# Prosody and the meanings of English negative indefinites

Frances Blanchette

Marianna Nadeu

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## Abstract

This paper investigates the acoustic correlates of Negative Concord (NC) and Double Negation (DN) readings of English negative indefinites in question-answer pairs. Productions of four negative words (*no one*, *nobody*, *nothing*, and *nowhere*) were elicited from 20 native English speakers as responses to negative questions such as "What didn't you eat?" in contexts designed to generate either a single negation NC reading or a logically affirmative DN reading. A control condition with no negation in the question was employed for comparison. A verification question following each item determined whether tokens were produced with the target interpretation. Statistical analysis of the f0 curves revealed a significant difference: DN is associated with a higher fundamental frequency than NC. In contrast, the NC and single negative control conditions were not significantly different with respect to f0. Analysis of the verification question responses showed significant differences between all three conditions (Control > DN > NC), in support of the hypothesis that participants assigned DN and NC structures to the single negative words in the critical conditions. The results are compared with previous work on Romance, and we demonstrate how English behaves like a prototypical NC language in that DN is the prosodically marked form.

**Keywords**: Double Negation, Negative Concord, prosody, syntax, English, denial negation

## 1. Introduction

Consider the following context: A professor assigns a student a lengthy and challenging set of readings, but later realizes the assignment may have been too difficult. They meet, and the dialogue in (1) ensues.

(1) Professor: So, what didn't you read?

Student: Nothing.

The negative indefinite *nothing* in (1) is ambiguous between a single and a double negation reading. On the double negation (DN) reading, *nothing* means 'everything': The student implies that, contrary to expectation, there is nothing she did not read. On the single negation reading, *nothing* simply means 'nothing': The student confirms the professor's expectation and implies that in fact she did none of the assigned reading.

Previous studies have shown that ambiguities like that in (1) exist in the Negative Concord (NC) languages Spanish and Catalan, in which two or more syntactic negations in a clause may contribute a single semantic negation (Espinal & Prieto 2011; Prieto et al. 2013; Espinal et al. 2016). These authors show that speakers of these NC languages access the DN 'everything' reading of (1) via a marked prosodic contour on the negative word. In fact, both prosody and gesture help to determine the selection of the single or double negative (logically affirmative) reading.

We begin with a discussion of NC and DN, and their relevance to the interpretation of negative indefinites in question-answer pairs like (1).

### *1.1 Negative Concord and Double Negation in English*

English is historically an NC language, but, in present day English, NC is heavily socially stigmatized. At the time of prescriptive grammarian Bishop Lowth's 1762 edict that, in English, two negatives should equal a positive (Horn 2010), the presence of NC in formal written texts had already diminished significantly (Nevalainen 2006).[1] Despite its proscription, English NC has persisted and has come to be associated with "non-standard" varieties including Appalachian (Wolfram & Christian 1976) and African American English (Green 2002) in the United States, as well as varieties of British (Anderwald 2002, 2005; Tubau 2016), Scottish (Smith 2001), and Irish English (Henry 2016).

It is widely accepted that, synchronically, "Standard English" is a DN language, which does not have NC (Ladusaw 1992; Déprez 2000, 2011; Watanabe 2004; Zeijlstra 2004; Kallel 2007; De Swart 2010; Espinal & Prieto 2011; Wallage 2012; Puskás 2012; Prieto et al. 2013; Longobardi 2014; Déprez et al. 2015; Espinal et al. 2016; Thornton et al. 2016; Tubau 2016; and others). More generally, languages have been argued to have either DN or NC grammars (Zeijlstra 2004). Under this view, Standard English has a distinct grammatical system from non-standard Englishes with respect to negation (Ladusaw 1992).

A growing body of work demonstrates that DN is possible in NC languages (Espinal & Prieto 2011; Prieto et al. 2013; Déprez et al. 2015; Espinal et al. 2016; Déprez & Yeaton, to appear).[2] These authors have demonstrated that speakers of prototypical NC languages reliably interpret both NC and DN given predictable combinations of prosodic and pragmatic features. Blanchette (2017) adds a series of quantitative gradient acceptability judgment studies which suggest that NC may also be possible in Englishes traditionally considered to be DN. This work calls into question the division between NC and DN grammars.

[1] See Nevalainen (2006) on the social motivations for this shift.

[2] See also De Swart and Sag (2002) and Longobardi (2014).

There is evidence that varieties like Appalachian English, considered to be non-standard, generate DN (Blanchette 2013, 2015). Consider the following dialogue, elicited from a speaker of Appalachian English:[3]

(2) Appalachian Speaker A: She said you didn't see nobody. (NC)

Appalachian Speaker B: I didn't see *nobody*. I did see one person I know. (DN)

Speaker A in (2) uses an NC construction. The utterance contains the syntactic negations *didn't* and *nobody*, and expresses only one semantic negation, meaning 'she said you saw nobody'. Speaker B then denies Speaker A's statement, asserting that it is not the case that she saw nobody, and, in fact, she saw somebody. The dialogue shows that both NC and DN are possible in this English variety.[4]

In this study, we adapt the experimental paradigms in Espinal and Prieto (2011), Prieto et al. (2013), and Espinal et al. (2016) to investigate whether DN and single negation readings in English behave similarly to Spanish and Catalan, using question-answer pairs like (1). Our experiment involves undergraduate students in a university laboratory setting, which we assume elicits the use of "Standard English" in the sense generally understood within the field of linguistics. As such, in addition to providing information on the prosodic patterns associated with single and double negation readings of negative indefinites in English, our results also inform the question of whether NC is possible in Standard English.

*1.2 The Syntax of NC and DN in Negative Question-Answer Pairs*

[3] Thanks to Tiffany Williams for providing this example.

[4] See Blanchette (2015) for additional examples of DN in Appalachian.

