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Infants' Responses to Speech Stimuli in the Headturn Preference Procedure

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1. Introduction

Many studies of cross-linguistic speech perception in young infants have indicated that at the beginning, they can discriminate nearly every phonetic contrast - including those that do not occur in their native language. This sensitivity to non-native contrasts was thought to deteriorate within the first year of life with the acquisition of their mother language[e.g.1].

Besides these studies of the perception of the segmental contrast, Jusczyk et al.[2,3] investigated infant sensitivity to prosodic markers for clausal units for native (English) and non-native (Polish) languages. Two types of speech samples (child-directed speech) were examined: "Coincident" samples were created by inserting one- second pauses at all clause boundary locations, and "noncoincident" samples were created by inserting the same number of pauses between words within clauses. Groups of 4.5- and 6-month old American infants were tested using the headturn preference procedure (HPP). The results indicated that even 4.5-month-olds listened significantly longer to the "coincident" than to "noncoincident" versions in English speech samples. They also reported that 4.5-month-olds, but not 6-month-olds, demonstrated significant preference for "coincident" versions in non-native (Polish) speech samples. From these results, Jusczyk et al. speculated that young infants have the potential universal ability to detect prosodic markers and that this sensitivity deteriorates by the age of 6 months.

To test this idea, we have started the experiments using child-directed Japanese speech both on Japanese 6.5-month-olds and American 4.5-month-olds[4]. The preliminary results of the study obtained up to now indicated that neither Japanese nor American infants showed preference for either versions in Japanese speech ("coincident" or "noncoincident"). These results indicate that perhaps not all languages are treated equally by young infants. To examine this possibility more specifically, further experiments on a more aged infant group are now being considered.

We also feel that it is necessary to confirm to what type of the stimulus pairs Japanese infants show preference (or discrimination ability) in the experiment using this HPP (headturn preference procedure). As far as we know, there are no experimental data on response patterns of Japanese infants measured with HPP.

In the present study, therefore, we investigated the response pattern of Japanese infants to the HPP using two types of stimulus pairs which are expected to be more distinctive to the

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infants than the above mentioned "coincident" and "noncoincident" speech sound pair. Stimulus pair 1 is Japanese speech sounds versus noise. Stimulus pair 2 is child-directed Japanese speech sounds versus English speech sounds.

2. Method

2.1 Stimuli

2.1.1 Stimulus pair 1: Speech versus non-speech sound

The speech sounds were drawn from spontaneous child-directed speech produced by a mother. The non-speech sound was a wide-band noise. For the non-speech stimuli, the same sound was used during the entire experiment. All stimuli were about 20 second in length. For each stimulus type, two samples for training trials and six samples for test trials were created (total eight samples each).

2.1.2 Stimulus pair 2: Japanese versus English speech sound

The stimuli were child-directed Japanese and English speech samples spoken by a bilingual female speaker. The speech was recorded while she was playing with a 18-month-old infant. The duration and number of the speech samples were the same as those of stimulus pair 1.

2.2 Subjects

2.2.1 Stimulus Pair 1:

The subjects were 24, 4- to 11-month-old infants (mean age: 251days, SD: 56days). Two additional infants failed to complete the experiment because of fussiness.

2.2.2 Stimulus pair 2:

The subjects were 34, 4- to 11-month-old infants (mean age: 211days, SD: 60days). Twelve additional infants failed to complete the experiment because of fussiness (10 infants) and experimental error (2 infants).

2.3 Procedure

HPP was conducted in the testing booth depicted in Figure 1. An infant was seated on its mother's lap in the center of the three-sided booth. A green light was mounted on the center panel, and a red light was mounted on each of the side panels at the infant's eye level. Loudspeakers were mounted behind the two red lights. An experimenter hid herself behind the center panel and observed the infant's behavior from a small peephole. She had a response box connected with a computer which controlled the presentation of the stimuli and registered the timing of the responses. She started trials and signaled the occurrence, direction and termination of headturns with one of the buttons on a response box. A trial began by flashing the green light

on and off in order to draw the infant's attention to the center. When the infant was oriented at midline, the green light was turned off, and one of the two side red lights began flashing. Once the infant turned to that side, an auditory stimulus began to play from the loudspeaker mounted behind the flashing red light. The stimulus was presented (and the side red light kept flashing) until the infant turned away for at least a continuous period of 2 seconds or until the end of stimulus.

