

The perception of prosodic cues in Brazilian Portuguese statements and echo-questions: analysis by resynthesis

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This paper presents the results of a study on Brazilian Portuguese statements and echo-questions that measured the relative role of prosodic parameters (melodic movement *versus* intensity and duration) in the perceptual recognition of these intonational contours. The same sentence (*Como você sabe*) was uttered with prosodic variations conveying different speech acts—assertion (meaning “*As you know*”) and echo-question (meaning “*How do you know?*”)—by ten speakers (five males and five females) from Rio de Janeiro (see Fig. 1). Previous studies have shown that the phonological contrast between assertions and echo-questions is performed on the last stressed syllable of the utterance [1, 2]. Using Praat [3], the F0 contours of these two speech acts were manipulated so as to evaluate the role of (i) the direction of F0 movement (rising or falling), and (ii) which syllable carries information on the functional value of these contours. First, a “neutral” stimulus was produced bearing F0 values set at the mean between assertion and echo-question for each syllable. Then, one syllable at a time of this neutral stimulus was modified so as to reproduce the original F0 movement from the statement or the echo-question, for one of the five non-final syllables of the utterance (*co/mo/vo/cê/sa*). Such modifications of the neutral contour were made either in isolation (each one of the five syllables modified using the two speech act targets — assertion and echo question) or modifying a set of syllables at a time (the pre-stressed and the stressed syllables in the nucleus, the stressed plus post-stressed syllables in the prenucleus and all syllables together). This process resulted in nineteen types of modifications of melodic contours. The role of duration and intensity was tested by transplanting these nineteen F0 stylized contours onto the assertion and echo-question original sentences that serve as phonemic bases, keeping their intensity and duration patterns [4]. There were, thus, thirty-eight synthetic stimuli (nineteen modifications of contours on two base sentences) used for the perceptual experiment. The recognition test was set up using the TP Worken platform [5]. Twenty-four Brazilian listeners had to decide whether each stimulus expresses a statement or a question.

The variation in the proportion of “question” interpretation according to two factors — the *original sentence* (two levels: statement x question) and the type of *stylization* (nineteen levels) —, and their interaction, was analyzed through a logistic regression. The analysis revealed that the interaction between the two factors is not significant. The *original sentence*, which carries differences in duration and intensity, does have a direct influence on the listener’s interpretation (an overall 10% increase in “question” interpretation) (see Fig. 2), but that is independent of F0 manipulations, which explains the greatest part of the observed deviance. Moreover, in order to evaluate the perception of each *stylization* as a statement or a question, the “neutral” stimulus was taken as a reference; then the eighteen stylizations were grouped into three sets of stylizations (see Fig. 2): (i) those that are not significantly different from the neutral stylization; (ii) the stylizations with rising ‘*sa*’, falling ‘*cê*’ + rising ‘*sa*’, falling ‘*você*’ + rising ‘*sa*’, falling ‘*como você*’ + rising ‘*sa*’, rising ‘*cê*’ + rising ‘*sa*’, rising ‘*você*’ + rising ‘*sa*’, increased significantly the proportion of “questions” answers, and (iii) the stylizations with falling ‘*sa*’ and rising ‘*cê*’ decreased the proportion of “questions” answers to a significant extent. We conclude that a relevant prosodic cue in Brazilian Portuguese for the distinction between assertion and echo-question is the type of F0 movement in the nuclear region, and especially on the last stressed syllable. Besides, the intensity and duration patterns contributed for the recognition of the functional value of the contours.

- (1) Como você sabe
As you know. (assertion) / How do you know? (echo-question)

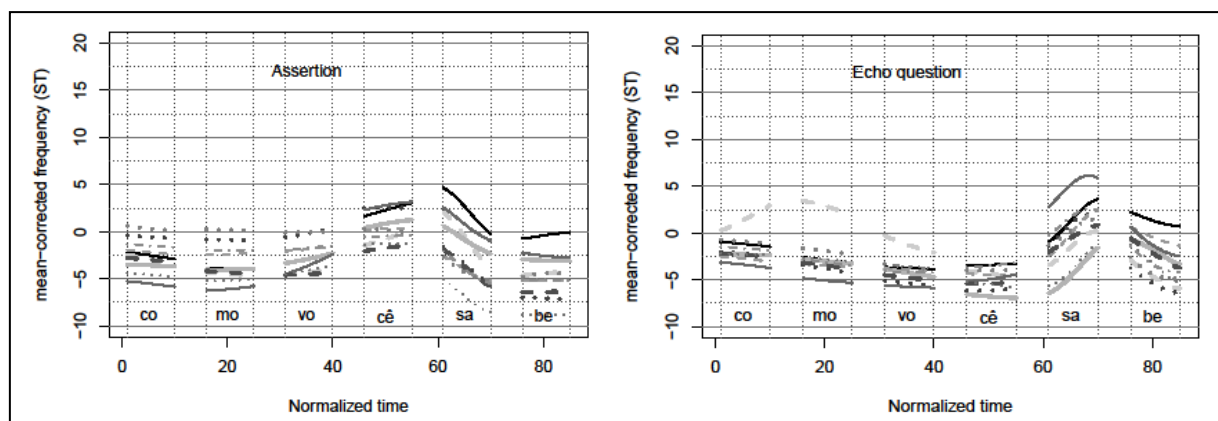


Figure 1. Plot of the mean F0 values (in ST) of normalized time over each modality: assertion (left) and echo-question (right).

- (2)

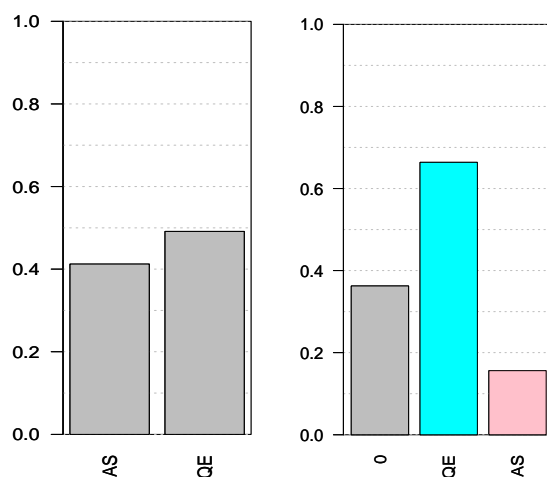


Figure 2. Mean ratio of interpretations “question” obtained by stimuli of (i) AS (statement) or QE (echo-question) segmental contour (left) and by the three groups of stylizations (right): group 0 (grey), group QE ‘question’ (blue) and group AS ‘assertion’ (pink).

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