Following standard syntactic models, we assume that the answer in question and answer pairs like (1) involves an elided structure in which the negative phrase has raised to the left periphery, and the remainder of the sentence has undergone deletion at the Phonological Form (PF) interface (Merchant 2001; Temmerman 2012). Under the ellipsis analysis, the structure for *nothing* in (1) would be roughly as follows:[5]

(3) $[_{CP}$ nothing$_1$ $[_{TP}$ ~~I didn't read~~ $t_1]]$

We further assume, following standard syntactic models of NC, that if a concord relation occurs between the two negations, this relation is established within the Tense Phrase (TP) in (3), prior to quantifier raising. It is therefore theoretically relevant to ask how this concord relation is established in the syntax, and how the DN reading is generated in the absence of concord. These questions have been subject to much debate in the theoretical literature, which we will touch upon briefly here.

We note first that acoustic data are not typically consulted in the construction of syntactic models, and that generative syntacticians in particular tend to rely solely on usage and acceptability judgment data (but see Espinal & Tubau 2016). Traditional applications of speaker intuitions in generative syntactic theory have been the subject of much debate (Hickok & Poeppel 2010). The distinction between acceptability and grammaticality, and the various non-grammatical factors shaping acceptability, have been known since the inception of

[5] Espinal et al. (2016) argue that their data support the hypothesis that the DN reading does not involve an elided structure, but rather the projection of a single Focus Phrase. We address this in Section 4.

generative grammar (Chomsky 1965: 11).[6] Barbiers (2005, 2009) discusses how both usage and acceptability may be shaped by normative pressures and other social constraints having nothing to do with grammar, proposing the notion of grammatical constructions which may remain unrealized.

In light of the heavy normative pressures shaping English NC, we suggest that in addition to providing a more accurate description of the contribution of prosody to the interpretation of English negation, our acoustic data can serve as an informative supplement to acceptability and usage data in the construction of syntactic models (as in Espinal & Tubau's (2016) analysis of Catalan and Spanish). More specifically, we submit that our acoustic data can inform the question of whether Standard English generates syntactic structures that are NC.

As distinct from Romance languages like Catalan and Spanish, the assumption that Standard English generates DN is uncontroversial. We adopt the model of English DN in Blanchette (2015), which assigns roughly the structure in (5) to the DN interpretation of a string like (4):[7]

(4) I didn't read nothing.
 'It is not the case that I read nothing.' (DN)
 'I didn't read anything.' (NC)

(5) I didNEG$_2$ read [NEG$_1$ SOME thing] (DN structure)

[6] More recently, on the distinction between grammar and acceptability, Chomsky et al. (2017:8) note: "surface stimuli deriving from the objects constructed by I-language can have any degree of perceived 'acceptability' or 'deviance', from perfect naturalness to complete unintelligibility".

[7] Blanchette (2015) adopts the syntax and semantics for negation and negative indefinites in Collins and Postal (2014).

In the structure in (5), $NEG_1$ and $NEG_2$ are occurrences of two distinct semantic negations, one that is contributed by the negative indefinite object of *read* containing abstract SOME ([$NEG_1$ SOME thing]; Collins and Postal (2014)), and another in preverbal position. The NC structure is generated through movement of a negation from the negative indefinite, and both the lower and higher occurrences of negation are pronounced:

(6) I did$NEG_1$ read [$NEG_1$ SOME thing] (NC structure)

This structure contains only one semantic negation, which spells out in two distinct places in the syntactic structure.

Crucially, the negative indefinite in both (5) and (6) is of the underlying form [$NEG_1$ SOME thing] (Collins & Postal 2014). Recalling the structure in (3), we see that this analysis predicts that the fragment answer *nothing* has the same underlying structure in both the NC and DN interpretations. A benefit of Blanchette's model over some others is that it accounts for both NC and DN structures without stipulating a difference in feature content or syntactic structure for the fragment negative indefinite, which has the same form in both interpretations (cf. Zeijlstra 2004; Espinal & Tubau 2016; a.o.). This aspect of Blanchette's model allows us to define the difference in meaning between the DN and NC readings of negative indefinites in question-answer pairs in purely pragmatic terms. We turn to this in the next section.

### *1.3 The Pragmatics of DN and NC in Negative Question-Answer Pairs*

Consider again the context in (1), which contains a syntactic negation in both the question (*What didn't you read?*), and the fragment answer (*nothing*). The structure of this brief discourse serves as the basis of our experimental design. To address the question of how the

NC ‘nothing’ and DN ‘everything’ readings of (3) are derived, we must first address the meaning of the negation-containing question. Following standard semantic theories, we assume that the denotation of a question includes the set of its possible answers that are true (Hamblin 1973; Kartunnen 1977).[8] Imagine now that the professor had assigned two monographs: Rizzi (1990) and Kayne (1994). The following then exhausts the possible answers to the question *What didn’t you read?*:

(7a) I didn’t read Rizzi.

(7b) I didn’t read Kayne.

(7c) I didn’t read Rizzi or Kayne.

Note that (7c) represents the NC response: It is true in a world in which the student read *nothing*, or neither of the two assigned monographs.[9] The truth conditional meaning of the NC response is therefore part of the question’s denotation set, but the DN response is not. How, then, are both of these reading derived? To answer this, we must consider the interaction between the negations in the question and the answer, which, following previous work, we analyze in terms of denial (Espinal & Prieto 2011; Prieto et al. 2013; Espinal & Tubau 2016; Espinal et al. 2016).

[8] See Dayal (2016) for an extensive review and synthesis.

[9] See Dayal (2016:44,46) on plural responses to questions in which the *wh*-expression is not specified for number.

Geurts (1998) proposes a typology with four types of denial negation, each of which is directed at a previous utterance, hence metalinguistic in the sense of Horn (1989[2001]).[10,11] Geurts distinguishes between proposition denial, directed at what the previous utterance asserts, and presupposition denial, which targets the previous utterance's presuppositions (p. 276). Following Abusch (2010), we assume that the *wh*-question contributes a soft existence presupposition which can be cancelled. In this case, the presupposition contributes the assumption that there exists something that the student did not read, and the question means: *assuming you did not read something*, *what did you not read*? (cf. Dayal 2016: 52). Under this analysis, we might think of the DN response nothing as an instance of presupposition denial in the sense of Geurts (1998). However, it can also be plausibly thought of in terms of proposition denial, in that it denies the truth of all of the propositions in the question's denotation set in (7a–c).

