

Intonational Cues in the Perception of Invitation and Information-Seeking Yes/No Questions by Mexican and Castilian Spanish Speakers

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1. Introduction

The intonation of Castilian and Mexican Spanish (henceforth, CS and MS) has been well studied from a phonetic and phonological perspective. Previous studies have described a variety of intonational contours for CS (see Alcoba and Murillo, 1999; Canellada and Kuhlmann Madsen, 1987; De la Mota, 1995; Kvavik and Olsen, 1974; Quilis, 1975, 1981; Quilis and Fernández, 1985; Navarro Tomás, 1918, 1939, 1944, among others) and MS (see Ávila, 2003; Beckman, Díaz-Campos, McGory and Morgan, 2002; Kvavik, 1974, 1979; Martín Butragueño 2003a, 2003b, 2004, 2005, 2006a, 2006c; Matluck, 1951; Prieto, Van Santen and Hirschberg, 1995; Sosa, 1999; Velázquez 2008a, 2008b; see Martín Butragueño 2006b for a review). Additionally, the intonation patterns of interrogatives from a production point of view in different varieties of Spanish have recently received considerable attention, such as Willis (2004, 2007) for Dominican Spanish; Willis (2005) for Puebla Mexican Spanish; Armstrong (2010) for Puerto Rican Spanish; García-Riverón et al. (2010) for Cuban Spanish; Robles-Puente (2011) for Bilbao Spanish, and Henriksen (2012) for Manchego Peninsular Spanish, to mention a few examples. However, this work which includes descriptions of the dialectal differences of yes/no questions (divided in the literature into echo, biased, counterexpectational, imperative, confirmation, information-seeking and invitation questions) has been heavily based on describing f_0 in production while the perception of intonational patterns in the interrogatives of different dialects of Spanish has received much less attention in the literature.

Recent cross-linguistic perception studies have shown that speakers can discriminate between questions and statements (D'Imperio and House, 1997; Face, 2005; 2007, among others) and more specifically, other work has shown that speakers are able to signal the difference between different types of interrogatives intonationally (Crespo-Sendra, Vanrell and Prieto, 2010; House, 2002). Crespo-Sendra et al. (2010) investigated the perceptual cues used by Catalan listeners to distinguish between information-seeking and incredulity yes/no questions showing that a difference in pitch scaling of the boundary tone HH% is the strongest cue for perceptually distinguishing between the two interpretations. House (2002), on the other hand, designed two perception experiments to investigate intonational cues and visual facial cues to interrogative mode in Swedish and found that both a widened f_0 range on a final focal accent and the time alignment properties of the f_0 rise and peak made important contributions to the interrogative percept. Of importance to this paper, there has not been much work on the perceptual cues of these interrogatives in different dialects of Spanish (see Face 2011, for an overview of the perception of Castilian Spanish intonation which includes interrogatives) and because of this we know very little about the contribution of prosodic features to intonational meaning in different varieties of Spanish.

This paper will focus on the perception of invitation (IV) and information-seeking (IS) yes/no questions (i.e., a question to which a 'yes' or 'no' answer is generally expected) in CS and MS. Pragmatically, polite invitation yes/no questions are used to offer something to the listener (e.g. would you like some cake?), while information-seeking yes/no questions are used to ask for some specific information (e.g. do you have some cake?). Previous phonological studies have described these yes/no questions as having a final rise in the nuclear peak, however, data in CS and MS suggest that these varieties of Spanish contrast information-seeking and invitation yes/no questions in the timing and

height of this final rise (De la Mota, Butragueño and Prieto, 2010). The goal of this study is to investigate the contribution of these prosodic features (tonal scaling and tonal alignment) to intonational meaning and to analyze whether the height of the nuclear peak and the timing of the final rise –or a combination of the two– signal perceptually the contrast between information-seeking and invitation yes/no questions in two dialects of Spanish.

2. Invitation and information-seeking yes/no questions in CS and MS

Information-seeking yes/no questions in CS have been described with a rising contour starting at the offset of the accented syllable. Thus, the nuclear accent shows f_0 dip with a sharp rise observed at the end of the utterance (Estebas-Villaplana and Prieto, 2010). These same information-seeking yes/no questions have been described with a different intonational tune in MS: with a high rise at the end of the utterance (Ávila 2003; De la Mota, Butragueño and Prieto, 2010). Specifically, in these interrogatives, the last pitch accent is realized with a local pitch minimum which continues into the post-tonic syllable and then rises dramatically in the boundary tone at the end of the utterance.

