

ASSYMETRIES IN PROSODIC PARAMETER PERCEPTION BY JAPANESE AND RUSSIAN SUBJECTS

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Abstract: *This paper addresses the differences in prosody perception patterns between Japanese and Russian subjects. Modifications of the prosodic parameter of pitch peak alignment in a three-syllable one-word contours induce asymmetric responses, whereby the parameter has a strong impact on the perception by Russian subjects, but no impact on the perception of the Japanese subjects.*

1 INTRODUCTION

Human language constitutes a set of patterns along with the rules for their construction, combinations and transfer, and in this sense it can be easily made an object of pattern and symmetry studies. It is possible to investigate the patterning both within one language and across languages. Similarly to nature, in language and across languages, perfect symmetry is much less common than symmetry-breaking. How symmetrical different languages could be in regard to each other is seen as the reflection of the universal patterning of human brain, yet the sources of symmetry distortions are traced in the language evolution (Aitchinson, 1996). Most studies of symmetry and patterning in language relate to syntax (e.g., Stonham & Yiu, 2003). In particular, much attention has been given to symmetry-breaking, asymmetries and antisymmetries in syntactical constructions (e.g., syntax antisymmetry theory by Kayne, 1994; and dynamic antisymmetry theory by Moro, 2000). Many studies of phonological systems and phonological laws also operate with the notion of symmetry (e.g., Johnson & Hume, 2003). However, although various systems of prosody and intonation description have

been put forward (e.g., Ladd, 1996), they do not normally consider symmetrical/asymmetrical patterning of the units. Since prosody and intonation are based on alternating acoustic patterns, it is also possible to address them from the viewpoint of symmetry theory. This paper considers asymmetries in the perception of prosodic parameters by Japanese and Russian subjects. The parameters employed in this study are the height of the pitch peak, which was earlier shown to be relevant for the perception of sentence type in short one-word stimuli (Makarova, 2001a) as well as pitch peak alignment (i.e. the exact location of the F0 maximum regarding the onset/offset of the accented syllable). Some earlier studies allow to hypothesize that the pitch peak alignment may contribute to the perception of sentence type in identification of short utterances (Makarova, 2001b). It is not clear, however, whether this feature can be symmetrical or asymmetrical across different languages.

2 MATERIALS AND METHODS

A set of re-synthesized stimuli with modified parameters of pitch peak height and alignment was prepared and employed in the perceptual experiment in which 40 Japanese and 40 Russian subjects (male and female, aged between 20 and 30) performed a sentence type identification task. Re-synthesis was performed on a one-word utterance 'banany' [*bananas*], read as a declarative by one female speaker of standard (Moscow) Russian who was 29 at the time of the recording. The sound file was sampled at 16 KHz. Re-synthesis of the original stimuli and their subsequent manipulations were performed with Praat software programme (PSOLA analysis and resynthesis mode). Two heights of the F0 (pitch) peak chosen for manipulations were 320 Hz (referred to as 'high peak') and 270 Hz ('low peak'). These heights were determined by the threshold of 'declarative' vs 'non-declarative' sentence type judgments by Japanese and Russian listeners established in earlier experiments (Makarova 1999a, 2000a, c, d). Fourteen identical manipulations of the pitch peak alignment were subsequently performed at both pitch heights, which yielded the total of 28 experimental stimuli. The peak was shifted within the accented and postaccented syllables and in about 20ms intervals (2 F0 periods). All the resulting sound files were copied 5 times each with 2.5s silent intervals between them and randomized to obtain the sound record for the experimental session.

3 RESULTS

ANOVA designs were conducted to test the perception data for the effects of alignment, subject group, and pitch height. The results show the major asymmetry in the perception of pitch peak alignment across the two subject groups: it is strongly significant (at $p < 0.001$) for stimuli identification by Russian subjects, but is insignificant for the Japanese subjects.

The results of the experimental stimuli identification by subjects are represented in graphic form in Figure 1 (panels a-d). First, as can be seen from the graphs, we can find

some common patterning in the perception by Japanese and Russian subjects: for both groups pitch height affects the perception: lower pitch peak height yields predominantly declarative judgments by both groups of speakers (panels a, b) whereas higher pitch yields an increase in the percentage of non-declarative judgments (panels c, d).