The infant was first given 4 training trials, then 12 test trials were carried out successively in random order, 6 trials for each type of stimulus. In each trial, the time that the infant oriented to the auditory stimulus was recorded as the infant's listening time to that stimulus. To avoid observer bias, the experimenter and the mother wore headphones over which loud music was played to mask the auditory stimuli.

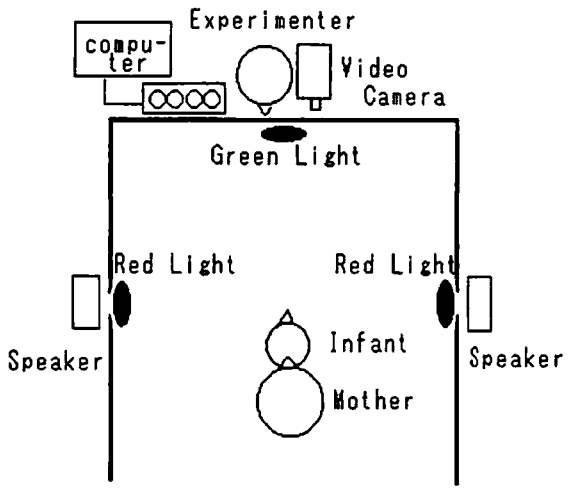

Figure 1 Testing Booth

3. Results

3.1 Stimulus pair 1: Speech versus Noise sound

The listening times of individual infants for the stimulus pair are indicated in Figure 2. In this figure, the ordinate is the listening time for the noise samples and the abscissa, the listening time for the speech samples. Figure 3 shows the mean listening time and its standard deviation for each stimulus type for all infants.

The data showed that the infants listened significantly longer to speech than to noise sample ($t_{(23)}=7.18$, $p<0.001$). The results revealed that the HPP can clearly demonstrate the infant's preference for speech.

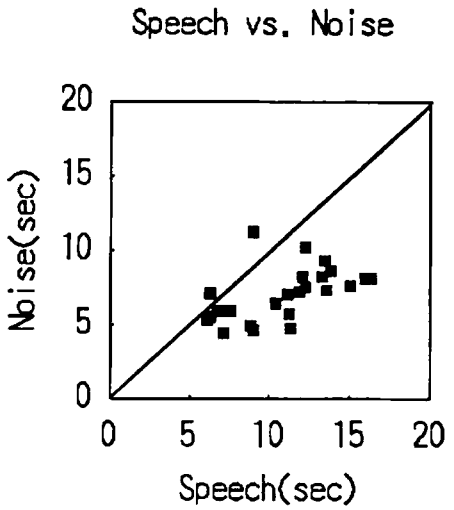

Figure 2 Listening times of individual infants for stimulus pair 1(speech vs. noise).

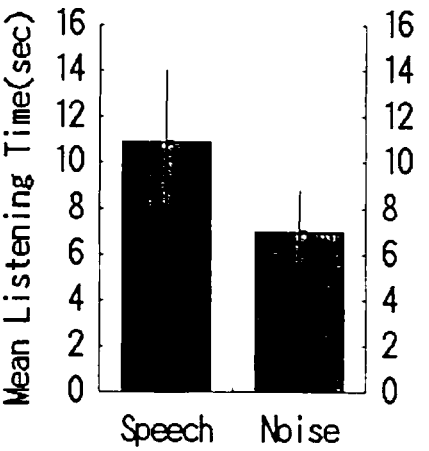

Figure 3 Mean listening times for stimulus pair 1(speech vs noise).

3.2 Stimulus pair 2: Japanese versus English speech sound

The listening times of individual infants for the stimulus pair are indicated in Figure 4. In this figure, the ordinate is the listening time for the English speech samples and the abscissa, the listening time for the Japanese speech samples. And circles indicate 4- to 6-month-old subjects and crosses indicate 6.5- to 11-month-old subjects. The subject group of 4- to 11-month-olds as a whole showed no preference for either language. However, there is a difference between the response pattern of the older group (6.5- to 11-month olds) and that of the younger group (4- to 6-month-old). Figure 5 shows the mean listening times and the standard deviations for the younger and older groups for each stimulus type. For the younger group, there are no difference in the listening times between the two stimulus types. For the older group, however, the listening time for Japanese speech samples tended to be longer than that for English speech samples.