In contrast to information-seeking yes/no questions, polite invitation or request yes-no questions are expressed by means of a different intonational contour in CS and MS (see Escandell-Vidal, 1996, 1999; Thorson, Borràs, Crespo-Sendra, Vanrell and Prieto, 2009). In MS it consists of a low tone during the stressed syllable followed by a high rise in the post-tonic syllable, while in CS the rise has been described to occur in the onset of the tonic syllable.

In addition to the differences in tonal alignment between these two yes/no questions, previous pilot production data conducted by the author and previous intonational descriptions of Spanish dialects (see De la Mota, Butragueño and Prieto, 2010) have observed differences in the final tonal scaling of these two questions. Specifically, invitation yes/no questions were produced with a higher utterance-final f_0 peak: Quilis (1993: 471), Sosa (1999: 200-202) and Ávila (2003) have reported a higher and longer final rise in MS yes-no questions, a phenomenon which seems to be specific to this Spanish variety. Thus, the effect of the height of the final rise is also examined in this study. Examples of the intonational patterns of invitation and yes/no questions are found in Figure 1 and 2, which show the f_0 contours of the prenuclear and nuclear peak in both an invitation and an information-seeking yes/no question produced by a MS speaker. It can be observed that these two intonational patterns differ in the alignment of the rise of the nuclear peak and also in the height of the nuclear and prenuclear peak.

Figure 1. Waveforms, spectrograms and f_0 countours of the utterance *Quiere un caramelo?* ‘Do you want some candy? Produced as an invitation yes/no question by a MS speaker (ms01f)

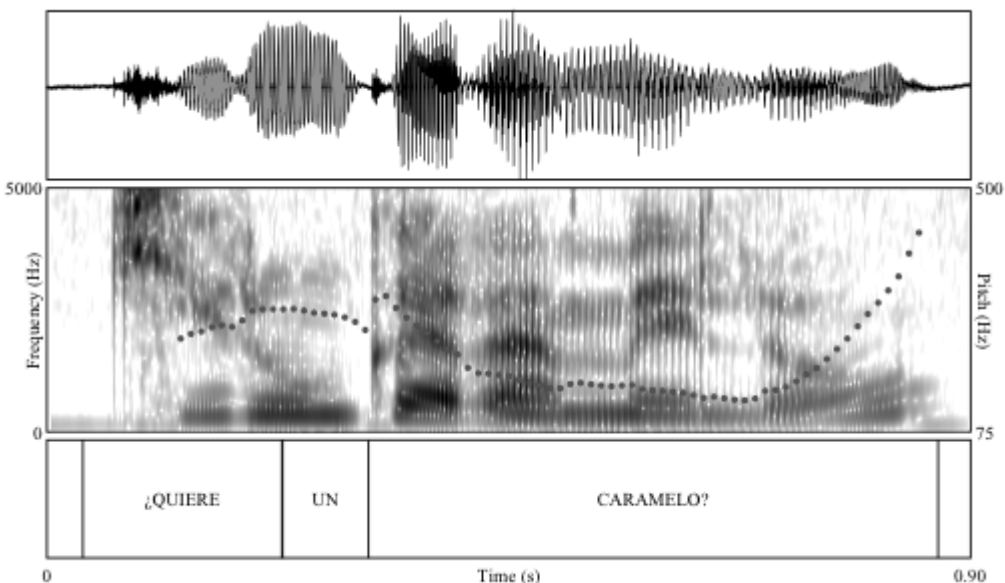
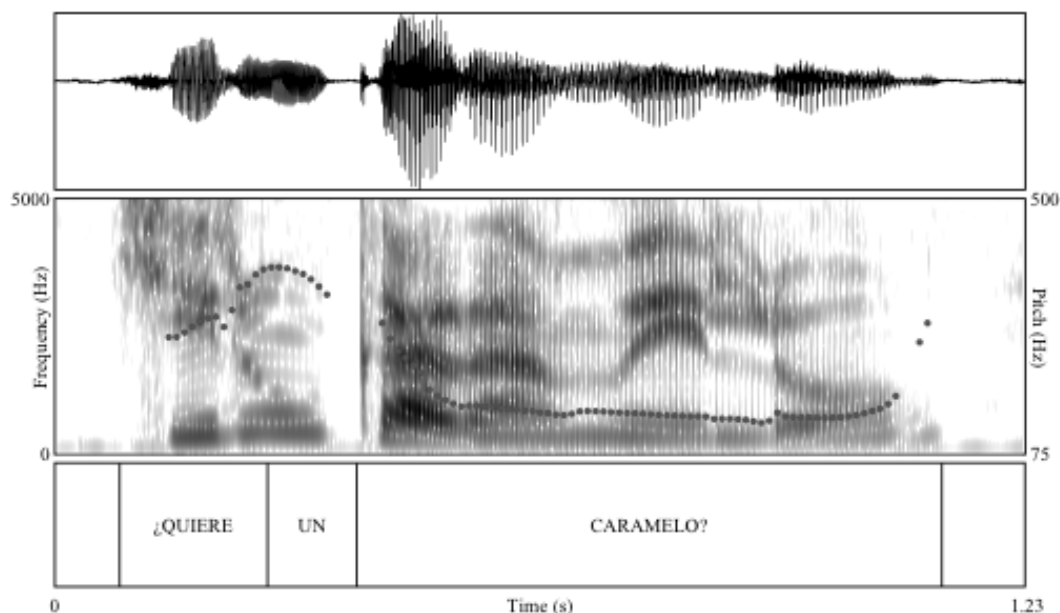