Setting aside the distinction between proposition and presupposition denial, we henceforth refer to the DN condition in our experimental data as simply denial DN. We note that regardless of whether we analyze it as being presuppositional or propositional in nature, it is only the DN reading, and not the NC reading, which can be thought of as a denial negation. This is because the question's denotation set includes a proposition that makes the NC response true (7c). In this sense, the DN reading is derived through interaction with the pragmatic context, while the NC reading is not. Our experimental data will demonstrate how this special pragmatic status of DN is marked prosodically. In anticipation of this, we turn next to a brief

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[10] Geurts (1998:292) argues that they are not all "purely metalinguistic", in that they are directed at both linguistic and metalinguistic objects.

[11] Both implicature and form denials are analyzed in terms of semantic transfer, where form or quotation denial targets the way in which the previous utterance was stated, and implicature denial targets scalar expressions like 'Mary ate five cupcakes', where 'five' implies an exactly reading.

overview of the relationship between prosody and information structure, and their relationship to negation.

*1.4 Prosody, Meaning, and Negation*

Prosody serves to highlight certain words and to break larger units of speech into smaller units, facilitating speech perception and processing. It also serves to convey information about sentence type, the structure of utterances, the status of entities in the discourse, pragmatic meaning, and information about the context in which speech is produced (Cole 2015). Languages, however, differ in their uses of prosody. For example, English prosodically marks information that is new in the discourse, and deaccents information that is discourse-salient or given (anaphoric deaccenting), whereas other languages do not (Ladd 2008). Similarly, some languages impose different prosody to a sentence like "Jessica got a promotion" depending on whether it responds to the question "What happened?", which elicits broad focus, or "What did Jessica get?", which elicits narrow focus on the object (Gussenhoven 2007; Elordieta 2007), whereas other languages do not distinguish prosodically between these two types of focus.

Previous work has suggested that in English negation is expected to have prosodic prominence because it presents new information (O'Shaugnessy & Allen 1983; Pierrehumbert & Hirschberg 1990). However, studies of negation in spontaneous speech have shown that this is not consistently so (Yaeger-Dror 1995, 1997; Kaufman 2002). Rather, it has been demonstrated that prosodic prominence on negation varies according to the specific discourse function it contributes (Kaufman 2002).

More recently, the body of work in Prieto and Espinal (2011), Espinal and Prieto (2011), Prieto et al. (2013), and Espinal et al. (2016) has demonstrated that, in Spanish and Catalan, DN interpretations of single negative words in question-answer pairs like (1) are characterized by an intonational form that is more complex than that of the single negation reading. These authors found that the DN interpretation of negative indefinites is reliably associated with a "contradiction intonation" contour (Prieto et al. 2013: 145,147). This pattern, represented as L+H* L!H% in the Autosegmental-Metrical (AM) model of intonational phonology (Pierrehumbert 1980; Beckman & Pierrehumbert 1986; Ladd 2008), is characterized by rising f0 on the stressed syllable followed by a complex falling and rising pattern on the posttonic (Prieto et al. 2013: 140).[12] This contrasts with the simpler rising falling pattern of the NC interpretation (L+H* L%), the typical pattern for broad, non-contradictory focus (Prieto et al. 2013: 140). DN interpretations have also been shown to be possible in the NC language of French (Déprez et al. 2015), in which they are prosodically more prominent than NC (Déprez & Yeaton, to appear).

Section 1.3 established that because it serves as a denial, the DN reading is pragmatically marked in a way that the NC reading is not. Previous work on the acoustic correlates of information structure in English demonstrates that focus, a pragmatically marked discourse function, and contrastive focus in particular, is marked by higher intensity, longer duration, and higher f0 (Breen et al. 2010). Because of its marked discourse function, we may also expect DN to be prosodically marked.

### *1.5 Study Objectives*

The experimental study we present here builds on previous work to further understand the contribution of prosody in the expression and interpretation of negation in context. The study was conducted with university students in a laboratory setting, an environment that, we argue,

[12] In the AM model, this notation represents the nuclear configuration associated with DN readings. The nuclear configuration or intonational contour includes a pitch accent (an f0 movement anchored on the nuclear stressed syllable) and a boundary tone (an f0 movement associated with the end of an intonational unit). For an introduction to the AM model, see Pierrehumbert (1980), Beckman and Pierrehumbert (1986), or Ladd (2008).

elicits the use of “Standard English”. Our aim is to investigate the prosodic strategies that this English employs to generate DN readings of single-word utterances. On the basis of previous work, we expect that the pragmatically marked status of denial DN will be instantiated by some form of prosodic “markedness” in comparison with single negative, non-denial interpretations (Geurts 1998; Breen et al. 2010). One possibility is that, like Catalan, English uses a specific intonational contour (a different type of pitch accent and boundary tone combination) to signal the DN reading of two syntactic negations. Another possibility is that DN renditions exhibit phonetic features associated with prosodic prominence (e.g. higher intensity and/or f0, or longer duration), while being realized with the same nuclear contour.

Additionally, we aim to investigate whether Standard English, thought to be prototypically DN, displays properties similar to or different from prototypical NC languages by comparing our results to previous work with similar experimental design.

## 2. Methods

### *2.1 Participants*

22 undergraduates were recruited from an introductory linguistics class at a public university in the United States. We discarded data from two participants, one male and one non-native speaker, leaving us with data from 20 female native American English speakers with ages ranging between 18 and 22 (*M* = 20.04, *SD* = 1.15).[13] Following the experiment, participants completed a language history questionnaire. Five different U.S. states were represented, including Kansas (1), Kentucky (1), Massachusetts (1), New Jersey (3), and Pennsylvania (14).

[13] Because students received credit for a course assignment in exchange for participation, for the sake of fairness, we tested non-native speakers even though they did not meet our criteria for participation. Since only one male signed up, and given that we did not have sufficient male voices to balance out the sample, we also discarded his data.

Three of the participants from Pennsylvania reported that they grew up in rural areas, and the remainder of the participants had suburban upbringings. Three reported having at least some knowledge of another language, 15 reported having had musical training, with experience ranging from 2 to 11 years and including both voice and instrumental, and none reported any hearing or speaking impairments (except for one speaker, who reported having been diagnosed with a lisp).

