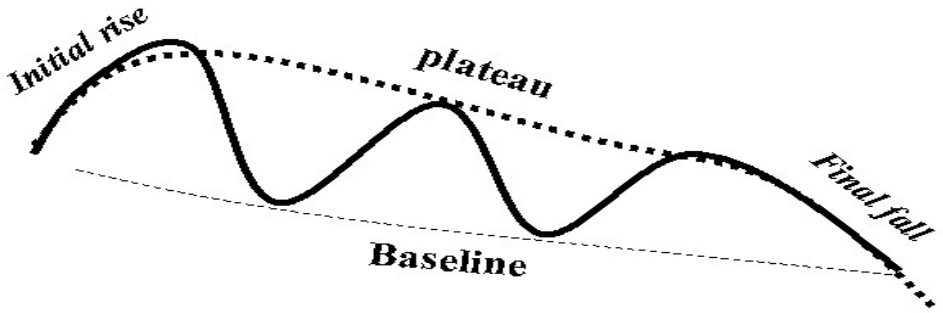

Figure 6: French sentence contour schematization reproduced with permission from Vaissière et al (2006).

When tests are performed by time point (see Section 4.3) on the whole sentence, however, the results reveal two regions of significant difference between two core conditions (NC and DN, cf. gray bars in Figure 5). The first region where the means differ significantly (3 consecutive time points, mean corrected p = 0.0052, mean t = 4.5558) occurs towards the end of the NCI-subjects, just past the highest point of the peak. The second, larger region of significance (6 consecutive time points, mean corrected p = 0.0108, mean t = 4.0904) arises at the peak and at end of the NCI-objects and continues into the first syllable of the prepositional phrase. The conditions did not differ significantly from one another elsewhere. Crucially, both regions of significant difference occur about the NCIs, with the DN realization at a significantly higher F0 than the NC one. The characteristic difference is thus more one of pitch span than tonal melody.

5.2 Comparison between DN & NC – Sentence-final F0 contour

When focusing on the sentence-final window, we found that both the DN and NC conditions follow the same general final falling contour (supplementary Figure S4). Notably, the two conditions do not significantly differ at any time point in our sentence-final window. This result contrasts with previous experimental work on the prosody of DN and NC in Catalan and Spanish (Espinal & Prieto, 2011) for which the DN interpretation was characterized by a contradictory contour. A final fall-rise tone, typical of a contradictory contour is not observed in our data. Significant differences are on or around the NCIs, a result which points away from an utterance-level contradiction contour.

5.3 Comparison between DN & NC – Other F0 measures

Comparison of maximum and minimum F0 values for each syllable in both of our windows revealed a significant difference in maximum F0 on the NCI-objects, where the DN condition was significantly higher than the NC condition (t = 2.0721, df = 37.999, p-value = 0.04509). The drop from the maximum F0 on the NCI-objects to the minimum F0 of the first syllable of the prepositional phrase approached significance in the anticipated direction of effect but did not meet the alpha threshold (t = 1.9539, df = 37.183, p-value = 0.05827). No other comparisons of max or min F0 values revealed significant differences.

5.4 Comparison between DN & NC – Duration

Differences in NCI duration, as well as on overall syllable duration across our primary window of interest were found. When both NCIs are taken together, those in the DN condition were overall significantly longer (t = 3.3259, df = 109.6, p-value = 0.0012, Figure 7). When examined individually, the NCI-subjects are significantly longer in the DN than the NC condition (t = 2.8452, df = 72.51, p-value = 0.005765). However, for the NCI-objects the difference does not reach our significance threshold (t = 1.711, df = 34.824, p-value = 0.09598). When grouped together with the verb to evaluate potential phrasing of the verb with the subject or the object (see Avanzi et al. (2014) for evidence that monosyllabic verbs can be prosodically phrased together with a subject in French), we found that in the DN condition, groupings of NCI and verb were significantly longer for both the (subject + verb) potential phrase (t = 2.7493, df = 149.95, p-value = 0.006707), and the (verb + object) phrase (t = 2.4923, df = 76.054, p-value = 0.01487) than in the NC and other conditions. Overall syllable duration across the six syllables in the first window was also significantly longer in the DN condition than the NC one (t = 5.6176, df = 214.41, p-value = 5.972e-08).

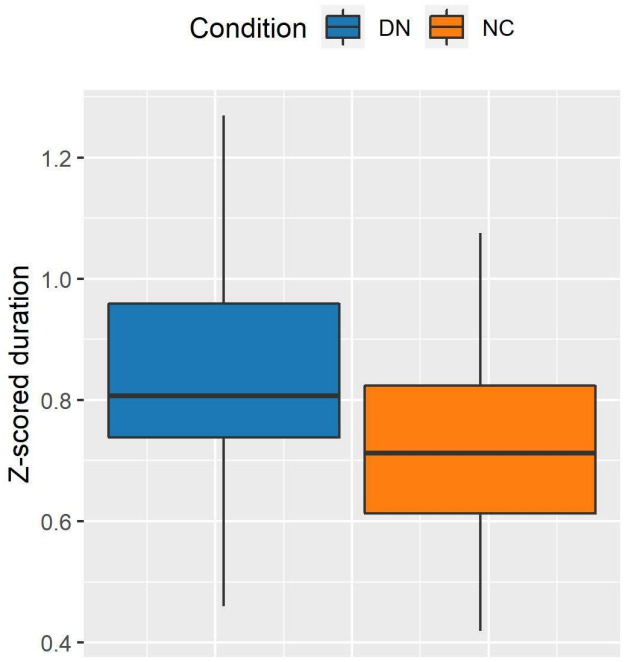

Figure 7: Duration of NCIs. NCIs are significantly longer in the DN than the NC condition.

5.5 Comparison of DN and NC readings to single-negative controls NegSub, NegOb

Following our analyses of the DN and NC conditions, we enlarged the comparison to the single-negative controls. Regarding melody, we first observed that in the NegOb condition, the non- negative-DP subjects manifested a lower and more delayed peak than the NCI-subjects in all the other conditions (Figure 8A). This is consistent with NCI-subjects being focused, not just in the DN condition, but also when they occur in the NC or NegSub conditions (Figure 8B). Furthermore, examining the object position, we noted that the melodic curve of the NCI-objects in the DN condition not only differed from the NC condition but also closely paralleled that of the NegOb condition (Figure 8C). In contrast, the melodic curve of the NCI-objects in the NC condition appeared qualitatively more similar to that of the non-negative-DP objects in the NegSub condition (Figure 8D). To test these similarities, we used equivalence tests (Lakens, 2017) to determine where the conditions could be considered statistically equivalent to one another.

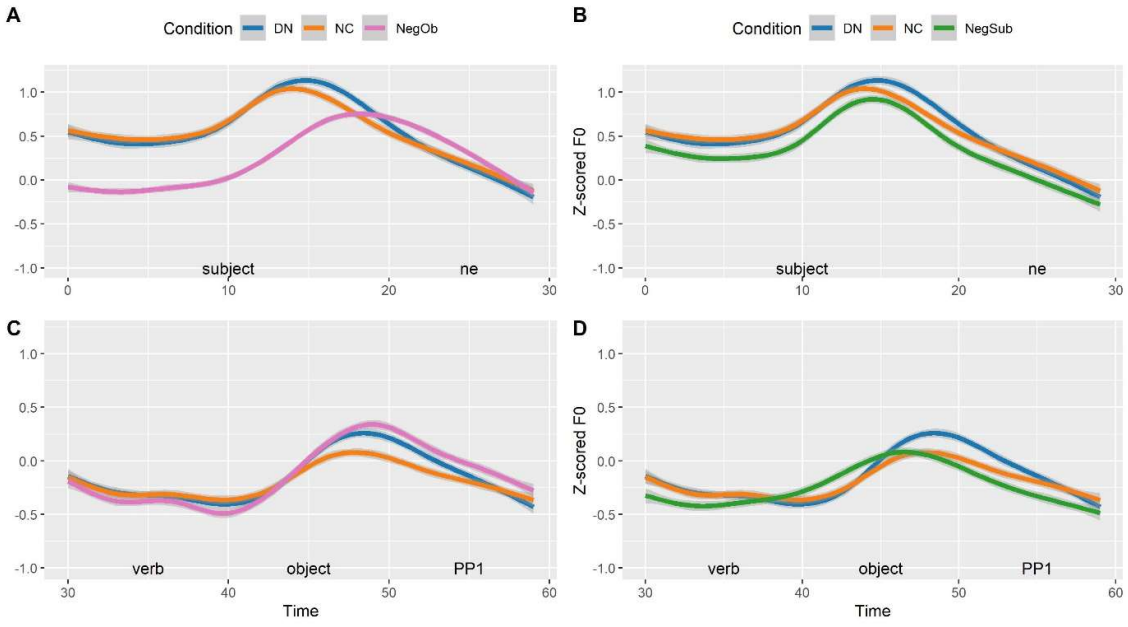

Figure 8. Critical (DN & NC) conditions compared to NegOb (A,C) and NegSub (B,D) conditions during the first part of the utterance (onset to just before the verb—A,B), and latter part of the utterance (verb to the onset of the PP—C,D).