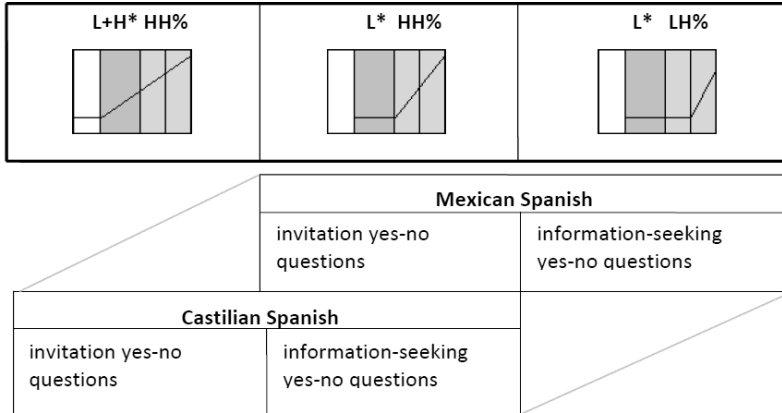
Figure 2. Waveforms, spectrograms and f0 countours of the utterance *Quiere un caramelo?* ‘Do you want some candy?’ Produced as an information-seeking yes/no question by a MS speaker (ms01f)



The most widely used framework in studies of Spanish intonation is by far the Tones and Break Indices (for Spanish there is Sp_ToBI) in the Autosegmental-Metrical (AM) approach to intonational analysis (see Beckman et al., 2002; Estebas-Vilaplana and Prieto, 2008; Hualde, 2003; Sosa, 2003). When transcribing intonation using the ToBI labeling scheme, we assume a series of conventions to differentiate among the contrasting prosodic structures and associated intonational events including several simultaneous tiers of phonological information (syllables, words, tones, break indices, and code). For the intonational analysis of utterances, the transcriber needs to decide which word is the most prominent accented word in and which of the remaining words in the utterance are accented, and then assign a tune, which consists of one or more pitch accents and a boundary tone to each prosodic phrase. There are two types of tonal events: pitch accents and boundary tones. Pitch accents mark the stressed syllable in specific words, and they are either monotonal or bitonal. For instance, H* (‘peak accent’) is the tone target on the accented syllable which is in the upper part of the speaker’s pitch range for the phrase, and L* (‘low accent’) is the apparent tone target in the lowest part of the speaker’s pitch range. The bitonal pitch accents in Spanish include L+H*, L+>H*, L*+H and H+L* (Beckman et al., 2002). The nuclear accent is a pitch accent that occurs near the end of an intonational phrase and it often sounds more prominent than other accented words in the same prosodic phrase (Pierrehumbert, 1980). In addition, the boundary tones are associated with the right edge of the prosodic phrase, and may be responsible for the most salient part of the intonational contour.