The university where this work was conducted is competitive and has relatively high academic standards. In order to be accepted, native English-speaking students must have previously demonstrated proficiency in Standard English through various standardized achievement tests and other formal prerequisites, and they are expected to employ this version of English in the classroom and when completing assignments (Johnson & VanBrackle 2011; Dunstan & Jaeger 2015; Horton 2017). We therefore assume that, in this formal environment, participants were primed to use their version of Standard English. In exchange for their participation, students received credit for a course assignment.

### *2.2 Materials*

The experiment was designed to elicit productions of the words *nothing*, *nobody*, *no one*, and *nowhere* in three different conditions. Following Prieto et al. (2013), we provided contexts that elicited either an NC or a DN interpretation of the target word. Each item included a context and a question, followed by a single word response, which participants were instructed to read aloud. We instructed participants to imagine themselves in the context and to read the word as though they were in the context, adding emphasis where necessary.[14]

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[14] Instructions were presented as follows: "In this experiment, we will ask you to imagine yourself in different contexts. You will read a context, then a question. The following screen will contain a word (or words) in green. Please say the words in green out loud. When you say the words, say them as if you were really in the context.

Following the instructions, participants completed three practice items, and had the opportunity to ask questions about the protocol before beginning the experiment.

Test items were divided into three conditions: NC, DN, and Control. The following examples illustrate an NC and a DN item for the word *nothing*:

(8) Negative Concord

Context: You and your roommate pay different bills each month. This month you have too little money to pay bills.

Question: Your roommate asks: What didn't you pay?

Response: Nothing.

(9) Double Negation

Context: You and your roommate pay different bills each month. This month you surprise your roommate and pay all of the bills.

Question: Your roommate asks: What didn't you pay?

Response: Nothing.

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You should find that some of the contexts and questions require an emphatic answer. Please try to convey that emphasis when you say the word or words in green. Lastly, you will be asked a True or False question about each context. The button with the green sticker (d) is True, and the one with the red sticker (k) is False. Once you have moved on you cannot go back to a previous screen. For this reason, it is important to read and think about each context carefully. You will now have a chance to practice. Remember to say the word in green, and use emphasis if necessary."

In (8), participants are asked to imagine themselves in a scenario in which they cannot pay the bills. In this context, the roommate's question about what was not paid elicits a single negation interpretation of the fragment *nothing* (i.e., that nothing was paid). In (9), the context asserts that the participant paid all the bills, and that nothing was not paid, the denial DN reading.[15]

Our stimuli included ten NC and ten DN items, and each participant produced five tokens of each of the four negative words. As illustrated in (8) and (9), each NC question had a parallel DN counterpart (and vice versa). Participants were divided into two subgroups, and received either the NC or the DN context for each item (e.g., either (8) or (9)), but not both.

Eight control items (two for each negative word) with no negation in the question were also included to determine how participants pronounce the words when there is only one negation and the response is neither NC nor DN. The following illustrates a control item:

(10) Single Negative Control

Context: You are having dinner at your friend's house. You forgot to bring dessert.

Question: Your friend asks: What did you bring?

Response: Nothing.

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[15] In items (8) and (9) the *wh*-phrase questions a direct object. English NC is sensitive to the position of the negative marker with respect to the negative phrase (Blanchette 2017). All English varieties in which NC is realized employ constructions with a negative direct object and preceding negative marker, but only a subset employ negative subjects in NC (Smith 2001; Anderwald 2002, 2005). Therefore, to establish a baseline for comparison and to avoid introducing potential confounds related to microvariation in English NC, the *wh*-phrases in our question-answer pairs questioned direct objects only.

Items for this experiment were interspersed with items for another experiment with a similar methodology, which served as distractors and are thus not discussed here.

Each item in the experiment was followed by a statement paraphrasing its meaning that participants had to judge as true or false. For the critical items, half of the statements were true on the NC reading, and half were true on the DN reading. Both subgroups of participants received the same statements, but because the context types were reversed, the target answer was also reversed. For example, the statements for both items (8) and (9) was “You paid every household bill this month”. For the group who received (8), which elicits an NC interpretation, the statement was false, but for the group that received (4), which elicits a DN interpretation, the statement was true.

Inclusion of the verification statement allowed us to assess whether participants interpreted the item as intended. This in turn allowed us to exclude non-target renditions from the acoustic analysis. In addition, these data constituted a behavioral measure that allowed us to compare participants’ comprehension across conditions.

### *2.3 Procedure*

Each participant saw a total of 48 items in context, including 20 critical items, 8 controls, and 20 distractors. The stimuli were presented electronically using E-Prime 2 Software (Psychology Software Tools, Inc. 2012). A keyboard was used for navigation through the experiment, as well as for entering responses to the verification question. Each item component (context, question, answer, and verification question) was presented on a separate screen. All items and instructions were in white print on a black backdrop except for the screen with the negative word, which had the text in green. Participants were instructed to say the word in green aloud. They advanced through the experiment at their own pace, and the entire protocol took between 15 and 30 minutes.[16] Following the experiment, participants completed a brief (approximately five-minute) language history questionnaire online, via Google Docs.

Oral responses were recorded using a Fostex DC-R302 recorder and a head-mounted Audix HT5 condenser microphone. The data were digitized at 44.1 kHz, 16 bit. Participants completed the experiment in a sound-attenuated booth, where they sat in front of a computer monitor by themselves.

*2.4 Data Processing and Analysis*

A total of 560 negative word tokens were recorded from the 20 participants whose productions we analyzed. However, the acoustic analysis was limited to items that received a correct answer to the verification question; i.e., those for which the oral answer was conceivably produced with the intended meaning according to the context provided. This resulted in a total of 504 tokens, which shows that participants tended to be accurate in their interpretation of the contexts. Another six tokens were discarded due to elision of a syllable or disfluencies, leaving a total of 498 tokens.