In the 6-time-point window on the object where the DN and NC conditions statistically differ, we found that the DN and NegOb conditions are statistically equivalent for 3 time points and the NC and NegSub conditions for 2 time points. By contrast, there are no statistically equivalent points between the DN and NegSub or the NC and NegOb conditions. This confirms the visual parallelism perceived in the respective curves.

When enlarging the duration comparison to include the baseline conditions of NegSub and NegOb, we observed first that duration for NCI-subjects—which was significantly greater in the DN than NC condition—was also significantly longer in the DN than in the NegSub condition ($t = 2.1721$, $df = 37.112$, p-value = 0.03631) and in the NegOb condition for the non-negative-DP subjects ($t = 15.395$, $df = 34.298$, p-value < 2.2e-16). In contrast, the duration for NCI-subjects did not differ in the NC and NegSub conditions but was significantly longer than non-negative-DP subjects in the NegOb condition ($t = 13.952$, $df = 29.854$, p-value = 1.289e-14). In sum, the duration of the NCI-subjects is significantly longer in DN than in all other conditions. On the other hand, the duration of NCI- subjects in the NC condition, though shorter than DN, does not differ from the NegSub condition and is significantly longer than the non-negative DP subjects of the NegOb condition.

Second, the duration of NCI-objects in the DN condition was not significantly different from the NC or the NegOb condition ($t = -1.5562$, $df = 37.998$, p-value = 0.1279), but was significantly longer than non-negative-DP objects in the NegSub condition ($t = 13.559$, $df = 37.527$, p-value = 4.87e-16). In contrast, NCI-objects were significantly shorter in the NC than in the NegOb condition ($t = -3.4759$, $df = 34.686$, p-value = 0.001388) but longer than non-negative DP objects in the NegSub condition ($t = 13.905$, $df = 36.589$, p-value = 3.544e-16).

These data are compatible with the view that NCI objects are focused in the DN condition and possibly in the NegOb condition but deaccented in the NC condition and phrased with the verb, essentially like non-negative objects.

The absence of an increased duration on the NCI-objects in the DN as compared to the NC condition appears surprising. But since the NCI-object is monosyllabic, we conjectured that lengthening could have spilled over to the following PP. And indeed, when measuring the combined duration of the NCI-object plus that of the first syllable of the following PP (PP1), the DN condition turned out significantly longer than both the NC condition ($t = 8.0744$, $df = 37.431$, p-value = 1.016e-09) and the NegOb condition ($t = 7.3437$, $df = 36.447$, p-value =

1.086e-08). Furthermore, in both of these latter conditions, as expected, the NCI-object + PP1 is significantly longer than a non-negative DP object + PP1 in the NegSub condition ($t = 19.548$, $df = 33.46$, p-value < 2.2e-16). Pursuing the duration comparison of the object + PP1 measure, the results show no difference for NCI-objects in the NC and NegOb condition ($t = -1.0997$, $df = 37.725$, p-value = 0.2784) but a difference between NCI-objects in the NC condition and non-negative DP objects in NegSub ($t = 11.537$, $df = 35.65$, p-value = 1.367e-13). In sum, there is evidence that object duration spilled over to the first syllable of the PP, with the DN condition showing greater duration than all the other conditions, paralleling what we observed for the object in F0 height, where the NCI-objects manifest a higher peak in the DN condition than in all the other conditions. Hence the most salient distinctions in melodic height and rhythmic duration cumulated on the NCI-object in the DN condition.

5.6 Summary of results

Based on the acoustic data, we found that the DN and NC recordings were distinguished in two ways. First, they differed significantly in F0 on the NCIs, with the DN reading being realized higher than the NC one. Second, in the DN readings syllable duration was consistently longer overall, as well as on the object NCI (+PP1) specifically. Furthermore, in the object position time window where the DN and NC conditions most differ, we observe statistical equivalence between the DN and the NegOb condition at several time points and between the NC and the NegSub condition where the object is a non-negative DP at several time points Finally, we found that in the sentence-final window the DN and NC conditions do not significantly differ in F0, meaning that the sentence final contour does not distinguishing between the conditions.

6 Discussion

6.1 Characterizing the prosody of French ambiguous multiple negative statements

In this section, we consider our results in terms of what they reveal about the prosodic analysis of French multiple negative sequences. Following a brief recap of the core features of French prosody, we return to our research questions and, based on our quantitative results, offer a prosodic characterization of each of our four conditions.

The autosegmental-metrical (AS) framework, which frames our discussion here, conceives of intonational tune as composed of a structured sequence of underlying H and L tones, with some tones associating with metrically prominent syllables to form pitch accents, and others marking the edges of prosodic constituents. What distinctly characterizes French prosody is that accents

806 are defined at the phrasal level, not lexically as in Italian or English. In French, three levels of
807 prosodic constituents are commonly distinguished: the Accentual phrase (AP) which has a
808 tonal pattern (L (H L)H*) with a final H* tone that has a demarcative function[10]; the
809 intermediate phrase (iP), distinguished by phrasal tones coded T-; and the larger intonational
810 phrase (IP), marked with a final boundary tone coded T% (Jun & Fougeron, 2000). Two
811 phonetic cues are well-known to distinguish among AP, ip, and IP boundaries, namely F0 peak
812 height, and vowel duration (Michelas & German, 2020). So, besides pitch, the final accented
813 syllable of a French rhythmic group is characterized by a significantly longer duration than the
814 syllable preceding it (Jun & Fougeron, 2002). An AP final H*, however is preempted by a
815 higher level (IP) boundary tone and is generally realized as a L% in declarative statements.
816 How focus is marked in French remains controversial. For some authors, focus is manifested
817 by a large, sharp rise and fall in pitch contour and an increased duration on the focused element
818 (Rossi, 1985; Touati, 1989; Di Cristo & Hirst, 1993; Clech-Darbon, Rebuschi, & Rialland,
819 1999; Di Cristo, 1998). Material following the focus presents a reduced melodic register and
820 is described as "flat", "deaccented" or "dephrased" (Touati, 1989; Di Cristo, 1998; Clech-
821 Darbon, Rebuschi, & Rialland, 1999), though as Jun and Fourgeron (2000) have argued, a post-
822 focus sequence while deaccented, is not always dephrased, as duration of AP-final syllables is
823 often maintained. For Féry (2001) phrasing, rather than pitch accent, is what characterizes
824 French focus. She argues that a focused constituent forms its own phrase, with its own tonal
825 structure, and sometimes short breaks before and/or after the phrase boundaries. She provides
826 experimental evidence that after a focused subject, the remainder of a sentence is realized with
827 a low intonation and no correlates of phrasing, and when an object is focused, it is phrased
828 separately, and the following (but not the preceding) material is dephrased. Finally, as Avanzi
829 et al (2014) have shown, French verbs are sometimes independently phrased and sometimes
830 dephrased, depending on their prosodic weight.