De la Mota, Butragueño and Prieto (2010) argue that “although in both Castilian and Mexican Spanish both invitation and information-seeking yes/no questions end in a high rise, the starting point of the rise seems to be important for distinguishing between the two meanings” (p.331). Specifically, in terms of the Autosegmental-Metrical (AM) approach to intonational analysis (Pierrehumbert, 1980; Ladd, 1996, among others) an early rise in L* HH% indicates the invitation meaning, a late rise L* LH% is used for information-seeking questions in MS. While in CS, invitation yes-no questions show a L+H* HH% contour, with an early rise which starts at the beginning of the stressed syllable, while the ‘later’ alignment is found in information-seeking yes-no questions, with a L* HH% configuration (Estebas-Vilaplana and Prieto, 2010, Thorson et al. 2009). As a result the same configuration, in this case L* HH%, can be attested in both varieties but may be used for different meanings.

Figure 3. F0 representation of the types of nuclear configurations found in invitation and information-seeking yes/no questions in Castilian and Mexican Spanish (from De la Mota, Butragueño and Prieto, 2010)



In De la Mota, Butragueño and Prieto (2010), speakers from CS and MS have been claimed to signal the difference between information-seeking yes/no questions and invitation yes/no questions intonationally. These dialectal descriptions will benefit from further experimental approaches, and specifically, perceptual experiments to indicate whether there is a categorical phonological contrast between these two types of contours for CS and MS speakers.

The goal of this study is to investigate if there is a categorical contrast between these two types of yes/no questions and to examine the contribution of f0 (specifically tonal scaling and tonal alignment) to intonational meaning in CS and MS. Based on previous phonological descriptions (De la Mota, Butragueño and Prieto, 2010; Estebas-Vilaplana and Prieto, 2010) a different proportion of invitation yes/no question responses is expected between the MS and CS speaker groups. Specifically, for the CS speakers, rise in the onset of the tonic syllable is expected to be perceived as an invitation yes/no question while rise in the post-tonic syllable is expected to be perceived as an information-seeking yes/no question. In contrast, for the MS speakers, only a rise in the boundary tone at the end of the utterance is expected to be perceived as an information-seeking yes/no question while rises in the tonic and onset of the post-tonic syllable are hypothesized to be perceived as invitation yes/no questions. In ToBI terms, the L* HH% configuration with an f0 rise in the onset of the post-tonic syllable is where there is an expected difference between both dialects of Spanish. If the predictions set forth in previous dialectal descriptions are accurate, MS speakers should consider this intonational pattern as an invitation yes/no question while CS speakers should consider it an information-seeking yes/no question. Finally, based on previous pilot production data and intonational descriptions of Spanish dialects (see De la Mota, Butragueño and Prieto, 2010) a higher final peak is expected to favor the perception of an invitation yes/no question.

3. Method

3.1. Stimuli preparation

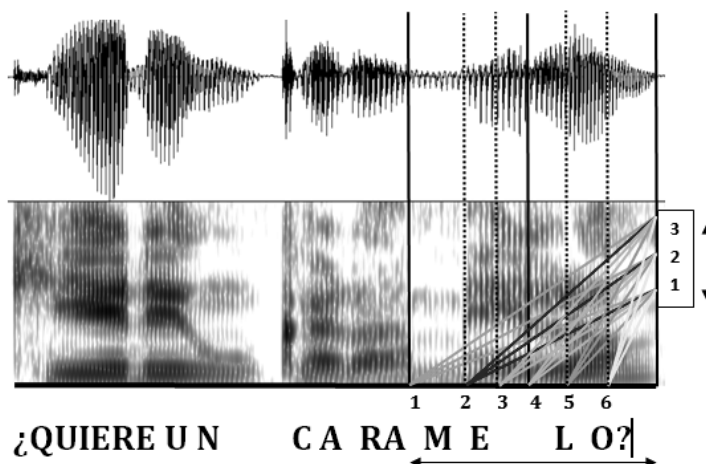
A forced-choice identification task with a binary response was applied to this contrast. The stimuli for the identification task were obtained from a native speaker of CS. The native CS speaker who produced the precursor for the stimuli listened to a script, which was prepared by the researcher (see below) and was presented with pictures that gave the pragmatic context for both types of questions. The native CS speaker was presented with the following situations:

- **Information-seeking yes/no question:** You are walking in the street with a friend and see a boy looking at candy in a store. You ask your friend if that boy wants candy.
(Response: ¿quiere un caramelo?)
'Does he/she want some candy?'