Although we need additional data from the more subjects to reach a clear conclusion, statistical analysis of the present data showed significant preference for Japanese speech samples in the older group (6.5- to 11-month olds; $t_{(12)}=1.88$, $p<0.1$), but not in the younger group (4- to 6-month-olds).

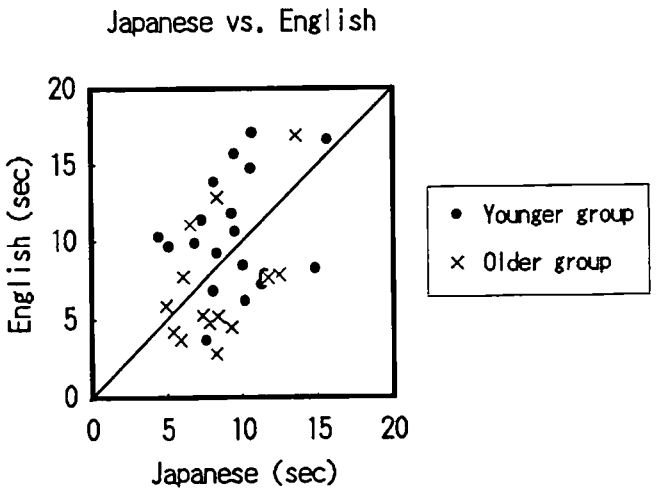

Figure 4
Listening times of individual infants for stimulus pair 2 (Japanese vs. English).
●:younger group (4- to 6-month-olds)
×:older group(6.5- to 11-month-olds)

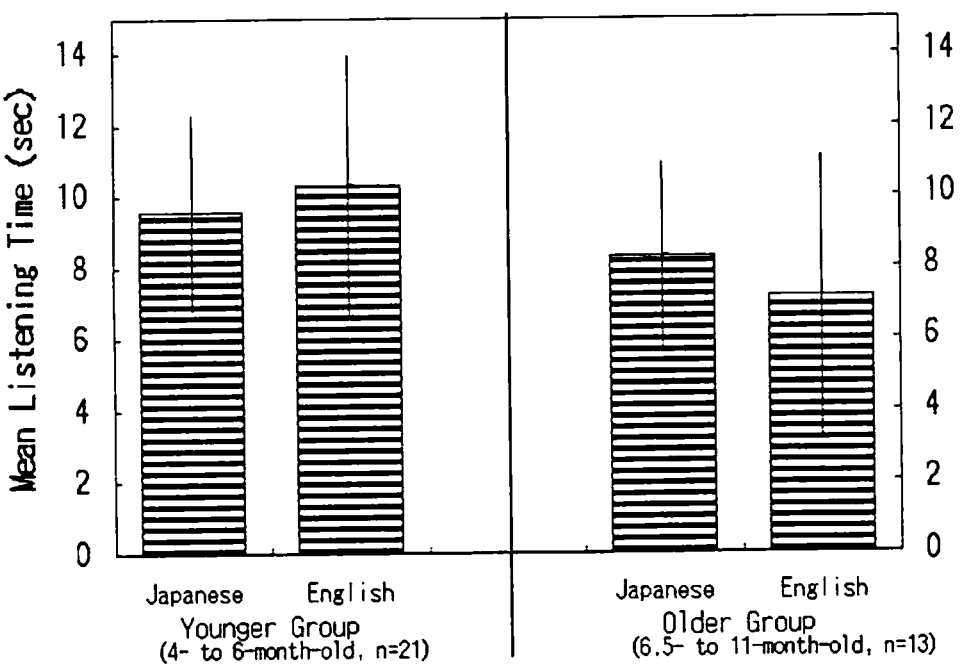

Figure 5 Mean listening times for stimulus pair 2 (Japanese vs. English).

4. Concluding Remarks

The present results showed that HPP is sensitive enough to measure the preference (or discrimination ability) of the Japanese infant of 4 to 11 months of age for certain types of stimulus pairs. Specifically, it is suggested that we can measure developmental changes in the preference for native speech sounds over non-native speech sounds. Thus, HPP is expected to be useful for the study of developmental changes of speech perception. Cross-linguistic experiments using HPP are now considered to investigate the development of clause perception in Japanese and American infants.

References

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