831 With this brief summary of French prosody and our acoustic results we now return to answer
832 our original research questions concerning the prosody of multiples negative sentences,
833 repeated here below:

[10] In APs with fewer than four syllables, either the H tone, the following L tone, or both fail to be realized, leaving a single rising tonal pattern LH*. This is what happened here, with the bi-syllabic subjects in our experimental stimuli.

1. In ambiguous sequences of NCI like (1) in French, can the two possible readings—NC and DN—be distinguished phonetically, acoustically, and prosodically?

If so:

2. How do the two readings differ? More specifically,
    a. What are the phonetic/acoustic properties that characterize the NC reading?
    b. What are the phonetic/acoustic properties that characterize the DN reading?
3. What do these prosodic profiles reveal about the prosodic structure and its interactions with the syntax, the semantics, or the pragmatics of these ambiguous sentences?

Our acoustic results allow us to answer our first research question positively. It is clear that when uttering ambiguous sentences with multiple NCIs, speakers produce characteristic acoustic distinctions when conveying the DN vs. the NC interpretation. The DN and NC readings differed in the F0 domain, where our analysis identified two regions of statistically significant contrast: the first on the second syllable of the subject NCI, and the second on the end of the object NCI leading into the first syllable of the following word. On the subject NCI, it seems that the distinction is at least in duration and possibly to a lesser extent in the height of the peak. On the object NCI, the distinction is clearly on the height of the peaks as well as on the duration. What characterizes the NC reading acoustically then, is a slightly lower earlier[11] peak on the NCI subject, and a distinctively lower peak on the object NCI. By contrast, the DN reading is characterized by a slightly offset, more pronounced peak on the subject and a significantly higher peak on the object, as well as by a significant lengthening of the last syllable for both NCIs.

Although statistically significant, these differentiating measures do not constitute a prosodic analysis for these readings, since such an analysis must be based on rhythmic structure assumed to be perceivable by speakers. The question of perception will be addressed in a forthcoming companion paper presenting a perception experiment. Here we offer a prosodic characterization of the two readings in the following section.

6.2 Framing acoustic results within current prosodic models

We turn now to a discussion of how our acoustic results can be analyzed within a current AS prosodic model to characterize the prosodic contour of each of our conditions. The fact that the NCIs present longer duration and are the only areas of difference in F0 is consistent with the view that they are focused. We further suggest that the NC and DN readings are characterized by a phrasing difference, consistent with Féry's view that focus in French is expressed at least

[11] It is possible that the slight distinction in the peak on the first NCI in the NC vs DN condition is influenced by the duration distinction. Duration being significantly longer in DN, the peak occurs slightly later.

as much through phrasing as through pitch accent. We now consider the prosodic profile of each reading in more detail.

For NC, the prosodic analysis we propose is represented in (16). We suggest that the subject NCI *personne* is focused, forming its own accentual phrase with a low tone on the first syllable, and a high boundary tone marking the subject accentual phrase on the second syllable. The object NCI, on the other hand, though bearing the phrasal H* of the VP, is deaccented.

(16) NC: Focus on *personne*; *rien* is deaccented and phrased as part of VP

L H_f* L L H* L%

(([$_{DP}$Personne]$_{AP}$) ([$_{VP}$ne Verb rien]$_{AP}$)..([$_{PP}$…PP…]$_{AP}$)$_{IP}$)

Although the peak on the subject NCI is slightly lower for the NC interpretation than for DN, its rather elevated height resembles the subject NCIs in the single negative condition and differs from that of a non-negative DP subject (Fig 8A & 8B). Furthermore, although the syllable duration of the NCI subject is slightly inferior in NC than in the DN condition, it does not differ from the NCI subject in the single negation condition and is significantly longer than a non-negative DP subject. These finding support the view that the subject NCI is under focus, possibly as the realization of broad focus on the sentence. Furthermore, the fact that in the NC condition, the NCI-object *rien* is i) realized with a lower peak than the NCI object of a single negative condition, and ii) turns out to be essentially comparable to a monosyllabic object that is non-negative is expected, if as we propose, the object NCI is deaccented on this reading as a consequence of the focus on the subject NCI. Although signs of deaccenting on the object are present (flatter melody in our acoustic analysis, cf. Figure 5), phrasing does not seem to be affected. The NCI object in the NC condition appears phrased with the monosyllabic verb forming a VP phrase and it continues to manifest the characteristic increased duration characteristic of an AP boundary (Michelas & German, 2020). Although shorter than the NCI object in the DN and NegOb condition, the NCI-object in the NC condition is longer than a monosyllabic non-negative object. This observation appears to support the Jun and Fougeron (2000) proposal that material after a focused phrase in French is deaccented, but not necessarily dephrased.

Turning now to the DN interpretation, the prosodic analysis we propose in (17) below differs characteristically from that of the NC condition. While, as in NC, we take the subject NCI to be focused in the DN condition, given the amplified height of its peak

and especially the significantly increased duration of its second syllable in comparison to the NC condition, we suggest that it may additionally form an iP of its own. This could explain why in this condition, the object is not affected. Indeed, the core distinction of the DN prosodic profile is that there is strong evidence that the object NCI is also focused and also forms a prosodic phrase of its own, carrying on its one syllable a L+H* or rising phrasal boundary tone. The low tone is often observed on the glide of *rien*, which appears sometimes almost syllabified (ri.jE) and the H* occurs on the nasal vowel. This is supported both by the height of the peak on the object NCI *rien* being the highest in comparison to all other conditions and duration consideration. Although the length of the monosyllabic *rien* does not significantly surpass that of other conditions, especially that of the NegOb condition, for which the object NCI also appears focused, lengthening in the DN condition is much more evident when the first syllable of the subsequent PP is taken into account. Because the DN condition exceeds all other conditions on both measures, this supports the view that the focused object forms its own phonological phrase. As it is squeezed between two foci which clearly form their own phrases (Féry, 2001), the verb seems to be deaccented and dephrased on the DN interpretation as does the final PP, which is generally marked with low tones up to the final boundary tone L%.

(17) DN: Focus on *personne* which forms *iP;* V is "dephrased" (Féry, 2001)(Fery 2001); Focus on *rien* which forms its own phonological phrase.

L H_f- L L LH_f* L%

((([$_{DP}$Personne]$_{AP}$)$_{iP}$ [$_{VP}$ne Verb ([$_{DP}$rien]$_{AP}$)] ([..PP..]$_{AP}$)$_{IP}$)

Nobody Neg Verb nothing

When we consider our two baseline conditions (NegSub and NegOb), there is evidence that the NCI subject and the NCI object are also focused in these single negative conditions. For the NegSub condition, we observe that the subject NCI is essentially equivalent in height to the NC condition and distinct from the non-negative subject NP in the NegOb condition. Duration of its second syllable is also comparable to that of the NC condition and significantly distinct from that of a non-NCI subject in the NegOb condition. These two acoustic measures both support the view that in the NegSub condition, the NCI subject is focused and forms its own accentual phrase, essentially paralleling the subject in the NC condition. For the NegOb condition in contrast, tonal evidence and duration support an analysis of focus on the NCI object since it manifests a prosodic profile comparable to that of the object in the DN condition. (Fig 8C, D).

Here as well, the object plausibly forms its own accentual phrase, with the pre-focus verb and the post-focus PP being deaccented and possibly dephrased in the case of the V or phrased with the subject (Avanzi, Christodoulides, & Delais-Roussarie, 2014). The prosodic analysis we offer for these single negation conditions are depicted in (18) and (19) for NegSub and NegOb respectively.

(18) NegSub: Focus on the subject NCI. The post-focus area is deaccented but not dephrased.

L H_f* L L H* L%

((([$_{DP}$Personne]$_{AP}$)$_{iP}$ ([$_{VP}$ne Verb DP]$_{AP}$) ([..PP..]$_{AP}$)$_{IP}$)

(19) NegOb: Focus on the object NCI. The verb may be dephrased.

