Segmentation of Korean Continuous Speech with Regard to PWC (Possible-Word Constraint) and Morphological Cues.

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Objective

The purpose of this study is to first, examine whether Korean listeners use Possible-Word Constraint (Norris, D., McQueen, J. M., Cutler, A., & Butterfield, S., 1997) in segmenting Korean continuous speech. PWC is a constraint on segmentation: if the speech material between a candidate word and a likely word boundary is not a possible word, then the activation of that candidate word is reduced. If Koreans use the PWC for segmentation, they will detect a Korean word faster in vowel contexts than in consonant contexts which are impossible words in Korean language, like nearly all languages of the world.

Second, when morphological cues are available, do Korean listeners still use the PWC as the only possible segmentation strategy irrespective of morphological information, or they use morphological information in preference to the PWC? In Korean, a single consonant can not form a real word, but certain consonants such as 'n', 'l' are contracted form of the morphemes, 'neun'(modifying particle), 'leul'(objective particle), respectively. If morphological cues are more powerful than the PWC for segmentation, then it will be easier to detect a word in a context which is a morpheme in Korean, regardless of whether the context is a single consonant or a single vowel. If the PWC is still more influential than morphological cues, however, then spotting words in vowel contexts will be easier than in consonant contexts regardless of their morphemic status. If morphological cues are not more powerful than the PWC, but have some effect on segmentation in addition to the PWC, then spotting words will not be that hard in consonant contexts which are morphemes, compared to non-morphemic consonant contexts.

Experiment 1

Methods

43 college students took part. 120 bisyllabic target words with high frequency were selected and embedded into nonsense strings by the addition of a vowel or a consonant at the beginning (or at the end) of the target words. Half of the words were preceded by contexts, and the other half followed by contexts. Half of the preceding (or following) contexts are vowels, the other half consonants. 120 fillers were also constructed in the same way as the target bearing items. All materials were recorded by a female speaker of standard Korean. Listeners were asked to press the button as quickly as possible whenever they spotted a real word and then to say aloud. Stimuli were presented using E-prime and RTs and errors were measured and logged on E-prime.

Results and Discussion

The raw reaction times (RTs) were measured from the offset of each target word. Analyses of variance (ANOVAs) were performed on both the RTs and error data, with either listeners (F1) or items (F2).

As shown in figure 1, Korean listeners spotted words significantly faster in vowel contexts than in consonant contexts. This result clearly shows that Korean listeners observe the PWC in segmenting continuous speech.

As far as context position (preceding vs. following) is concerned, the listeners spotted words significantly faster in following contexts than in preceding contexts. Besides, in following contexts, context type (vowel vs. consonant) effects were much weaker. Previous studies involving the PWC obtained similar results concerning the context position effects (McQueen, J. M., Otake, T., & Cutler, A., 2001). But any special attention was paid to these. Norris et al. (1997) reported different findings where listeners detected words easily in preceding contexts, but this is probably because all target words used in their experiment had strong syllable on the first syllable. According to Metrical Segmentation Strategy (MSS), listeners tend to insert word boundaries before strong syllables.

In this regard, this context position effect may be related to 'lateral inhibition', where once the target word has reached a certain level of activation by the early portion of the input, its activation is affected by a relatively small margin by the later portion of the input. This can explain why following contexts are significantly easy to spot words in, and didn't make all that much difference in RTs between vowels and consonants, compared to preceding contexts.

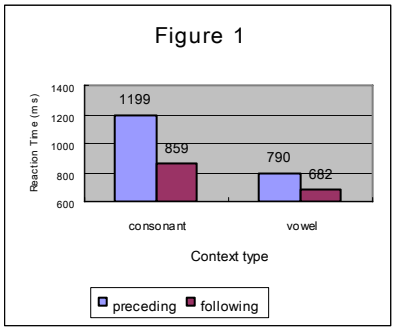

Figure 1. Mean Reaction Time (ms) as a function of context type (vowel vs. consonant) and context position (preceding vs. following) in Experiment 1.

Experiment 2

Methods

42 students who had not participated in experiment 1 took part. 120 two-syllabic target words with high frequency were selected and half of them were followed by vowels and the other half by consonants. Half of the vowels (or consonants) were morphemes, and the other half non-morphemes. 120 fillers were constructed. Other procedures were identical to that of Experiment 1.

Results and Discussion

As shown in figure 2, listeners spotted words faster in vowel contexts than in consonant contexts, even when morphological cues were available. But they also used morphological information as well. When contexts are morphemes, word spotting was significantly easier compared to non-morphemic contexts, though morphological information did not have the same amount of effects on vowels and consonants.

These results challenge previous studies with regard to universality of the PWC. Norris, D., McQueen, J. M., Cutler, A., Butterfield, S., & Kearns, R. (2001) claims that the PWC is language-universal rather than language-specific. They reported two word-spotting experiments where English native speakers found it easy to spot words in a context consisting either of a CVC syllable with a schwa or of a CV syllable with a lax vowel, though both of these contexts are not possible lexical words in English. On the other hand, spotting a word in a context consisting of a single consonant was hard, which could never be a possible word in any languages. Similar findings were obtained in Sesotho (a Bantu language), where a single syllable can not be a possible stand-alone word, while a bisyllablic residue is a possible Sesotho word. But speakers of Sesotho detected words in a single syllable context just as easy as in a bisyllable context (Cutler, A., Demuth, K., & McQueen, J., (2002).

Experiment 2 showed somewhat different results in this regard. If the PWC really is determined by a universal notion, then we should expect word spotting to be equally easier in all vowel contexts, and equally harder in all consonant contexts, regardless of their morphemic status in a specific language. But spotting words in morphemic consonant contexts was significantly less difficult than in non-morphemic consonant contexts. As for vowel contexts, spotting words was significantly and dramatically easier in morphemic contexts than in non-morphemic contexts. These findings suggest that the PWC appears to have language-specific properties. In other words, the PWC operated in a way which was affected by the language specific information.

These results also imply that the PWC may involve top-down process. Originally the PWC is claimed to operate entirely in a bottom-up manner, based on goodness-of-fit with acoustic input. But this study shows that top-down information (i.e. morphological cues) gets involved in the process of segmentation using the PWC.

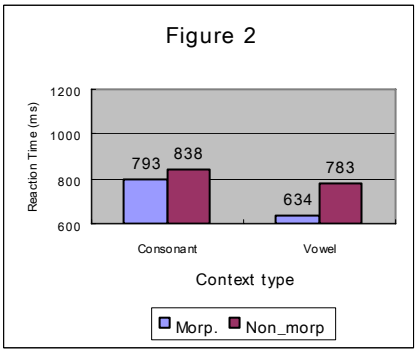

Figure 2. Mean Reaction Time (ms) as a function of context type (vowel vs. consonant) and morphemic status of the context (morpheme vs. non-morpheme) in Experiment 2.

Acknowledgments

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