Early discrimination of declarative and question intonation

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Introduction

Previous research has shown a developmental change in the acquisition of sound categories: non-native contrast discrimination declines while native contrast discrimination is either maintained, improved or learned (Werker & Tees, 1984; Saffran et al., 2006).
Although most previous studies have focused on examining segmental categories, some have investigated infants´perception of prosodic categories, namely lexical stress, lexical pitch accent and lexical tone.
Lexical stress discrimination develops after 6 months for learners of variable stress languages, but not for learners of fixed stress languages (Skoruppa et al., 2009, 2011).
Lexical tone discrimination has been shown to be performed at 4-6 months whether the distinction is native or not, but only maintained at 9 months in the former (Mattock & Burnham, 2006; Mattock et al., 2008).
The rising/falling Japanese pitch accent is only discriminated by Japanese infants at 6-8 months (Sogabe et al., 2006).
There are few studies of developmental course of infants' perception of linguistic intonation.
Languages differ in how the distinction between statements and yes-no questions is conveyed – e.g. In European Portuguese this distinction is marked by prosodic means (Frota, 2002) – and so infants must distinguish between the prosodic features associated with statements and questions to understand implied meanings of utterances.
Across languages, statements and yes-no questions are marked both by morphosyntax and intonation (e.g., English), not marked by intonation (e.g., Shekgalagari – Hyman & Monaka, 2011), or overtly cued by intonation only (e.g., Portuguese – Frota, 2002).
So far, there are only two studies looking at intonation discrimination, both in English.
Soderstrom et al (2011) – using materials that neutralised the word order cue, found overall preference for questions, but no discrimination between the 2 categories, only evidence for an attentional bias towards questions.
Geffen and Mintz (2011) – using stimuli containing both word order and intonation cues, found 7-month-olds successfully discriminate this contrast, however it is not clear if infants used prosodic characteristics or available word order cues.

The present study

We examined 5-6 and 8-9 month old infants' perception of declarative and yes-no questions in European Portuguese – a language that marks this sentence type contrast only by prosodic means: by the nuclear contour, and more specifically the boundary tone (declarative: H+L*L%; question: H+L*LH%), with longer durations of nuclear and post-nuclear syllables in questions (Frota, 2002).
Perception tests showed that this prosodic contrast is perceived by adult native speakers (Falé & Faria, 2005).

Research Question

Is infants' discrimination of intonation maintained (akin to native discrimination of lexical tone), learned (akin to native discrimination of lexical stress or lexical pitch accent) or neither (as in Soderstrom et al's results for English), in a language where intonation processing is crucial to sentence type distinctions?
If maintained: both younger and older infants would discriminate
If newly developed: only older infants would discriminate
If preference for questions: infants would attend more to questions overall

Methodology

Participants

32 infants;
16 younger (7 female, M = 5 months 24 days, range 5 months 3 days-6 months 23 days),
16 older (10 females, M = 8 months 15 days, range 7 months 11 days-9 months 29 days)

Stimuli

Segmentally varied one-pseudoword utterances produced by a female native speaker in infant-directed speech.

Habituation trials stimuli:
malo. lemo. loma. mela. rono. rano. nurra. nirra.
malo? lemo? loma? mela? rono? rano? nurra? nirra?

Test trials stimuli:
lamo. milo. mola. luma. norro. reno. nerra. rina.
lamo? milo? mola? luma? norro? reno? nerra? Rina?

Acoustic data:
Boundary tone difference
L% for declaratives, mean=163 Hz;
LH% for questions, mean=380 Hz). Longer duration of yes-no questions (236 ms longer on average)

Procedure

- Infants tested using the visual fixation paradigm (Stager & Werker, 1997)
- Habituated with lists of nonwords, half the infants habituated with declarative, half with question intonation, until a pre-set habituation criteria reached
- Test phase presented infants with a list of different nonwords in both declarative and question intonation
- Each trial lasted 16 seconds
- Presentation of test stimuli counterbalanced between infants (same/switch trial first)
- *Look* software was used (Meints & Woodford, 2008)
- Looking times recorded and compared
- If infants were sensitive to the intonational contrast, they should display longer listening times to the switch trials

Figure 2: Attention stimuli

Figure 3: Example participant, habituation phase

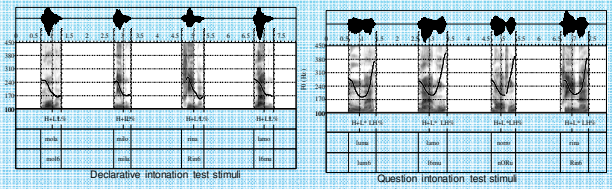

Figure 1: Test stimuli examples

Results

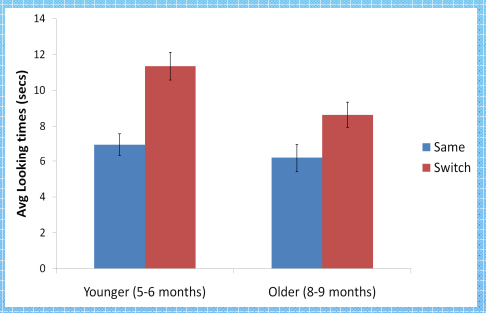

Figure 4: Average looking times (secs) to the same/switch test trials, across the two age groups

- Significant difference between same and switch test trials ($F(1,30) = 48.5$, $p < .001$, $\eta^2 = .62$)
- No effect of group ($F(1,30) = 3.78$, $p = .06$, $\eta^2 = .11$)
-No interaction between trial and group ($F(1,30) = 3.93$, $p = .06$, $\eta^2 = .12$).
-Paired T-tests for each age group, significant difference between same and switch trials for both (younger $t(15) = 5.72$, $p < .001$; older $t(15) = 4$, $p < .01$).
- However, age effect was almost significant: older infants seem to become disinterested in the task quicker, as shown by younger infants displaying significantly longer average looking times to the first 4 habituation trials – $t(30) = 2.78$, $p < .01$. The marginal effect of age group and marginal interaction could be attributed to the task being less attractive to older infants (so novelty effect is smaller).

Discussion

- Results show infants learning European Portuguese demonstrate a discriminate ability for the statement/question prosodic contrast as early as 5 months.
-This ability is maintained during the first year (akin to lexical tone development and unlike lexical stress and lexical pitch accent distinctions).
-Given that infants were presented with phonetically varied stimuli, discrimination assumed to reflect infants´ability to extract common prosodic features that characterise each of the sentence types.
-Regarding previous findings with English, our results are consistent with Geffen and Mintz (2011), although it is not clear what cues English infants used to discriminate (word order and/or intonation?). Our study is the first to demonstrate discrimination on the basis of prosodic cues only.
- This early discrimination ability may facilitate the acquisition of the grammar of declarative sentences and yes-no questions, given the relation between intonation and the grammatical distinction in sentence type, in European Portuguese.

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