Development of Perceptual Distinction between Phonemic Contrasts in a First and Second Language

Elzbieta B. Slawinski,
Psychology Department, The University of Calgary
2500 University Dr. Calgary, Alberta T2N 1N4

In order to perceive a contrast between phonemes of a particular language a child has to develop an appropriate phonological system. Such a phonological system includes a phoneme inventory imposed on a multidimensional phonetic space that is divided into a set of classes. These classes differ by distinctive features along one or more dimensions.

It has become increasingly apparent that there are developmental influences on the categorical perception of the [r], [w], and [l] phonemes; however, the exact nature of these influences has not been determined. Specifically, it has not been definitively found whether the attainment of adult perceptual capabilities is a gradual process or whether it occurs more abruptly.

Phonemic perception is a product of processes that occur at sensory (auditory) and cognitive (interpretive) levels. Phoneme discrimination during infancy is based on acoustical differences between phonemes and is thus performed on the sensory level [1]. During the process of language acquisition in a particular linguistic environment, a child seems to engage her/his attentional system in the interpretation of the sensory level output [1]. This system seems to have the capacity to modify its use of environmental information to arrive at an interpretation of phonemic contrast appropriate for the language to be acquired. Such a modification might include enhancement or suppression of auditory information depending on its relevance in the language. Children, while acquiring the phonology of a language, learn to classify phonemes along the relevant dimensions of the phonetic space. Thus, the development of a phonemic contrast might correspond to an improvement in the ability to reject irrelevant information and accept relevant information which constitute the distinctive features of the language being acquired. At the same time children are also gaining proficiency in the integration of these distinctive features in order to arrive at the phoneme percept. It has been demonstrated that such improvement in the integration of distinctive cues is associated with a diminished range of uncertainty [2], and is reflected by steeper slopes of identification functions and more prominent peaks in discrimination functions of facilitating two-cue comparison pairs [4].

In order to assess the course of development of perceptual distinction between initial prevocalic [w], [r], and [l], performance of children of various ages was examined on identification and discrimination tasks.

Three age groups of English children (three, four, and five years old) and adults were recruited as participants in a study of the perceptual development of the [r-w] contrast. The experimental paradigm involved a two-alternative forced choice identification task. The stimuli employed in the identification task were acoustic tokens of a [r-w] synthetic continuum ranging from 'red' to 'wed' and varying in F_2 and F_3 onset frequencies (spectral acoustical cue) and F_2 and F_3 transition durations (temporal acoustical cue). Percent identification data was computed and transformed to yield measures of phonemic boundaries. The significant shifting in phonemic boundaries ($F(3,36) = 4.61$; $p < .01$) and increasing steepness of the identification function ($F(3,36) = 3.2$; $p < .01$) as a function of age supports the hypothesized progressive development in phonemic perception (Figure 1).

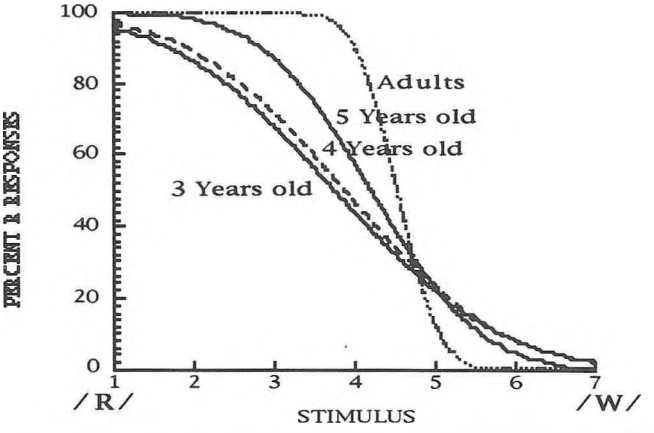

Figure 1.Identification of 'red' and 'wed' by 3, 4, and 5 year old children and adults. Steepness of the curves increases with increased age of participants.

The development of the incorporation of spectral and temporal acoustical features in the perception of the phonemic contrast between [r] and [l] sounds in the initial prevocalic position for English and Japanese children and adults with different exposure to English was also examined. Integration of both spectral and temporal information enables English listeners to efficiently discriminate between [r] and [l] sounds in the initial prevocalic position. Furthermore, adult English listeners discriminate facilitating two-cue comparisons pairs better than conflicting two-cue comparisons pairs [4]. This corresponds to a perceptual equivalence of temporal and spectral cues, and is the result of a language-specific phonemic categorization process and as such should be a gradual process.

Four groups of monolingual English children in the range of 3-6 years of age, and four groups of Japanese children in the range of 3-7 years of age, and two groups of Japanese adults with different exposure to English participated in the aforementioned study. A set of oddity discrimination tasks differing in the relation between spectral and temporal acoustical cues was administered to participants. Out of two continua that varied spectrally from F2 and F3 onsets characteristic of 'rake' to those of 'lake', but had different temporal patterns, two-cue facilitating and conflicting oddity discrimination tasks were prepared.