- **Invitation yes/no question:** You are sitting in the park with a friend and you have a bag of candy and you offer your friend a piece of candy.
(Response: ¿quiere un caramelo?)
'Would you like some candy?'

The native CS speaker produced 5 instances of each type of yes/no question '¿*Quiere un caramelo?*' 'do you want some candy?' and one precursor (as an invitation yes/no question) was chosen as the base stimulus because it was considered to be enunciated clearly and with a normal speech rate. Thus, the target stimuli in the perception study were the manipulations of the utterance '¿*Quiere un caramelo?*' 'would you like some candy?/ does he/she want some candy?' which is ambiguous without prosodic information¹. To create the stimuli for the experiment, the f₀ value at the end of the recorded sentence was manipulated in *Praat* (Boersma and Weenik, 2010). The scaling of the prenuclear pitch accent of the base stimulus was neutralized, since some scaling differences between IS and IV were found in the original recordings, to disable the height of the prenuclear peak as a cue. Specifically, the prenuclear peak was neutralized by stylizing the f₀ peak using the mean f₀ values for the two base sentences (information-seeking and invitation) produced resulting in a peak of 170Hz. The materials for the identification task consisted of three continua in which three different parameters were manipulated using the information-seeking and the invitation yes/no questions as end points. These parameters were pitch height of the nuclear peak, peak alignment of the final rise and a combination of both prosodic features. Thus, in the tonal height continuum, the tonal scaling of the nuclear peak was manipulated based on the ranges produced by the speaker in both types of yes/no questions from a high to an extra-high pitch from 200Hz (average in the information-seeking yes/no questions) to 300Hz (average in the invitation yes/no questions) in 3 steps of 50 Hz each, and the alignment of the rising tone was manipulated in six steps with the rising of the nuclear peak occurring in the onset of the consonant, onset of the vowel and midpoint of the vowel in both the penultimate (me) and final (lo) syllables (tonic and post-tonic syllables). These increments were chosen to allow for a continuum in pitch height and peak alignment. The rise onset in each of the stimuli was at a pitch level of 132 Hz. There was not an offset of this final rise as the rise occurs as the very end of the sentence.

Figure 4. Schematic diagram of the continua consisting of manipulated stimuli ranging from information-seeking to invitation yes/no questions (pitch height and peak alignment).



¹ One reviewer points out that the utterance would only be ambiguous if it were "¿un caramelo?" but with the verb "querer" there could be an automatic bias for the invitation interpretation. To minimize the risk of biasing subjects in one direction, participants completed a tutorial before completing the perception experiment, which outlined the background and context for each type of question, to ensure that they understood the pragmatic contexts.

3.2. Participants

Six (6) native speakers of CS and MS between 19 and 38 years old participated in the experiment. These speakers (3 from each dialect) were either from Madrid (CS) or Mexico City (MS). These participants were all native speakers of their dialect but at the time of the experiment were residing in the United States completing undergraduate or postgraduate studies, and were highly proficient in English. They reported not speaking another language apart from Spanish and English; they had completed their primary and secondary education in their country of origin, returned to Madrid/Mexico City at least once a year and reported continuous contact with other Spanish-speakers from their home country.

3.3. Procedure

Listeners were instructed to maintain their hands near the keyboard and press the keys when ready. They were also told that they could repeat the stimuli as many times as needed. Participants were seated at a laptop in a quiet room and the stimuli were played back through headphones. Participants were explained the two contexts and were presented a slideshow with images that described the specific pragmatic context for each of the questions together with a description of each use. In addition, participants completed the identification task in one training session which consisted of one block containing the eighteen synthesized stimuli presented in randomized order before completing the experiment.