The data were segmented in Praat (Boersma & Weenink 2016). First, the beginning and end of the word were manually annotated via inspection of the synchronized waveform and spectrogram. Then, syllable boundaries were marked following criteria in Turk et al. (2006). In all cases, intervocalic consonants were assumed to be onsets of the second syllable.

After segmentation, a series of measurements were extracted automatically. We extracted two relative measurements: relative duration of the stressed syllable (stressed syllable duration divided by the total word duration) and relative intensity of the stressed syllable

[16] E-Prime software collects reaction time information for self-paced tasks, but because items were not controlled for length, analysis of these data to draw inferences about processing difficulty would not be valid.

(stressed syllable intensity divided by the total word intensity). The intensity parameters were set at: 100-Hz minimum pitch, 0-second time step, and subtract mean = yes. For more information, see the manual provided in Praat (Boersma & Weenink 2016).

These measurement values were z-score transformed by speaker. (Values were normalized separately.) Z-scored transformed measurements were analyzed in R (R Core Team 2015) using linear mixed effects regression (LMER) models (Bates et al. 2015).

In addition, time-normalized f0 values were extracted using ProsodyPro (Xu 2013), a Praat-based software developed to facilitate prosodic analysis of large corpora of speech data. Specifically, f0 values were extracted at ten equidistant points within each syllable, thus allowing us to compare different renditions of the same word across speakers and contexts. F0 values were also z-score transformed to allow us to compare across speakers. The resulting f0 curves were then analyzed statistically using smoothing spline (SS) ANOVAs (Gu 2014). SS ANOVA has been used in phonetic research to compare tongue shapes generated through ultrasound imaging (Davidson 2006), formant trajectories (Simonet et al. 2008; Nance 2014), as well as f0 curves (Mathes 2015). First, smoothing splines are fitted to each of the data sets being compared (here, NC vs. DN vs. Control). The smoothing splines plus the Bayesian confidence intervals are then plotted to visually compare the curves. The lack of overlap between the confidence intervals is interpreted as indicating a statistically significant difference between the curves (Davidson 2006).

The responses to the verification questions for the critical and control items (n = 28) were also analyzed statistically to determine whether participants were equally likely to give target responses in the DN, NC, and Control conditions. The data were analyzed in R using a general linear mixed effects regression model (GLMER; Bates et al. 2014).

The next section reports results of the acoustic and behavioral analyses.

## 3. Results

### *3.1 Acoustic Data*

### *3.1.1 Point Data*

Figures 1 and 2 illustrate the normalized mean intensity and duration values for the negative words in the critical and control conditions.