L H* L L LH_f* L%

((([$_{DP}$ DP]$_{AP}$)$_{iP}$ ne Verb ([$_{DP}$ rien]$_{AP}$) ([..PP..]$_{AP}$)$_{IP}$)

We can summarize our prosodic analyses as follows. In the NC condition, the subject NCI is focused while the object NCI is deaccented although not dephrased but rather phrased along with the verb as in a regular transitive statement. In the DN condition, both the subject and the object NCI are focused and form their own independent prosodic phrases, while the verb and final PP are deaccented (and possibly dephrased). Given that our NCI subject and object are both rather short, the full expansion of the phrasing differences we propose, although experimentally supported by our data, may nevertheless be rather subtle to perceive. Deaccenting on the second NCI in the NC reading is not accompanied by dephrasing, which may impede perception. In contrast, the second focus on the second NCI in the DN reading makes for a more marked prosodic structure that may facilitate perception. In each of the single negative conditions, the NCIs are focused and the pre- or post-focus areas deaccented. These prosodic and acoustic data support the conclusion that when the NCIs in French are negatively interpreted--in the sense that they associate with semantic negation and sentential scope--they appear to be systematically focused. In contrast, the non-negatively interpreted object NCI in the NC condition appears to be deaccented.

As noted above, and as observed in our four experimental conditions, the final tone in the production of our negative sentences, multiple or single, is generally a falling tone F%. This is not particularly surprising for our single negation or NC sentences since these are all negative statements, expected, like positive ones, to simply offer a speaker's update to the discourse context. This may be less expected in the case of the DN readings of our multiple negative sentences, however. Recall that in previous investigations of the ambiguity of multiple negative prosody in other NC languages, reviewed above in Section 2.3, the DN interpretation was

regularly associated with a contradiction contour[12]. This contour, in particular the end, appears to share some similarities across the different languages studied, culminating in a fall-rise and especially a final H% boundary tone. A similar description for a contradiction contour in English is discussed in Goodhue & Wagner (2018). They provide a picture (reproduced as Figure 14) of a characteristic rendering of the contradiction example (20) below:

(20)A: You are not a friend of Jenny's

B: No, I am a friend of Jenny's

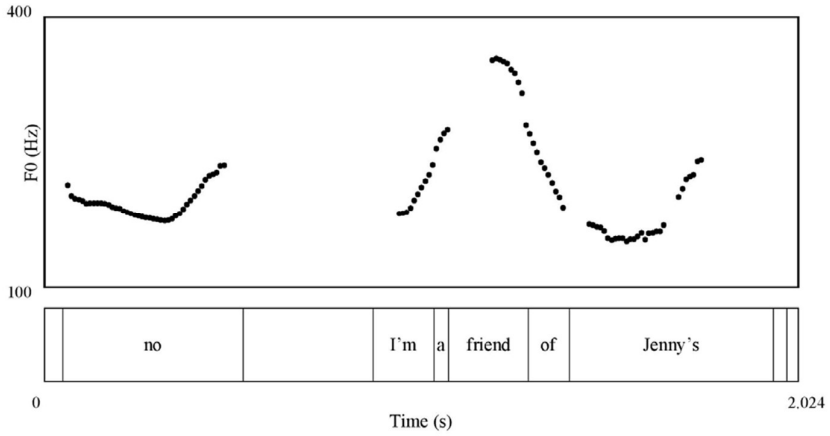

Figure 10. Reproduction of the characteristic contradiction contour, reproduced from Goodhue & Wagner (2018)

Our experimental data do not support the view that a contradiction contour (or context) is involved in fostering access to a DN interpretation. Since the final boundary tone of our DN utterances is usually L%, this tone tends to signal an agreement with the interlocutor as well as a commitment by the speaker to the truth of the proposition stated, not a disagreement or correction (Beyssade & Marandin, 2007; Ward & Hirschberg, 1985). Recall that our multiple negative stimuli were designed as statements meant to reinforce the situation described in the context, for both the NC and the DN readings. The final low boundary tone observed in our data serves as evidence that this was indeed how speakers interpreted the target propositions. Our results, hence, provide solid evidence that neither a contradiction context, nor a contradiction contour is needed for speakers to access DN readings in French. The most common pattern for DN readings obtained here involves focusing of both NCIs and a final L% boundary tone signifying consent and readiness for update rather than the denial of a previous statement or presupposition. In this respect, double negation readings in French cannot be taken

[12] A related contour termed "implication contour" is also discussed for French by Portes et Reyles (2014).

990 to always involve a non-compositional metalinguistic negation[13] but can be understood as
991 supporting a compositional semantics compatible with the grammar of the language. Such a
992 compositional analysis in turn supports the conclusion that French NCIs can be semantically
993 negative expressions.

994 ### 6.3 Theoretical Implications

995 In this final section, we discuss what the distinct prosodic profiles we uncovered reveal about
996 the interaction of prosody with the syntax/semantics and pragmatics for the French ambiguous
997 negative sentences considered. The goal of this section is to outline some broad implications
998 from our experimental findings on the intonation of French multiple negative sentences for the
999 different theoretical models in the literature.

1000 Our brief review of the theoretical landscape in Section 2.2 distinguished three main types of
1001 approaches to negative concord dependencies, 1) the agreement approach, 2) the resumptive
1002 quantification approach and 3) the ambiguity approach that lead to differing predictions
1003 concerning conditions on the accessibility of NC and DN readings for speakers and the
1004 contribution of grammar to these possibilities. Here we consider the implications that our
1005 empirical findings support with respect to these theoretical approaches. Our discussion will
1006 stay clear of detailed aspects of particular theoretical accounts to aim at broad consequences
1007 for the general treatment of these negative dependencies.

1008 In current multiple Agree approaches (Ladusaw, 1992; Zeijlstra, 2004; Penka, 2011;
1009 Giannakidou, 2006) the phenomenon of negative concord is derived compositionally on the
1010 assumption that all NCIs in a concordant sequence are non-negative expressions licensed
1011 syntactically and semantically under agreement with a c-commanding negative operator
1012 (Zeijlstra, 2004 and following). On this view, all NCIs in a sequence have the same non-
1013 negative interpretation and entertain the same dependency with negation. In other words, NCIs
1014 in a sequence are expected to essentially behave alike[14]. Such a predicted parallelism, however,
1015 is not supported in our data which reveal, on the contrary, a distinct asymmetry. For the NC
1016 reading, recall that our study provides evidence that the subject NCI is focused while the object
1017 NCI is deaccented. This finding indicates that in a concordant sequence, one NCI is realized
1018 with more prosodic prominence than the other. At best, then, our findings about the NC reading
1019 prosody raise unexpected questions for multiple Agree models, as they show that concordant
1020 NCIs have asymmetric prosodic effects on one another. Concerning the DN reading, given the
1021 parametric distinction that Agree model posit, as Puskas (Puskás, 2012, p. 628) puts it "we

[13] Contradiction can of course also be a triggering factor for a DN in French. See Larrivée (2016) for a discussion.
[14] See Haegemand and Londhal (2010) for similar conclusions to which they bring challenges.