In the identification task, the eighteen stimuli of ‘*¿quiere un caramelo?*’ were repeated ten times and were presented in each of the ten blocks in randomized order. Subjects were instructed to listen to each stimulus as many times as necessary and to take as much time as needed to classify each question (as either an invitation or an information-seeking yes/no question) by pressing a button on the keyboard.² Participants pressed one of the two buttons depending on whether they considered the question an *ofrecimiento (un caramelo)* ‘an offer/invitation (candy) or *solicita información (si el chico quiere un caramelo)* ‘request information (if the kid wants candy). In order to record the proportion of responses for each question type, the experiment procedure was run using *Praat*. The stimuli were presented auditorily through the computer, via headphones and responses were registered automatically by the *Praat* experiment software. Participants were given as much time as needed, therefore, no reaction times were measured. Thus, for the experiment there were a total of ten blocks of 18 stimuli (180 tokens) produced by six participants totaling 1080 tokens.

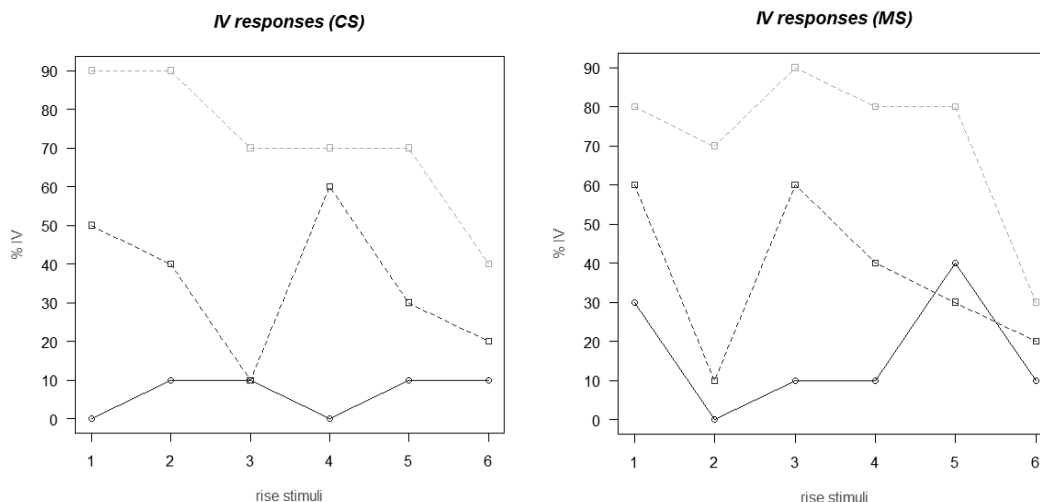
4. Results

The graphs in Figure 5 show the proportion of responses identifying each stimulus as an invitation yes/no question along the continuum in which the rise timing was manipulated (six steps: onset of the consonant, onset of the vowel and midpoint of the vowel on both the tonic and post-tonic syllables). The three lines indicate the three different tonal heights in the manipulation (200Hz = bottom, 250Hz = middle and 300Hz = top). Both graphs are separated by speaker dialect (left=CS, right=MS).

As we can see, the function does not present a downward trend left-to-right, revealing that the timing of the rise seems to play a minor role in distinguishing between the two types of yes/no questions. However, we can observe notable differences in the proportions of the three different tonal heights.

² The motivation for using a forced-choice task in this pilot study was to test if there was a categorical (binary) option in different types of nuclear configurations between invitation and information-seeking yes/no questions in CS and MS as noted in the literature. However, future work on the perception of intonational meaning will benefit from a scale instead of the forced choice task used in this study.

Figure 5. Mean “invitation” identification proportion as a function of rise step number averaged over subjects. Each line represents final pitch height (bottom= 200Hz, middle=250Hz, top=300Hz). The left graph represents the CS group and right graph represents the MS group.



