Priming and Blocking in the Processing of Japanese Verb Morphology

Complex Verb Morphology and the 'Decomposition' Model of Morphological Processing

Native speakers have a remarkable capacity to recognize and understand a word by distinguishing it from a large number of phonologically or orthographically related words. In the processing of verb forms in languages with a complex morphological system, this capacity should play an important role because a verb can be associated with a variety of morphological elements such as tense/aspect markers, person/number agreement morphemes, modality affixes, and so on. Taft and Forster (1975) proposed an influential model for understanding this capacity that complex word forms are represented in a 'decomposed' manner during the process of word recognition. Marslen-Wilson et al. (1993, 1994) provided evidence for the decomposition model by a series of experiments with a cross-modal priming paradigm. They found that a morphologically related prime ***walked*** facilitated the processing of a target ***walk*** although a semantically related but morphologically irregular prime ***gave*** did not facilitate the processing of a target ***give***. This is because a verb stem ***walk*** is activated after the decomposition of the past tense suffix ***-ed*** from the prime ***walked***, whereas the recognition of morphologically irregular words does not involve such processes. Allen and Badecker (2002) investigated the problem further to find that a semantically related irregular prime ***taught*** facilitated the processing of a target ***teach*** provided that the prime and the target are orthographically distinct. They attributed the lack of priming effects in ***gave-give*** cases to the combination between blocking effects by orthographic homonyms and priming effects due to the semantic relatedness that eventually canceled out each other. Their combination account is still in need of confirmation because Sonnenstuhl et al. (1999) found weak priming effects by irregular stem allomorph primes in their experiments with German diminutives. These conflicting results from different languages raise a question as to the universality of the cognitive mechanisms behind the priming and blocking effects in the processing of complex words. In this paper, we therefore investigated into the processing of Japanese complex verb morphology through two experiments with a cross-modal priming paradigm. The experimental data from Japanese, a non-European language with a complex system of verb morphology, should provide valuable information about the universality of the cognitive mechanisms for the morphological processing.

Methods for Experiment 1 and 2:

Twenty-four native Japanese speakers participated in Experiment 1 and 2. After the presentation of a fixation point on the CRT screen for 400ms, the participants heard either white noise or auditory prime words in a stereo headphone set. The visual probe was presented in the standard Japanese orthographic system including 'kanji' and 'hiragana' characters for 400ms immediately after the offset of the auditory stimuli. The participants were instructed to press a 'yes' key if the visually presented target was a real word and a 'no' key if it was a non-word. Lexical decision latency was measured from the onset of the presentation of each visual probe.

Stimuli for Experiment 1:

Three sets of twenty-three words were selected for Experiment 1, consisting of (i) transitive verbs, e.g. ***kaesu (return; transitive)***, (ii) semantically related intransitive verbs without regular morphological relationship to the transitive verbs, e.g. ***kaeru (return; intransitive)***, and (iii) potential forms that consist of a transitive verb stem and a suffix ***–eru (be able to)***, e.g. ***kaeseru (be able to return)***. Intransitive verbs and transitive verbs are different only in a single hiragana character. We regard transitive-intransitive pairs in Experiment 1 as equivalent to the English ***gave-give*** type 'orthographically similar' pairs. A transitive verb is used as a probe for the intransitive prime condition, the potential prime condition, and the baseline condition with white noise. The stimuli are divided into three lists using the Latin square design in order that no single word may be repeated in each list.

Expectations for Experiment 1:

The purpose of Experiment 1 was to test the hypothesis that priming effects similar to those reported by Marslen-Wilson et al. can be found with the experimental materials from the Japanese derivational verb morphology.

Morphologically transparent potential forms were expected to facilitate the lexical decision for the target words, but morphologically irregular intransitive verbs were expected to shown no priming effects.

Results of Experiment 1:

A series of one-way ANOVAs with repeated measures among (i) the intransitive prime condition, (ii) the potential prime condition, and (iii) the white noise condition were conducted in both reaction times and error rates, using subject (F_1) and item (F_2) variabilities. Lexical decision times for the targets in the potential prime condition (M=591ms) were significantly shorter than those in the white noise condition (M=674ms) [$F_1(1,23)=12.69$, $p<.01$; $F_2(1,22)=12.71$, $p<.01$] and those in the intransitive prime condition (M=673ms) [$F_1(1,23)=30.58$, $p<.001$; $F_2(1,22)=10.13$, $p<.01$]. There was no significant difference in the latency between the intransitive prime condition and the white noise condition [$F_1(1,23)=0.002$, $p=.967$; $F_2(1,22)=0.08$, $p=.776$]. No significant effect was found in error rates. These results confirmed our hypothesis that the priming effects by the morphologically transparent primes can be observed in Japanese.

Stimuli for Experiment 2:

Three sets of twenty-four words were selected for Experiment 2, consisting of (i) transitive verbs, e.g. ***kowasu (break; transitive),*** (ii) semantically related intransitive verbs without regular morphological relationship to the transitive verbs, e.g. ***kowareru (break, intransitive)***, and (iii) potential forms with a regular morphological relationship to the transitive verbs**,** e.g. ***kowaseru (be able to break)***. Intransitive verbs differed from the corresponding transitive verbs by more than two hiragana characters. We regard the intransitive verbs used in Experiment 2 as 'orthographically less similar' to the target words compared to the intransitive verbs used in Experiment 1.

Expectations for Experiment 2:

The purpose of Experiment 2 was to test the hypothesis that blocking effects by orthographic homonyms were responsible for the apparent lack of priming effects in semantically related prime-target pairs as proposed by Allen and Badecker. If semantically related intransitive-transitive prime-target pairs in Experiment 1 showed no priming effects because of their orthographic similarity, orthographically less similar intransitive-transitive pairs in Experiment 2 were expected to show priming effects due to their semantic relatedness.

Results of Experiment 2:

One-way ANOVAs were conducted in the same way as in Experiment 1. Lexical decision times for the target words in the potential prime condition (M=609ms) was significantly shorter than those in the white noise condition (M=702ms) [$F_1(1,23)=21.58$, $p<.001$; $F_2(1,23)=19.03$, $p<.001$] and those in the intransitive prime condition (M=649ms) [$F_1(1,23)=6.04$, $p<.05$; $F_2(1,23)=5.03$, $p<.05$]. In addition, lexical decision times in the intransitive prime condition was shorter than those in the white noise condition [$F_1(1,23)=10.43$, $p<.01$; $F_2(1,23)=7.16$, $p<.05$]. There was no significant effect in error rates. The expectation that orthographically less similar primes facilitate the processing of target words was confirmed. A possible explanation for the difference between the potential prime condition and the intransitive prime condition is that priming effects by decomposed verb stems are almost equivalent to those of the verb itself, which gave much stronger priming effects compared to those of semantically related intransitive verbs.

Conclusion:

Experimental data from the processing of Japanese verb morphology supported the decomposition model of morphological processing, because morphologically transparent potential forms, which can be decomposed into a stem and a suffix, showed strong priming effects in both Experiment 1 and 2. The combination of blocking and priming effects is also observed. That is, orthographically similar prime-target pairs showed no priming effects whereas less similar pairs showed weak priming effects. Since morphologically transparent potential forms showed stronger priming effects compared to orthographically less similar intransitive primes, the priming effects resulting from the morpheme decomposition should be distinct from those induced by the semantic relatedness. These findings endorse the view that the cognitive mechanisms for the processing of complex words are universal regardless of the superficial differences in the morphological system of individual languages.