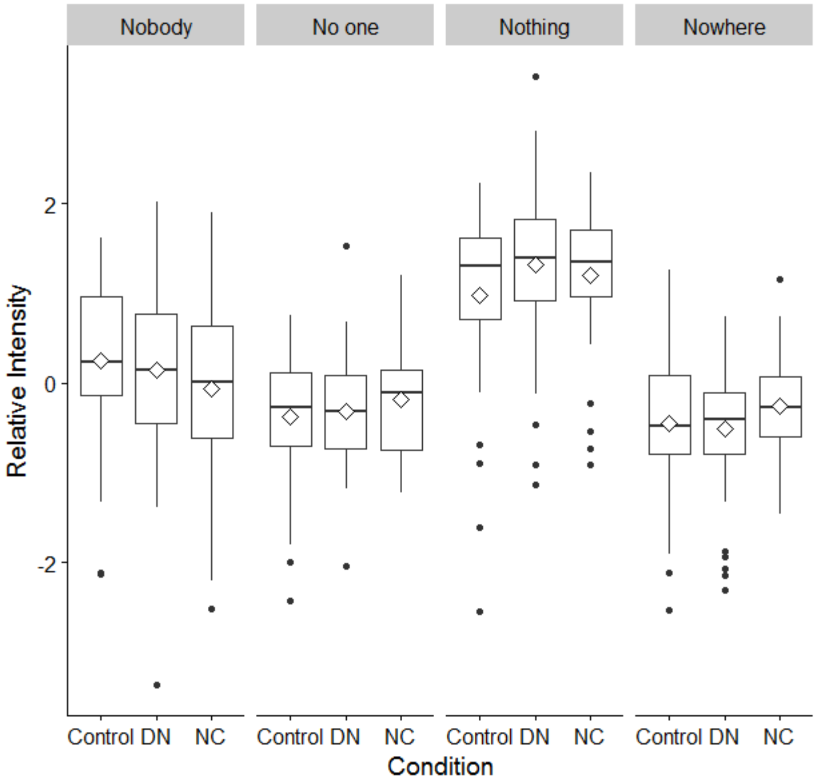


**Figure 1.** Relative intensity (z) of the stressed syllable in negative words by condition (Control, DN, NC).

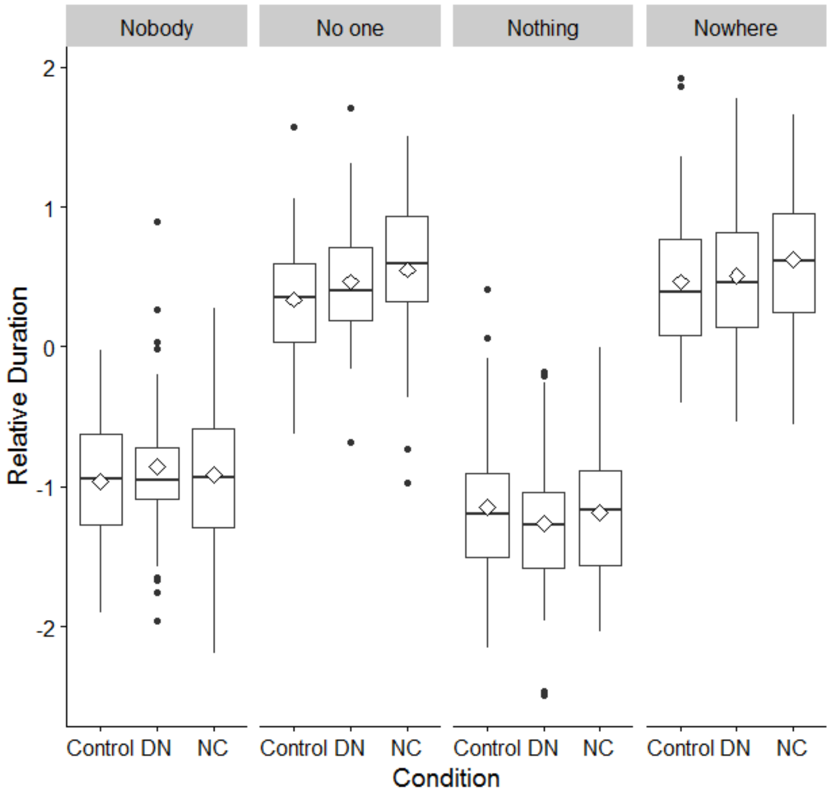


**Figure 2.** Relative duration (z) of the stressed syllable of negative words by condition (Control, DN, NC).

The figures illustrate that, although there were differences between words, both relative intensity and relative duration of the stressed syllable with respect to the word were the same for each negative word across experimental conditions. The small variations that we observe seem negligible, and, in fact, statistical analyses confirm that. Two LMER models were fitted, one for relative stressed syllable duration and another one for relative stressed syllable intensity. Both models had Condition as a fixed effect and random intercepts and slopes for Participant and Item. We found no significant difference in duration between the Control Condition and DN ($\beta$ = .05, SE = .22, *p*(z) = .21) or NC ($\beta$ = .03, SE = .22, *p*(z) = .14), and no significant difference in intensity between the Control Condition and DN ($\beta$ = .06, SE = .23, *p*(z) = .24) or NC ($\beta$ = .12, SE = .23, *p*(z) = .5).

*3.1.2 F0 Curves*

As regards the analysis of f0 curves, Figures 3 and 4 show the smoothing splines plus the Bayesian confidence intervals for the target negation words. Since *nobody* was the only three syllable word, it was analyzed separately given that the relevant syllables (stressed and final) would not line up if all the data were analyzed together.

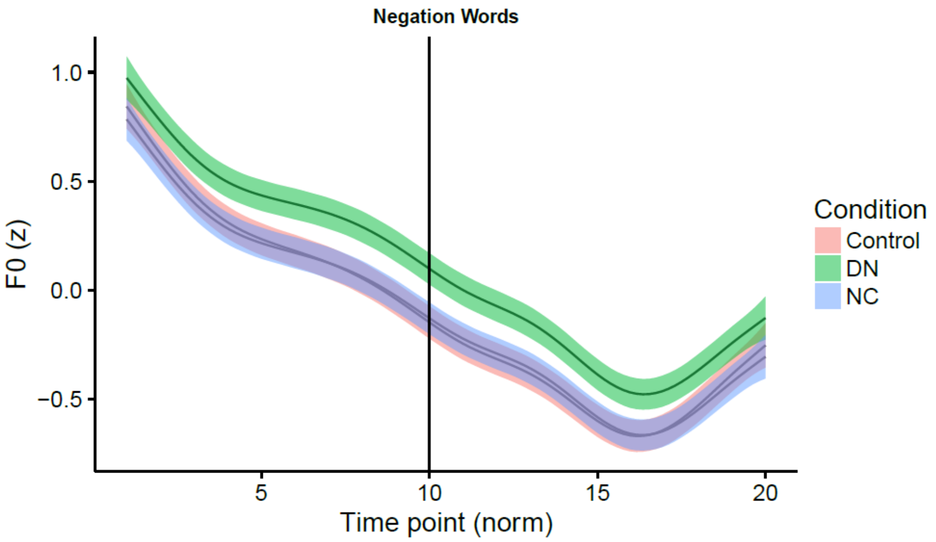


**Figure 3.** Smoothing splines and 95 % Bayesian confidence intervals for the f0 curves corresponding to two-syllable negative words *no one*, *nothing*, and *nowhere* by condition. The vertical line indicates the syllable boundary.

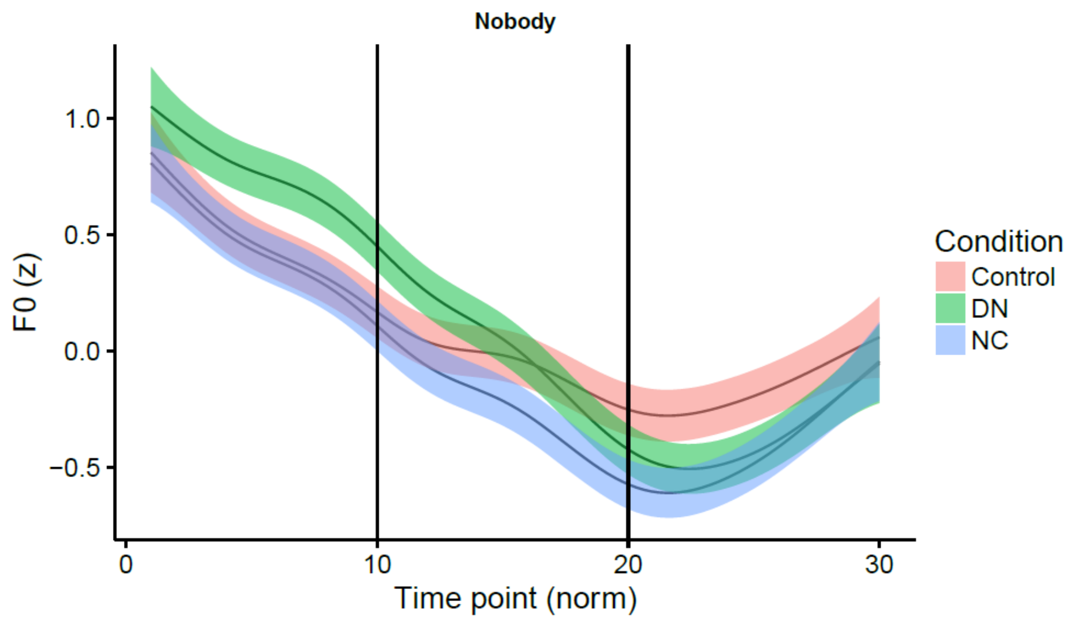


**Figure 4.** Smoothing splines and 95 % Bayesian confidence intervals for the f0 curves corresponding to the three-syllable negative word *nobody* by condition. Vertical lines indicate syllable boundaries.