The data were analyzed under a mixed-model logistic regression, which was fit to the data by using the statistical tool R (R Development Core Team, 2008). For the model presented here, the dependent variable was whether a token was identified as IV and timing of the rise (six steps: onset of the consonant, onset of the vowel and midpoint of the vowel in both the tonic and post-tonic syllables), tonal height (200Hz, 250Hz, 300Hz) and the dialect of Spanish spoken (MS, CS) were tested as potential predictors (as fixed effects). Both rise timing and tonal height were coded as continuous variables and Speaker was included as a random effect, using the *lmer* function in the *lme4* package of the R statistical package (Bates, Maechler and Bolker, 2011). Also included in the model were three interactions, one between the height of the stimuli and the rise of the stimuli, one between group and height and one between group and rise. The model’s fixed effects are shown in Table 1, alongside the factors’ estimated coefficients and their predictive significance:

Table 1. Coefficients of fixed effects; higher coefficients indicate a greater likelihood of an Information-seeking yes/no question response.

	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	2.691	0.690	3.899	<0.0001
Rise	0.088	0.171	0.514	0.607
Height	-1.628	0.315	-0.155	<0.0001
Group = MS	-0.147	0.936	-0.158	0.874
Rise: height	0.044	0.079	0.555	0.578
Rise: group = MS	-0.405	0.225	-1.798	0.072
Height: group = MS	-0.069	0.435	-0.158	0.874
Rise: height: group =MS	0.178	0.107	1.658	0.097

Negative coefficients, listed in the ‘Estimate’ column, indicate that a token was more likely to be perceived as IV with the factor listed. The default category for subject group was the CS group. The model had a significant intercept ($z = 3.899$, $p < 0.0001$) and predicted that the higher the rise, the more likely it will be perceived as IV ($z = -0.155$, $p < 0.0001$), correlating with a decreased probability of a IS response. However, the other main effects (rise and group) did not reach significance. In addition, the two-way interactions of rise and height, and height and group did not reach significance, as the interaction between rise and group, and the three-way interaction between rise, height and group.

5. Discussion and conclusions

The results from this preliminary study indicate that a difference in the pitch scaling of the final rise is the primary factor that helps both CS and MS listeners distinguish between information-seeking vs. invitation yes/no questions. Contra De la Mota et al. (2010) and Estebas-Vilaplana and Prieto (2010), this perceptual experiment cannot reject the null hypothesis in favor of a categorical phonological contrast in terms of the rise onset points between these two types of contours for CS and MS speakers (at least not due to the timing of the rise alone), but suggests that tonal height is important to distinguish between both types of yes/no questions. Similar to the results in Crespo-Sendra et al. (2010), where the difference in pitch scaling of the boundary tone HH% was found to be the primary factor that helps Catalan listeners distinguish between an information-seeking vs. an incredulity interpretation, the results from this experiment show that a difference in pitch scaling helps CS and MS speakers distinguish between information-seeking and invitation yes/no questions.

Even though tonal alignment was found not to be a significant predictor of the question type percept in this study, it may enhance the interpretation of meaning when combined with other phonetic factors besides tonal scale. It is also possible that other cues which were neutralized in this experiment are important in distinguishing between these two types of yes/no questions. For instance, the height of the pre-nuclear peak was neutralized since some scaling differences were found in the original recordings, and it may be the case that the pre-nuclear peak is a primary cue in the distinction of these two types of questions.

Additionally, duration was not a factor included in the manipulation of the stimuli. Specifically, the last pitch accent in information-seeking yes/no questions in MS is characterized by a local pitch minimum which continues into the post-tonic syllable and then rises dramatically in the boundary tone at the end of the utterance (De la Mota, Butragueño and Prieto, 2010). Because of the incorporation of two tones in the final syllable it is possible that duration may be a robust perceptual cue. Future work is necessary to achieve a detailed phonetic description of the intonational patterns of yes/no questions produced by different dialects of Spanish. Specifically, perception studies with more participants (it is important to note that this preliminary study is based on responses of a relatively small sample size) and more and different stimuli while controlling a variety of acoustic cues such as duration, f₀ rise, f₀ peak, both in the pre-nuclear and the nuclear pitch accent. In addition, a CS speaker produced the precursor in this experiment. Future work should include precursors of both origins in order to evaluate the bias. It goes without saying that the abundant dialectal descriptions of intonation patterns in the literature will benefit from further experimental approaches, and specifically, perceptual experiments to test whether the descriptions of different categorical phonological contrasts are also perceived as such by the listener.

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