Separated repeated measures analyses of variance (ANOVA) were performed for English and Japanese children as well as adults. There were significant main effects for age as well as language exposure, condition (two-cue facilitating and conflicting), and for comparison pairs. The pooled discrimination functions for the two-cue facilitating condition are displayed in Figure 2 for English children, in Figure 3 for Japanese children, and for English and Japanese adults in Figure 4. There is a significant change among English children in the ability to integrate spectral and temporal acoustical cues during perceptual distinction of the [r-l] contrast as a function of age. Thus, with increasing age, children rely more on phonemic similarities

than on acoustic dissimilarities, as they are showing improved discrimination between the middle range of comparison pairs as compared to those closer to phonemic templates (Figure 2).

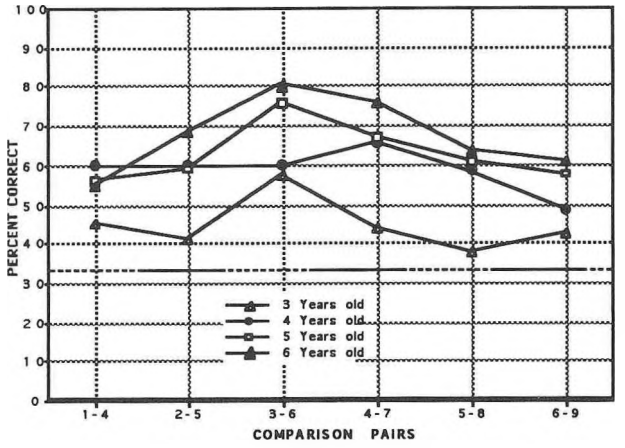

Figure 2. Discrimination curves for four age groups of English children. Percent of correct responses increases with increased age of children group.

Perceptual distinction of [r-l] by Japanese children (Figure 3) shows a different picture: 3, 4, and 5 year old children seem to rely on detection and classification of acoustical differences only. However, the discrimination accuracy of [r] and [l] sounds by 7-year old Japanese is based on the process of attending to patterns of acoustical cues which differentiate this phonemic contrast, and subsequently comparing them to the multidimensional representation of the phonemic percept. The difference obtaining between English and Japanese children in the course of acquisition of the [r-l] phonemic contrast is likely due to a difference in the duration and intensity of exposure to English. The Japanese children were first exposed to English 3-4 years later than English children.

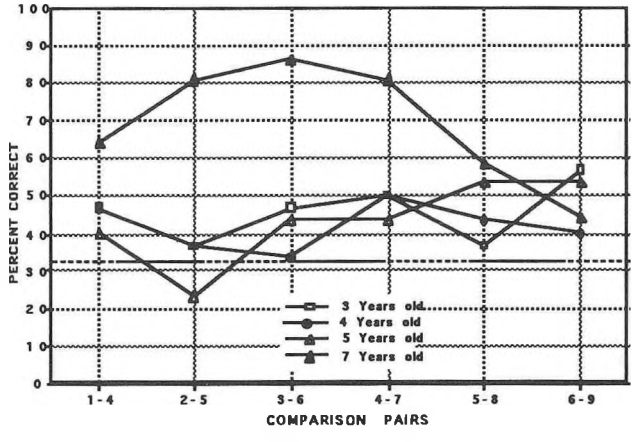

Figure 3. Discrimination curves for four age groups of Japanese children. The performance of three younger age groups is very poor. Only the oldest age group demonstrates high scores on discrimination.

A similar effect of the exposure to English on discrimination performance can be observed in results obtained for English and Japanese adults (Figure 4) [3].

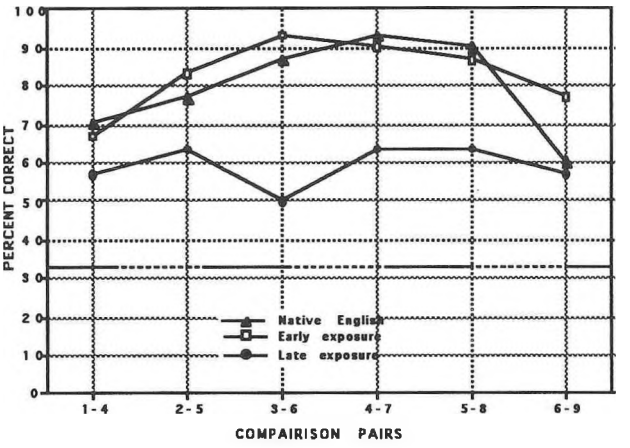

Figure 4. Discrimination curves for three groups of adults with different exposure to English. Native English and Japanese with intensive exposure demonstrate very high performance scores. Japanese listeners with limited exposure demonstrate much poorer discrimination.

In conclusion, it has been found that English and Japanese children, and Japanese adults with different degrees of exposure to English, did not rely in the same manner on the available acoustical cues needed for prevocalic [r], [w], and [l] discrimination. While discrimination or identification by older English and Japanese children, and Japanese adults with an early and intensive exposure to English, was strongly based on similarity or dissimilarity between percepts derived from the integrated information of spectral and temporal cues, the performance of younger English and Japanese children and Japanese adults with a late and less intensive exposure to English relied to a lesser degree on the perceptual configuration of acoustical cues and was probably more influenced by the acoustical dissimilarities. The observation that there is a significant improvement in the ability to integrate acoustical cues with increasing age supports the hypothesis that the attainment of perceptual distinction between phonemic contrasts is a gradual and progressive development in the proficiency of categorical perception [5].

References

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