1022 expect DN to be impossible" in NC languages like French, a pronouncement that does not
1023 square well with its confirmed availability in our results and the demonstrated success of
1024 context in influencing the availability of DN readings for French speakers (Fig 3). Within this
1025 framework, however, Puskás (2012) articulates an interesting account of how DN readings
1026 obtain in Hungarian, where she assumes NCI are non-negative expressions. She proposes that
1027 DN readings can be licensed if one [uNeg] NCI moves to a focus position that houses the
1028 negative version of a Verum Focus operator, while the other is licensed as usual in this model,
1029 i.e.: under agreement with the regular negative operator. For Puskás, it is the conjoined
1030 semantic presence of the two negative operators (i.e.: the regular sentential negation and the
1031 negative verum focus operator) that builds DN readings with semantically non-negative NCIs.
1032 Prosodically, Puskas describes the Hungarian DN reading with different intonation patterns for
1033 the two NCIs involved: the post-verbal NCI is uttered with a flat deaccented prosody, while
1034 the preverbal one bears a heavy primary stress H*L, marking association with focus in
1035 Hungarian[15]. Pragmatically, DN readings in Hungarian are said to have a corrective import
1036 akin to denial or metalinguistic negation, which unlike regular negation is used not to reverse
1037 the truth value of a proposition but rather to object "to a previous utterance, on any grounds
1038 whatsoever" (Horn, 1989, p. 362). Although Puskás' proposal succeeds in allowing DN with
1039 non-negative NCIs, it does not align well with our prosodic findings for French. The pattern of
1040 one NCI being focused and the second deaccented is indeed one we have observed in our data,
1041 but in French, it links quite solidly with the NC reading rather than with the DN one.
1042 Furthermore, since the negative Verum Focus operator of Puskás' account is meant to encode
1043 the corrective import of a DN reading, the prediction--presumably correct for Hungarian--is
1044 that DN readings should not occur in the absence of corrective import. But as we observed, a
1045 corrective import and a correlative contradiction prosody do not come into play to elicit DN
1046 readings in French in our results. Hence the problem of how DN could arise in French in the
1047 absence of such a Verum focus operator in a framework with non-negative NCIs remains
1048 open.[16]
1049 We now consider the implications of our findings for the resumptive quantification model
1050 (May, 1990; Déprez, 2000; de Swart & Sag, 2002; de Swart, 2009; Fălăuș, 2007; Iordachioaia,
1051 2009) which takes NCIs to be negative quantifiers that can be interpreted either with relative
1052 scope -- leading to a compositional DN reading -- or as a single negative polyadic quantifier.

[15] Puskás' prosodic description is based on intuition here, not experimental findings.
[16] Puskás (2012) distinguishes two types of DN readings in Hungarian. We have ignored this distinction here because both are taken to rely on the same corrective function.

Clearly, the demonstrated highly ambiguous nature of French multiple negative sentences, confirmed here experimentally (Fig 3) is consistent with the built-in constructional ambiguity of the resumptive quantification approach. These results, in contrast, clash with the parametric distinction between NC and DN characterizing the agreement approach for which contextual DN/NC ambiguity for individual speakers is unexpected. Our results furthermore show that French NCIs when interpreted negatively appear to systematically associate with focus. This is evident both in our critical (NC and DN) conditions and in the unambiguous control single-negation conditions (NegSub, NegOb) where NCIs in subject or object positions manifest heightened peaks and longer duration compared to non-negative DPs. In contrast, NCIs that are deaccented fail to manifest an independent negative meaning. The relationship between focus and negative interpretation is commonly underscored in the literature as, for instance, in Watanabe's (2004) analysis of NC, based on the premise that NCIs are inherently negative expressions when they associate with a possibly morphologically realized focus feature or in Giannakidou's distinction between emphatic NCIs and non-emphatic NPIs in Greek. Recent work by Giannollo (2020) further provides evidence of this link in the historical evolution of NPIs to NCIs, suggesting quite fittingly with our results that, in NCIs, association with focus comes to be grammaticalized (Gianollo, 2020). Our findings here provide prosodic evidence of this link for French NCIs. Evidence that both NCIs are focused in the double negation interpretation and that, as we suggest, they each form their own prosodic phrase fits well with the view that they are each independently negatively interpreted to lead a compositional DN reading. Furthermore, within a resumptive quantification approach, our observation that in the NC reading, the subject NCI is focused and the object NCI deaccented as a consequence suggests that there could be a prosodic constraint flagging the construction of a polyadic negative quantifier. Instead of the parallelism constraint on resumptive quantification proposed in (May, 1990)[17], our results suggest that the formation of a polyadic quantifier could instead be conditioned by prosody. All the members (NCIs or other quantifiers) of a polyadic quantification may have to belong to the same enlarged prosodic domain, delimited at one end by a prosodically prominent quantifier, and at the other end by deaccenting. Such a prosodic constraint, which echoes Richards (2010) proposal on wh-in situ, could possibly bring new light on some of the locality restrictions which famously limit NC readings, with limitations ranging on how far deaccenting could affect post-focal material in particular languages, a topic

[17] As Déprez et al (2013; 2015) showed however, although parallel pronominal NCIs sequences favor NC interpretations and, hence, the formation of a resumptive quantifier on May's view, parallel full DP sequences do not. This raises difficulties for a definition of parallelism in morpho-syntactic terms

still poorly understood at present. A prosodic constraint on polyadic quantification formation may also help clarify why the nature of the NCI as pronominal vs a full DP matters for the interpretation of multiple NCI sequences in French and other languages[18]. Due to their smaller prosodic weight, pronouns may more easily integrate a dependent prosodic domain than full-fledged DPs. Such a prosodic constraint, consistent with our experimental results and a resumptive quantification analysis of NC, opens rich consequences far beyond the current scope of this study. It also raises sufficiently intriguing new questions to warrant further investigation.

Let's finally turn to our third type of NC model, namely the ambiguity approach pioneered in (Longobardi, 1987)and Herburger (2001). In both of these works, NCIs were assumed to be lexically ambiguous, but since then, a number of other approaches have been developed that attributed ambiguity to differences in the morphosyntactic feature composition of NCIs (Espinal and Tubau 2016b), the internal structure they may have (Déprez, 2000 and following) or to a combination of NCI-internal negative features and the syntactic operations in which these features may take part (Collins & Postal, 2014). Déprez (2000 and following), argued that only NCIs that occurred high in the internal structure of their containing constituents could be negative. As the relationship between a high structural position in a DP and focus is one often entertained in the literature, the current finding brings suggestive support to the structural perspective argued for in this work. A more recent model in Déprez (2018; Déprez & Poletto, 2019)interprets NCI ambiguity as dynamic in the sense that negative interpretation is the output of an interaction between the internal structure of NCIs and the external syntactic position in which they are merged or re-merged in the course of the derivation. Again, the correlation between focus and negative interpretation in our finding maps well with such a view, assuming that focus often corresponds with edge positions in either the DP or sentential domain. As noted in Section 6.2, what our results suggest is that French NCIs are interpreted negatively only when they are associated with focus and not when they are deaccented. It could be that this distinction flags the ambiguity of NCIs. Note however, that a pure ambiguity approach distinguishing a negative [+focus NCI] from a [-focus NCI] one (however this is encoded in a given lexical or morphosyntactic model) is clearly insufficient to explain their distribution. Our results that NCIs are interpreted non-negatively only when deaccented, implies a dependency to whatever caused the deaccenting in the first place. Yet deaccenting is surely not a sufficient

[18] Similar distinctions have also been noted in other languages. See Déprez et al (2015) for Spanish and Catalan, Iacoponi and Déprez (2017) and Acquaviva (1999)for Italian, Haegeman and Zanutini (1991; 1996) for West Flemish among others.

condition. A deaccented [-focus NCI] needs at least to be a strong NPI, which in French further eschew licensing by the negation marker *pas* that always leads to an obligatory DN reading. Whether this effect could relate the prosodic properties of the French negation *pas,* is an interesting speculation, if for instance the presence of *pas* could fail to license deaccenting or cause an interruption in post-focal deaccenting[19]. Though interesting, a verification of these speculations extends beyond the scope of this paper. The point to be noted at present is simply that our findings appear compatible with an ambiguity approach, because of the link they establish between focus and negative interpretation and deaccenting and its absence even if by itself, this link clearly does not suffice to address the distributional issues that any ambiguity approach raise.

To take stock, in this section we have sought to evaluate the implications of our prosodic findings for a variety of account of negative concord in the literature. A strong interpretation of our findings indicates that French NCIs are associated with a negative interpretation when they are prosodically focused and that this meaning can be recruited to build a compositional semantics for DN readings. In French, triggers for DN readings cannot simply be assumed to result from pragmatic conditions linked to denial. If so, the possibility of these readings needs to be an integral part of the syntax of these French negative dependencies. In sum, the fact that French multiple negative constructions are eminently ambiguous, and manifest characteristically distinct prosodic profiles that map to their distinct readings argues for a language-internal ambiguity that must be built on their syntax, and against the view the French could manifest a parametric choice for NC, with DN arising as a consequence of a general pragmatic process of denial independent of the syntax of the language. Moreover, the particular prosodic characterization we have uncovered for each of the readings appears most compatible with models that make room at least as one alternative for a characterization of French NCIs as semantically negative.