As shown in Figure 3, the stressed (first) syllable of disyllabic negation words shows a falling f0 movement that continues to fall during the posttonic until it reaches its minimum around the final syllable mid-point, where it increases slightly. We observe almost complete overlap between the Control and NC conditions. As for the DN condition, while it presents the same overall contour shape, the normalized f0 curve does not overlap with the other two, given that it is significantly higher.

Figure 4 shows that *nobody*, with three syllables, presents the same nuclear contour as the two syllable words (i.e., the overall shape of the f0 curve is the same), with a progressive f0 fall from the beginning of the word until it reaches the f0 minimum within the last syllable, at which point there is a change in f0 direction. Like in Figure 3, the DN condition exhibits higher f0 in the first syllable (the stressed syllable, site of the nuclear pitch accent) than the other two conditions. In addition, it also presents a higher f0 than the NC condition in the second syllable, although not in the third syllable. In that last syllable, the Control condition fails to reach the minimum f0 reached in the other two conditions. The f0 rise in the second part of the last syllable is much less steep in the Control condition than in the other two conditions.

*3.2 Verification Question Response Data*

Figure 5 illustrates participant responses to the true or false verification questions, included after each experimental item to evaluate whether participants interpreted the contexts as intended. Percentages of expected responses for the single negative Control, DN, and NC condition are shown.

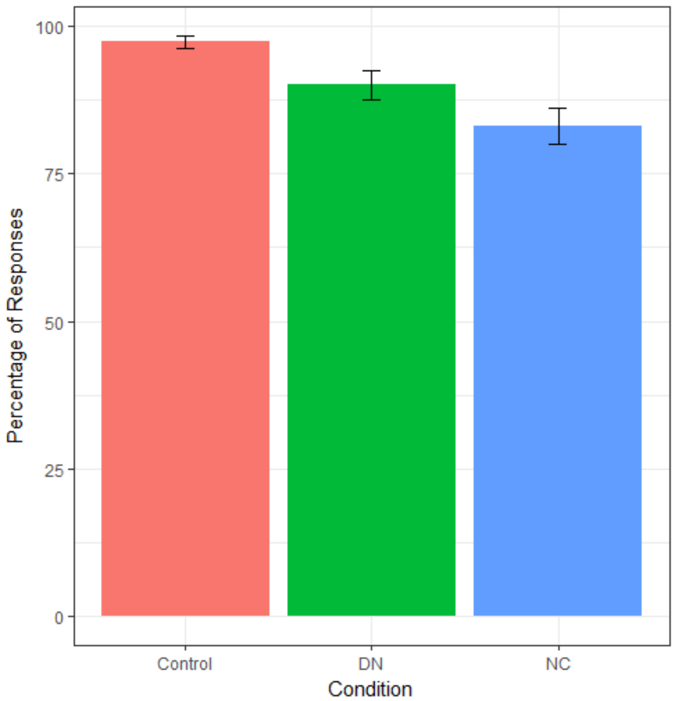


**Figure 5.** Percentage of target-like responses to Control, DN, and NC verification questions.

Figure 5 shows that responses were on target most of the time in all three negation conditions. Performance was nearly at ceiling in the single negative Control condition, in which responses were target-like 97 % of the time. In the DN condition responses were target-like 90 % of the time

time, and for NC participants gave 83 % target-like responses. A GLMER model comparing response rates for NC and DN item pairs (e.g. (8) vs. (9)) with random intercepts for Participant and Item was performed to determine the effect of condition on target response.[17] This revealed that DN and NC target response rates were not equivalent, and that participants were significantly more likely to give non-target like answers with the NC items than they were with DN ($\beta = -.66$, SE = .30, $p(z) < .05$).

Because they have different contexts, the control items could not be paired with the critical items. Therefore, a separate GLMER was run to compare the critical conditions against the single negative controls. This revealed that participants gave significantly fewer target-like responses in both the DN ($\beta = -1.39$, SE = .51, $p(z) < .01$) and the NC ($\beta = -2.01$, SE = .49, $p(z) < .001$) conditions than in the Control condition.

Summarizing, our acoustic results show that NC and single negation interpretations of negative indefinites have similar intonational form and identical f0, while DN, though similar in intonational form to NC and single negation, is marked by higher fundamental frequency. In the comprehension task, participants performed well on all conditions, but had greater difficulty with DN than with the single negative control items, and had the lowest frequency of target-like responses on the NC condition.

## 4. Discussion

### *4.1 Prosody and the Meanings of Negative Indefinites*

[17] The sparsity of data prevented us from using a maximal random effects structure (Barr et al. 2013). Additionally, a log likelihood ratio test confirmed that adding the interaction between condition and negative word does not significantly change the model ($\chi^2$ (3) = 2.77, $p > .05$). We therefore calculated only the effect of Condition on correctness, taking Participant and Item as random variables.

Our acoustic results demonstrate that denial DN is the marked interpretation for single negative indefinites in question-answer pairs, as compared with the single negative meaning of both the NC and the Control items. The markedness of DN was encoded by fundamental frequency alone. The overall shape of the prosodic contour for DN, NC, and the single negative controls was found to be the same, but f0 was significantly higher for the DN items than for both the NC and control items, which had overlapping f0 values.

This result is both similar to and different from the results reported for Catalan in Espinal & Prieto (2011), and for Spanish and Catalan in Prieto et al. (2013) and Espinal et al. (2016), all of which used a perception task to examine the behavior of single negative words in question-answer pairs. Our results pattern with previous ones in that a more marked prosody is used in English to convey a denial DN interpretation rather than an NC one, but, unlike in Spanish and Catalan, the difference does not seem to be phonological, but rather, phonetic. That is, English does not seem to employ a different combination of pitch accent and boundary tone, but rather f0 register.