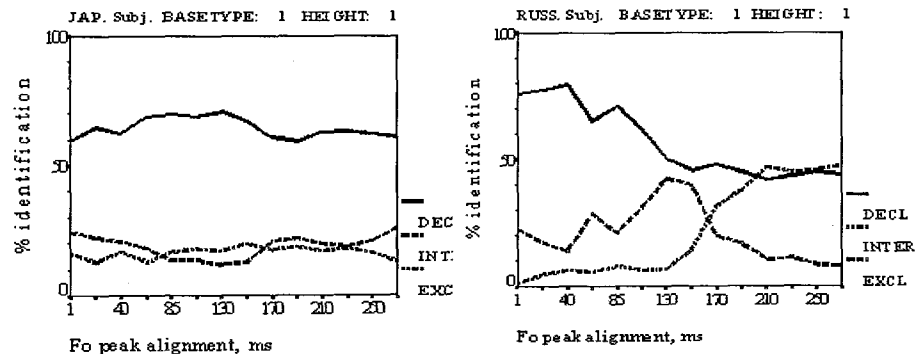
Second, the effect of pitch peak alignment on the perceived sentence type is strongly asymmetrical. Japanese subjects perceive all the low-pitched stimuli as declarative irrespective of their alignment, and react to the rightward shift of pitch peak alignment in higher pitched stimuli by an increase of exclamatory judgments. For Russian subjects the rightward shift of pitch peak alignment in low pitched stimuli causes a decrease of declarative and an increase of interrogative judgment.

Third, with the change of pitch height, we find symmetry distortion in the perception of pitch peak alignment for Russian subjects, whereby the effect of alignment is stronger for the set of higher-pitched stimuli where we observe a clear categorical shift (located close to the accented vowel offset) in perception from predominantly interrogative to predominantly exclamatory.

4 CONCLUSION

It has been suggested that over 75000 years ago all humans spoke one language, whereby the spread of languages was happening from the west to the east (Aitchinson, 1996). As the languages were diverging, a gradual distortion of symmetry occurred in copying patterns. At every linguistic level, we can therefore expect a certain degree of similarity, and of difference across in any pair of languages. This experiment shows that pitch height perception patterns are transferred across languages, whereas some other parameter perception (such as pitch peak alignment) can be more language-specific. The difference in the effect of the pitch peak alignment on the categorization of sentence type can be explained by the differences in the customary sentence type/pitch pattern mapping in Russian and Japanese (Makarova, 2000).

We can also see how within one language, at a higher perceptual pressure (a higher pitch peak), the symmetry is distorted more than at a lower pressure (a lower pitch peak).



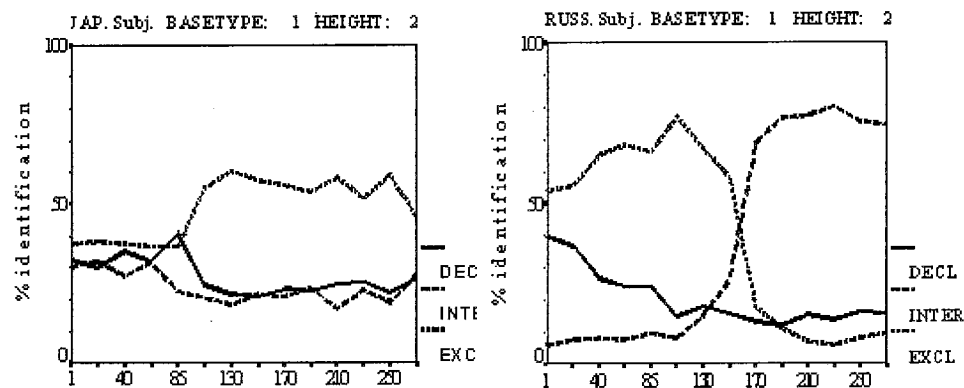


Figure 1. Perception of stimuli by Japanese and Russian subjects

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