A further speculative perspective opened by the finding of this paper is that the possibility of either NC readings or DN readings may be subject to prosodic constrains. We have shown that DN readings require that both NCIs be focused. Besides markedness, since double foci constructions are not very common, this finding predicts, for French, that contexts or constructions in which double foci are impossible should disallow DN readings altogether. NC

[19] On this view, note that an intriguing possibility arises for dialects such as Quebecois French that allow NC with pas; this could be due to distinct prosodic properties of the negation pas, which may also perhaps be linked to the possibility of having constructions like: *Pas personne est venu*, which are impossible in standard French. Labelle (2017) for one, suggest that to trigger an NC interpretation with an NCI pas must be adjacent to it. Perhaps this adjacency requirement has a prosodic motivation.

readings, on the other hand, involve the association of a focused NCI with a deaccented one that depends on it. We speculated that this dependency may constitute a prosodic constraint on polyadic quantification or non-negative NCIs that could well be sensitive to language-internal or crosslinguistic distinctions to be further understood.

7. Conclusion

To our knowledge, the present work constitutes the first experimental investigation of the prosody of ambiguous multiple negative sentences in French. As such, its first goal was to determine whether prosody was used by speakers to distinguish the two readings that these sentences allow, and if so to characterize the acoustic and prosodic cues that were recruited for this purpose. A first result that our production experiment provides evidence for is that the two readings are indeed acoustically and prosodically distinguished. We further show that the NC reading maps with a prosodic profile in which the first NCI *personne* has distinctive prosodic prominence while the second appears, by comparison, melodically subdued and deaccented. In the DN reading in contrast both NCIs manifest prosodic prominence and are independently prosodically phrased, leading to a structure where the subject NCI separates from the rest of the sentence in its own intermediate phrase, while the object NCI builds its own accentual phrases with a significantly heightened peak and an increased duration. We interpreted these results as showing that the NC reading is distinguished by a prosodic dependency that the second deaccented NCI entertains with a first focused one. The DN reading, in contrast, features two independently prosodically prominent expressions. As such, these findings support the view that prosodic prominence on French NCIs is linked to negative meaning, a conclusion confirmed by our observation that NCIs in single negative sentences also manifest prosodic prominence consistent with focus. As discussed above, these finding are most compatible with theoretical models for French that integrate the possibility of negative NCIs in the syntax/semantic interface and envision NC and DN alternations as both allowed by the grammar, independently of any macro-parametric choice that would allow only NC and leave DN readings to the discourse level pragmatics of denial or contradiction. Our findings demonstrate that DN readings in French can be triggered in pragmatic settings that do not involve objecting to a negative statement or presupposition and include the possibility of reinforcing a generalization present in the context. Based on our results, we further speculated that NC readings may be subject to a prosodic constraint, requiring one prominent NCI to trigger a prosodic dependency on another such as deaccenting. Verifying whether comparable

prosodic restrictions also constrain NC readings in languages where they can alternate with DN could offer an interesting new avenue of research.

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Supplementary Materials

List of stimuli

Type	Context	Crit	Question	Answer	Verb	ID
Critical1 NC	Dans cet hôtel, les clients ne sont pas contents du service :	personne n'aime rien ici.	Tout le monde aime quelque chose ici.	F	aimer	1
Critical1 NC	Dans notre famille on est tous allergique à l'alcool :	personne ne boit rien dans les soirées.	Ils ne boivent pas d'alcool.	V	boire	2
Critical1 NC	Tous les profs s'ennuient en conseil de classe :	personne ne dit rien pendant les réunions.	Ils restent tous silencieux.	V	dire	3
Critical1 NC	Il fait vraiment trop chaud aujourd'hui :	personne ne fait rien dehors.	Ils ont tous trop chaud pour faire quelque chose.	V	faire	4
Critical1 NC	Les profs se plaignent tous que les élèves n'étudient pas pendant les vacances :	personne ne lit rien en été.	Les élèves lisent tous quelque chose.	F	lire	5
Critical1 NC	Depuis toujours, cette cantine est absolument infecte :	personne ne mange rien ici.	Les gens ne mangent pas ici.	V	manger	6
Critical1 NC	Dans ce pays, la monnaie n'a plus aucune valeur :	personne ne met rien à la banque.	Les gens placent leur argent à la banque.	F	mettre	7
Critical1 NC	On vient de couper l'électricité et il fait tout noir ici :	personne ne voit rien dans la pièce.	Ils voient tous quelque chose.	F	voir	8
Critical2 DN	Dans ce restaurant on trouve toujours quelque chose de bon :	personne n'aime rien dans les plats proposés.	Ils aiment tous quelque chose.	V	aimer	9
Critical2 DN	Chez les jeunes, la consommation d'alcool est effrayante :	personne ne boit rien dans les soirées.	Ils ne boivent pas d'alcool.	F	boire	10
Critical2 DN	Chez nous, les profs veulent tous donner leur avis :	personne ne dit rien pendant les réunions.	Ils disent tous quelque chose.	V	dire	11
Critical2 DN	A l'approche des dates butoir, tout le monde travaille dur pour finir à temps :	personne ne fait rien ces jours-là.	Ils ne font pas de travail.	F	faire	12
Critical2 DN	Dans cette école exceptionnelle, absolument tous les élèves font leurs devoirs :	personne ne lit rien pour sa classe.	Les élèves lisent tous quelque chose.	V	lire	13
Critical2 DN	Même quand on fait un régime, il faut se nourrir :	personne ne mange rien pendant un mois.	Ils ne mangent pas pendant un mois.	F	manger	14
Critical2 DN	La plupart des gens amassent un tas de bricoles inutiles :	personne ne met rien dans son placard.	Les gens laissent les placards vides.	F	mettre	15
Critical2 DN	Les études cognitives nous montrent que même les aveugles ont une vision inconsciente :	personne ne voit rien du tout.	Tout le monde voit quelque chose.	V	voir	16
Critical3 NegOb	La rupture avec son copain l'a complètement déprimée :	Noëlle n'aime rien en ce moment.	Noelle déteste tout.	V	aimer	17
Critical3 NegOb	Quand on sort, il faut un chauffeur sobre :	Raoul ne boit rien aujourd'hui.	Il ne boit pas d'alcool.	V	boire	18
Critical3 NegOb	Parce qu'elle est très timide,	Aline ne dit rien pendant les cours.	Elle dit toujours quelque chose.	F	dire	19
Critical3 NegOb	Comme elle est très religieuse,	Marla ne fait rien le dimanche.	Marla fait toujours quelque chose le dimanche.	F	faire	20
Critical3 NegOb	Comme elle travaille comme relectrice toute la semaine,	Marie ne lit rien le week-end.	Marie lit quelque chose le week-end.	F	lire	21
Critical3 NegOb	Pour bien digerer,	les gens ne mangent rien le soir.	Les gens ne mangent pas le soir.	V	manger	22
Critical3 NegOb	Comme il est très dépensier,	Julien ne met rien de coté pour l'avenir.	Julien n'économise pas son argent.	V	mettre	23
Critical3 NegOb	Elle est très intelligente mais elle a la tête dans les nuages :	Lucie ne voit rien autour d'elle.	Lucie est très observatrice.	F	voir	24
Critical4 NegSub	Quand on s'amuse, on a pas toujours envie de rester sobre :	personne n'aime l'eau dans les fêtes.	Ils aiment tous l'alcool.	V	aimer	25
Critical4 NegSub	Dans ce bar, il y a de l'ambiance et on consomme beaucoup d'alcool :	personne ne boit d'eau ici.	Ils boivent tous de l'eau.	F	boire	26
Critical4 NegSub	Tout le monde fait très attention pendant ce cours :	personne ne dit mot pendant une heure.	Les étudiants restent silencieux.	V	dire	27
Critical4 NegSub	Beaucoup de gens se lèvent très tôt pendant la semaine,	personne ne fait ça le dimanche.	Ces gens font tous la grasse matinée le dimanche.	V	faire	28
Critical4 NegSub	Tous les meubles d'Ikea viennent avec des notices de montage :	personne ne lit ça en général.	Les gens ne lisent pas les notices.	V	lire	29
Critical4 NegSub	Les oeufs sont difficiles à digérer. On en mange plutôt le matin ou le midi :	personne ne mange ça le soir.	Tout le monde mange des oeufs le soir.	F	manger	30
Critical4 NegSub	Les mini-jupes sont super à la mode :	mais personne ne met ça à l'église.	Les femmes mettent toutes des mini jupes à l'eglise.	F	mettre	31
Critical4 NegSub	Dans la brousse, les gens se promènent tout nu :	personne ne voit ça ici.	On voit tous ça ici.	F	voir	32
Control	Il y a un match de foot cet après-midi :	tout le monde va au stade.	Les gens restent tous à la maison.	F	NA	33
Control	La leçon d'aujourd'hui n'était pas trop claire :	chaque élève avait des questions de clarification.	Les eleves n'ont pas compris la leçon.	V	NA	34
Control	Son ordi est cassé :	Alain va en acheter un nouveau.	Alain ne veut plus d'ordinateur.	F	NA	35
Control	Il fait vraiment très beau aujourd'hui :	tout le monde est dehors.	Les gens restent tous à l'intérieur.	F	NA	36
Control	Demain, c'est un long week-end :	tout le monde part à la campagne.	Les gens profitent de la nature.	V	NA	37
Control	Le printemps est arrivé :	tous les arbres sont en fleurs.	Il n'y a que des feuilles sur les arbres.	F	NA	38
Control	Aujourd'hui les gens ne se parlent plus face à face :	tout le monde utilise son téléphone portable.	Les gens n'ont pas de contact direct.	V	NA	39
Control	C'est une habitude chez nous après le diner :	tout le monde regarde la télévision.	Les gens regardent la télévision le soir.	V	NA	40