The crucial point for our purposes is that, in Spanish and Catalan, it is the DN reading that is associated with a more marked prosody (with the complex boundary tone vs. the more simple boundary tone of the NC reading), and not NC. In our data, the more marked reading (DN) is rendered with an overall higher f0 register. The acoustic properties of this markedness are at least partially consistent with the results in Breen et al. (2010), who found that English contrastive focus is marked by a higher f0, greater intensity, and longer duration than regular, non-contrastive focus. English thus behaves like prototypical NC languages in marking DN prosodically, with expected crosslinguistic differences in terms of how this marking is realized (Ladd 2008).

Our acoustic results are also informative with respect to the broadly assumed English-internal division between NC varieties and Standard English, thought to be prototypically DN.

Our participants, undergraduate students at an established university trained in the conventions of Standard English, and in an environment that elicits formal academic language, reliably distinguished prosodically between NC and DN readings, aligning NC constructions with their single negative semantic equivalent. This suggests that like Spanish and Catalan, English is a language that generates both NC and DN, each with its own set of prosodic, syntactic, and pragmatic conditions. To further explore the nature of the syntactic and pragmatic conditions associated with NC and DN interpretations, we turn now to a discussion of the verification question response data.

*4.2 The Comprehension of Single and Double Negation*

As discussed in Section 1, we began our study with the standard assumption that single word answers to *wh*-questions involve movement of the questioned phrase to a left peripheral position and PF deletion of the remaining material (Merchant 2001; Temmerman 2012; a.o.). This assumption provides the basis for our argument that participants are assigning NC and denial DN interpretations to the critical items in our study: The second negation is deleted, but syntactically present in the underlying structure.

Espinal et al. (2016) question the assumption that single negative words in negative question-answer pairs are the surface reflex of movement to the left periphery followed by PF deletion. These authors interpret their results, which show differences between single words and full sentences with two negatives and no deletion, as indicating the absence of an elided structure in the single negative word condition. They assert that instead of projecting a full clausal structure, the negative indefinite is the surface reflex of a singular Focus Phrase (Espinal et al. 2016: 167).

Our behavioral results, in conjunction with our acoustic findings, suggest that the elicited negative indefinites were in fact the surface reflex of a full elided clausal structure. As discussed in Section 1.3, the NC and DN responses in negative question-answer pairs serve distinct pragmatic functions. The NC response selects a true proposition from the denotation set contributed by the question, while the DN response serves as a denial, either at the propositional or the presuppositional level (Geurts 1998). The DN response thus has a special status with respect to the discourse. Note now that, given that they have the same meaning, the NC and the Control conditions have identical status with respect to the discourse. Therefore, if participants are assigning the same structure in these conditions (e.g., the projection of a single Focus Phrase), we might expect similar target response rates for NC and Controls in the offline verification question.

Although participants had consistently high rates of target responses (97 % for the Controls, 90 % for DN, and 83 % for NC), there was a significant difference in their responses across all three conditions. This result shows that the negation in the question played a role in the interpretation of the fragment answer. This is in contrast with the acoustic results, which reflect identical prosody for the NC and Control conditions, and significant differences in fundamental frequency between these two conditions and DN. We argue that this asymmetry between the acoustic and behavioral results supports the hypothesis that participants were assigning an NC structure underlyingly to the fragment answer in the NC condition. If participants were not integrating the negation in the question into their fragment answer, then we would not expect to see a significant difference in the NC and Control responses to the verification question.

We therefore conclude, on the basis of these data, that participants' NC productions involved an elided structure with two syntactic negations, as in (3) and (6) above. Under this analysis, our results demonstrate that Standard English speakers have syntactic knowledge of NC. In conjunction with the uncontroversial assumption that their grammars also generate DN, which our acoustic and behavioral data also support, we put forth the more general conclusion that Standard English grammars generate both NC and DN. This conclusion aligns Standard English with prototypical NC languages like Spanish and Catalan, which, as discussed above, have also been shown to generate both.

Before concluding, we consider the behavioral results in isolation. The fact that participants gave significantly fewer target-like responses in the DN condition than with the Controls provides an offline measure which suggests that denial negation is more difficult to process than single or descriptive negation (Horn 1989[2001]), corroborating the online eye-tracking measures in Orenes et al. (2016). This is in contrast with the eye-tracking results in Noh et al. (2013), in which descriptive and metalinguistic negation were found to induce equivalent processing loads. Our results therefore contribute additional empirical information to inform this debate.

With respect to performance on the NC condition, our analysis raises the question of why, if participants' grammars can generate both NC and DN constructions, verification question responses for the NC items were significantly less target-like than both the DN items and the controls. We propose two possible explanations for this. One possibility is that participants' degraded performance on the NC condition is an effect of the prescriptive ban on NC. While the acoustic data reflect participants' online expression of NC as single negation, the offline comprehension measure allows for time to reflect on the acceptability of NC in the formal context of a university laboratory. It is therefore possible that, given time to consider their response, degraded performance on the NC condition is a reflex of normative pressures, and not a true grammatical effect.

Another possible explanation is that the NC response interacts with the presuppositions projected by the question in a manner that yields some level of pragmatic infelicity. Consider again the NC item in (8) above, repeated here as (11):

(11) Context: You and your roommate pay different bills each month. This month you have too little money to pay bills.

Question: Your roommate asks: What didn't you pay?

Response: Nothing.

The negative question contributes the soft presupposition that there exists something that the interlocutor did not pay. This soft, cancelable presupposition includes an existence assumption which takes scope over a negation. The Control condition, on the other hand, which does not contain a negation in the question, contributes only the soft existence presupposition (Abusch 2010). We suggest that the negation in the existence presupposition makes it more difficult to cancel, yielding some level of pragmatic infelicity that impacts interpretation. Further work is required to decide between these and other possible interpretations, and we set this question aside here.

## 5. Conclusions

On the basis of the acoustic and behavioral data presented in this paper, we have argued that Standard English is a language that generates both NC and DN. The acoustic data further support the conclusion that DN, which serves as a denial negation in our stimuli, is the marked form relative to NC and single negation. The specific acoustic correlates associated with the DN reading provide further support for the generalization that English marks information structure prosodically, exploiting in particular the mechanism of increased fundamental frequency.

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