Participant exclusion protocol

We needed to ensure that participants understood the task, and that the contexts were generally successful in guiding participant interpretation. All participants performed effectively at ceiling for the fillers and single-negative controls (Figure S1A – same as Figure 3 in the text). For the critical items (DN & NC), responses to the verification questions were coded as being +/- contextually congruent, as well as +/- NC interpretation. For example, a contextually congruent DN response in the DN condition would be +congruent, -NC, and a contextually incongruent NC response to the same item would be -congruent, +NC, as a contextually incongruent response to a DN item would imply that the participant accessed an NC interpretation of the sentence.

For the DN & NC conditions, participants overall gave contextually congruent responses in 79.9% of trials. The influence of context was slightly higher in the NC condition (mean = 87.05%, t = 10.439, df = 27, p = 5.608e-11) than in the DN one (mean = 72.77%, t = 4.0083, df = 27, p = 0.0004329), but was significantly above chance in both cases. Participants were more likely to give contextually congruent responses for an NC item than a DN one (t = 2.1328, df = 45.298, p = 0.03839). This NC preference also appeared in an overall slight preference toward +NC responses ((+congruent) responses to NC items + (-congruent) responses to DN items) overall (mean NC = 57.14%, mean DN = 42.86%, t = 2.6212, df = 54, p = 0.01136, Figure 2B). For a more in-depth discussion of the contextual influence results and the effect of context on interpretation, see Déprez & Yeaton (2018).

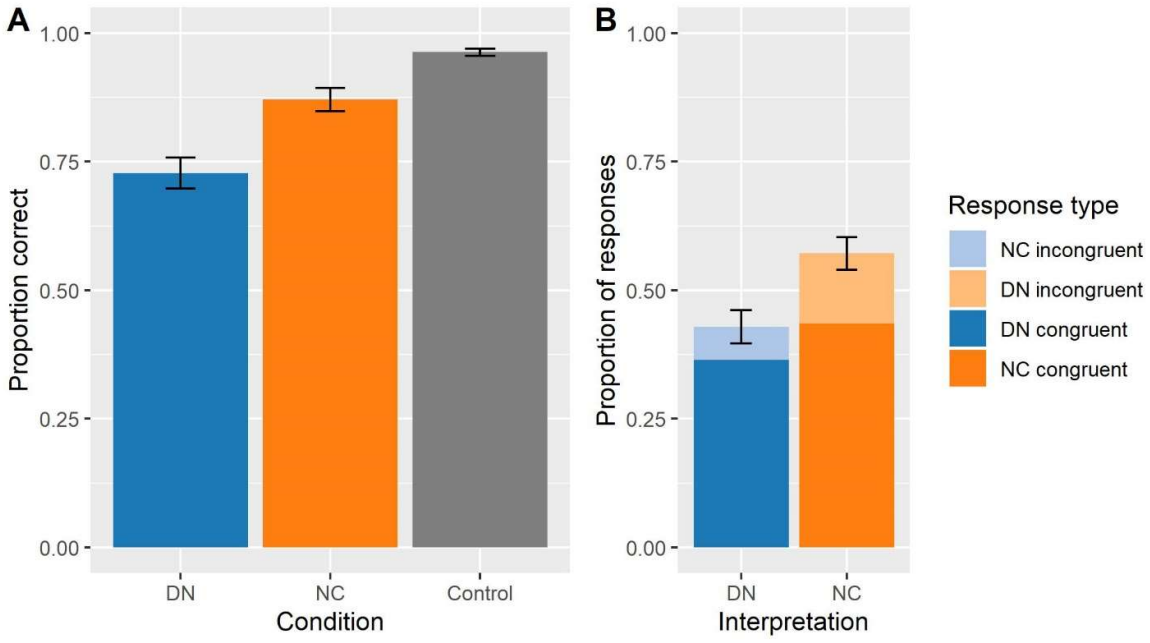

Figure S1: A (same as Figure 3 in the text): Percent context-matching responses by condition. Error bars represent 95% confidence interval. Participants performed at ceiling for the single negative controls and filler items. Overall context was very successful at guiding participant interpretation in the ambiguous DN and NC conditions, with contextually congruent responses significantly above chance in both conditions. B: Overall proportion of NC (NC congruent + DN incongruent) and DN (DN congruent + NC incongruent) responses to verification questions. There was an overall slight preference toward NC responses. Error bars represent 95% confidence interval.

Once we established that the contexts were overall successful in guiding interpretation, we wanted to include in our prosodic analysis only those participants who were susceptible of having a prosodic distinction between the two meanings, i.e.: the participants who readily accessed both interpretations. This was implemented by excluding from further analysis those participants who provided contextually incongruent responses to more than half of the items in either or both of the critical DN and NC conditions (n = 8). Once these participants were excluded, the productions of 20 participants (16F) remained included in the acoustic analysis. Participants' overall NC (NC congruent + DN incongruent) and DN (DN congruent + NC incongruent) responses are shown in Figure S2, with a single vertical bar representing each participant. The vertical black lines delineate the participants included in the acoustic analysis (between the black lines) from those excluded.

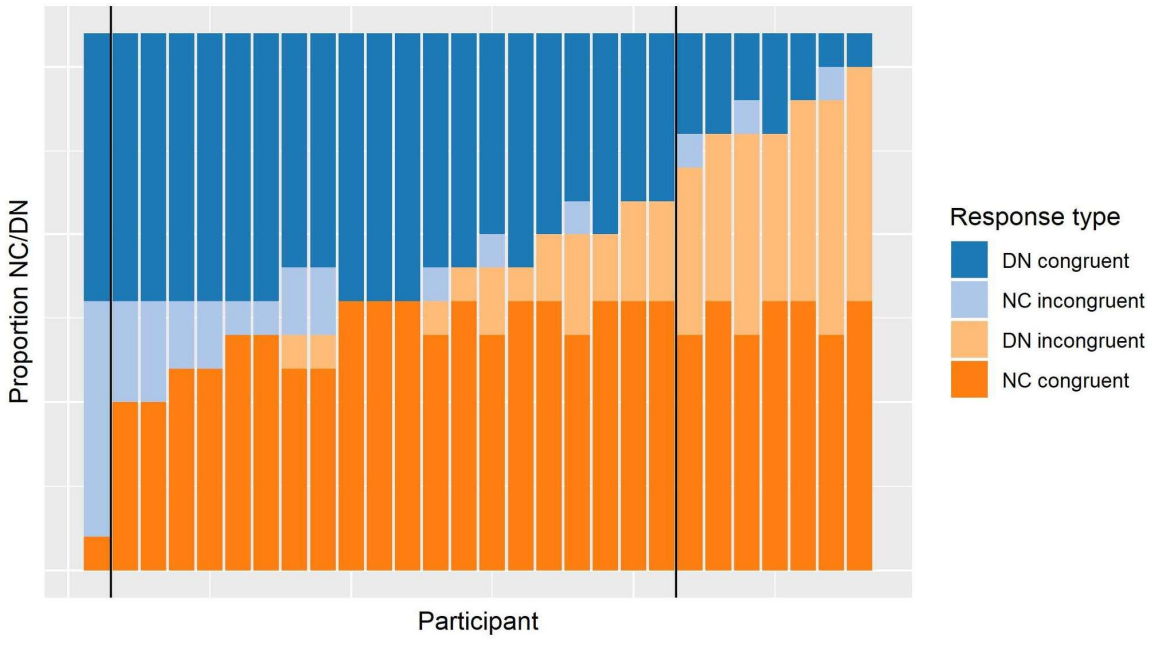

Figure S2. Overall DN and NC responses by participant. Participants' (one vertical bar per participant) overall NC (NC congruent + DN incongruent) and DN (DN congruent + NC incongruent). The vertical black lines delineate the participants included in the acoustic analysis (between the black lines) from those excluded.

Additional figures

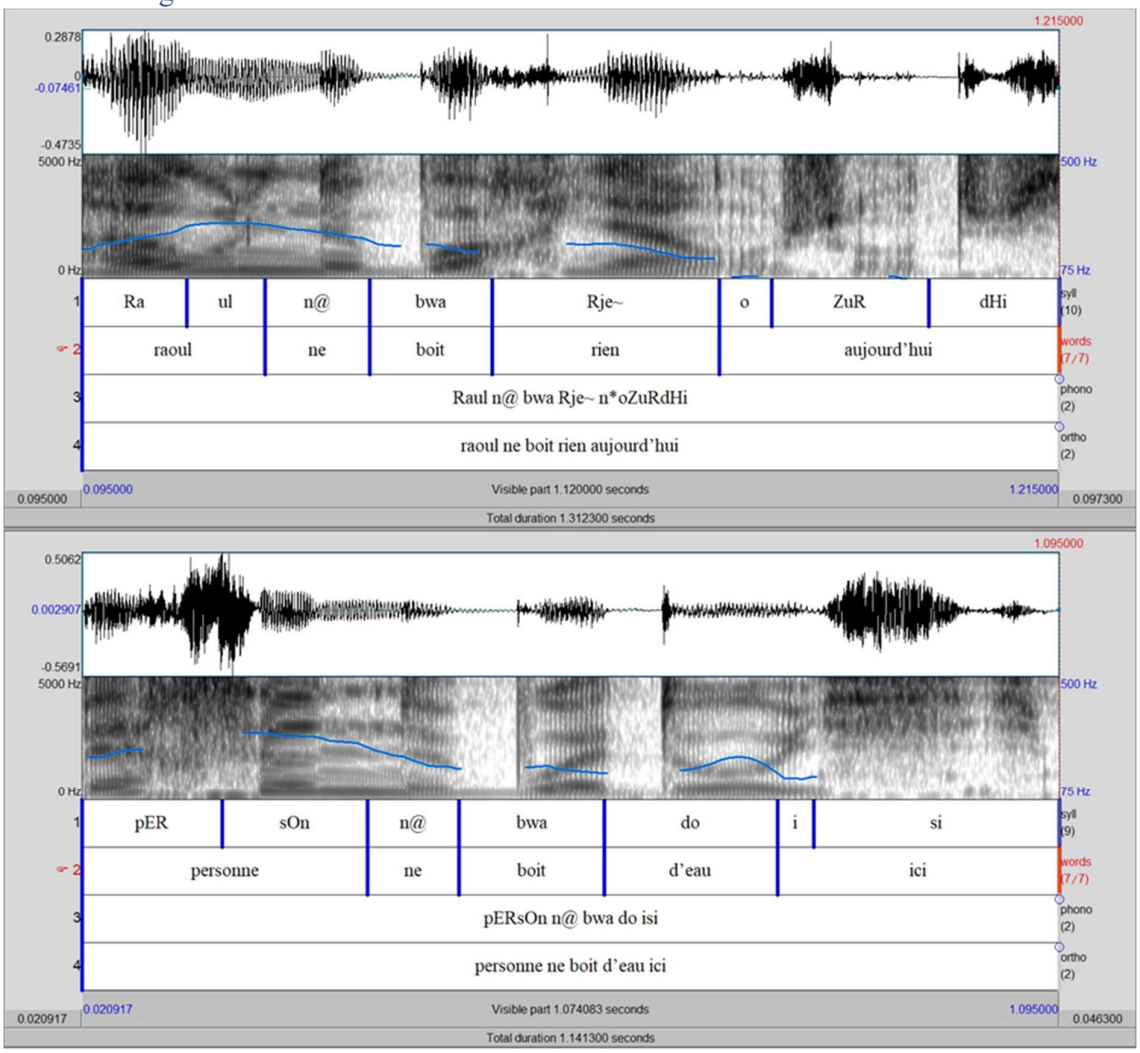

Figure S3. Praat images of representative NegOb (top) and NegSub (bottom) productions by the same speaker. Note the blue curve plotted over the spectrogram indicating f0.

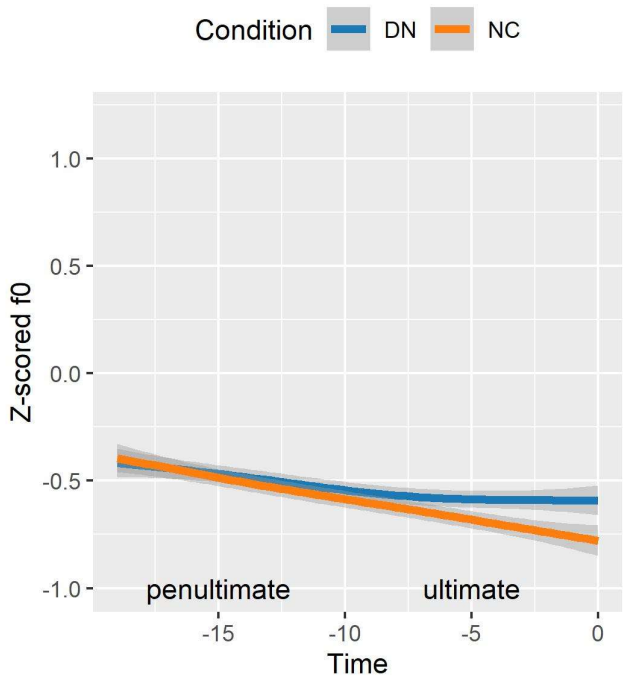

Figure S4: Sentence-final prosodic contours. No significant differences are found between the critical conditions. The x-axis represents the normalized time points (10 per syllable) from the end of the utterance (time point 0).

Data and code availability statement

Stimuli were presented using the PyGame library (Shinners, 2011) in Python 2.7 (Van Rossum & Drake Jr, 1995) on an Asus laptop running Windows 7.

All data manipulation and statistics were conducted in R (R Core Team, 2019)apart from the sample-wise t-tests which were conducted in MATLAB (MATLAB, 2017), for easier looping. The dplyr (Wickham, François, Henry, & Müller, 2019) and tidyr (Wickham & Henry, 2019)packages were used heavily in the data preparation and organization. The TOSTER library (Lakens, 2017) was used to perform the equivalence tests. The ggplot2 (Wickham, 2016) library was used to produce the figures.

We have made the statistical analysis code and raw data available via the OSF here: [Link here after review]