ONSET-CODA ASYMMETRY IN SECOND-LANGUAGE SYLLABLE PERCEPTION BY JAPANESE TEACHERS OF ENGLISH

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ABSTRACT

The paper reports the results of an experiment in second-language speech that provides further evidence for the view that syllable onsets and codas are asymmetric, and for the view that English proficiency affects Japanese listeners' speech perception performance. When two groups of Japanese listeners (Japanese college students and Japanese teachers of English) were asked to count syllables in spoken English words and nonwords, the performances of both groups declined as the number of consonants in the target item increased, but onsets led to a more drastic decline in performance than did codas. The results of Japanese teachers of English further revealed that upper-level English teachers performed the task significantly better than Japanese college students whereas lower-level English teachers did significantly worse. Among the three groups of participants, lower-level English teachers were the most strongly affected by phonological constraints on syllables in Japanese.

Keywords: asymmetry, syllable structure, onset, coda, second-language learners, speech perception

1. INTRODUCTION

Syllable onsets and codas are not of equal status. The asymmetry of onset and coda positions has been frequently reported in the literature from several different perspectives. For example, syllable structure is said to be asymmetric, such that codas form part of the syllable rhyme while onsets do not ([2]). Structurally, fewer phonological contrasts are realized in coda position than in onset position in some languages ([1]). In realization of CVC syllables, consonants are better identified in onset position than coda position ([7][17]). Perceptually, such asymmetry between onsets and codas have been proposed to arise because onsets are more "perceptually salient" than codas ([9][17]).

Onset-coda asymmetry in Japanese was tested and confirmed in a series of syllable-counting studies ([10][11][12][13]). Their results indicate that native English listeners correctly identified the number of syllables in spoken English words without being affected by consonant clusters in either onset or coda position, whereas Japanese college students were strongly affected by consonants in onset and coda positions. This performance difference is rooted in structural differences in syllables between English and Japanese; three and four consonants are allowed in onset and coda positions, respectively, in English, whereas only one consonant is allowed in both onset and coda positions in Japanese ([3][15]). This structural difference between the languages is considered to be a main factor that causes syllable identification difficulty in speech perception ([4][5][10][11][12][13]) and epenthetic vowel insertion in speech production ([5][14]). The importance of correct syllable identification was introduced in English teaching for elementary school children ([6][8][16]).

However, few studies have been conducted to investigate how well Japanese teachers of English, who are expected to have high English proficiency, identify syllables in spoken English words. Therefore, this study investigates 1) whether the onset-coda asymmetry with Japanese listeners is further confirmed and 2) whether Japanese teachers of English identify the number of English syllables better than Japanese college students because the former is expected to have a higher English proficiency than the latter.

2. METHODS

Thirty-three Japanese teachers of English (16 males, 17 females) with at least one year of teaching experience participated in the study, twenty of whom were in full-time tenured positions. Thirty-three Japanese college students also participated in the study as a control group.

The materials were a subset used in previous syllable-counting studies ([10][11][12][13]). There were thirty-two real words that varied in the number of syllables from 1 to 6 (e.g., *bee*, *splints*) and thirty-two nonwords that were either 1 or 2 syllables that varied in the number of consonants in onset and coda positions from 0 to 3. The vowel of the nonwords was always /ɛ/, which is the vowel that appears in *head* and *bed*. For 2-syllable nonwords, the same vowel /ɛ/ occurred in both syllables, the second of which has a primary stress. The nonword

stimuli were as follows: *e*, *ep*, *eps*, *emps*, *pe*, *pep*, *peps*, *pemps*, *spe*, *spep*, *speps*, *spemps*, *sple*, *splep*, *spleps*, *splemps* for 1-syllable stimuli, and *ede*, *edep*, *edeps*, *edemps*, *pede*, *pedep*, *pedeps*, *pedemps*, *spede*, *spedep*, *spedeps*, *spedemps*, *splede*, *spledep*, *spledeps*, *spledemps* for 2-syllable stimuli. The stimuli were produced by a female and a male American English speaker. A total of 128 stimuli were used.

The experiment was conducted in a quiet room individually or in a pair. The participants heard the stimuli through headphones at a comfort listening level. They were instructed to listen to a stimulus word carefully, and to identify the number of syllables in each target word by clicking a number between 1 and 10 appearing on the computer screen. The experiment was divided into two blocks, one block for each speaker. Within each block, the stimuli were randomized. The order of the two blocks was counter-balanced among the participants. Prior to the experiment, a brief textual description of English syllables was given, and eight practice trials with feedback were provided for the participants so as to familiarize them with the task.

3. ANALYSES

3.1. Analysis procedures

In this paper, only nonword stimuli were analysed. First, the identification accuracy of each stimulus word was calculated per participant. Then, the stimulus words were categorized in terms of the number of consonants within the syllable positions (onset or coda). For example, /splɛ/ was treated as a 3-consonant word in onset position and as a 0-consonant word in coda position.

A two-way ANOVA with position (onset and coda) and the number of consonants (0-3) as two within-subjects variables and identification accuracy as a dependent variable was conducted. For multiple comparisons, the Ryan method at a significant level of $p < 0.05$ was conducted. When Japanese college students and Japanese teachers of English were compared, a three-way ANOVA was conducted with position and number of consonants as within-subjects variables and group (Japanese college students and English teachers) as a between-subjects variable.

3.2. Results

Figure 1 shows the mean identification accuracy as a function of the number of consonants and position for Japanese college students (left panel) and for Japanese teachers of English (right panel). First, the students' data was submitted to a two-way ANOVA in order to replicate the same onset-coda asymmetry reported in previous syllable-counting studies ([10][11][12][13]). A significant main effect of the number of consonants was observed [$F(3,96) = 26.571$; $p < 0.0001$]. The interaction between number of consonants and position was also significant [$F(3,96) = 16.458$; $p < 0.0001$]. Post-hoc comparisons revealed that when the number of consonants was either 0 or 1, identification accuracy was significantly higher in onset position than in coda position whereas when it was 3, the opposite pattern emerged. Furthermore, in onset position, all but one comparison (0 vs. 1) were significant (0 = 1 > 2 > 3), whereas in coda position, only the comparison between 0 and 2 was significant (0 > 2). Altogether, the current analysis confirmed the onset-coda asymmetry with college students.

Next, a two-way ANOVA was conducted with the teachers' data. The results demonstrated a significant main effect of number of consonants [$F(3,96) = 55.827$; $p < 0.0001$]. The interaction between the number of consonants and position was also significant [$F(3,96) = 18.486$; $p < 0.0001$]. When the number of consonants was either 0 or 1, the identification accuracy was significantly higher in onset position than in coda position, whereas when it was 2, the pattern was reversed. Furthermore, in onset position, all but one comparison (0 vs. 1) were significant (0 = 1 > 2 > 3), whereas in coda position, only some comparisons were significant (0 > 2; 0 > 3; 1 >3).

The data of the two participant groups were submitted to a three-way ANOVA. The results showed that the main effect of the number of consonants was significant [$F(3,192) = 79.64$; $p < 0.0001$] but the main effect of group was not ($p = 0.1552$). A two-way interaction between the number of consonants and position was also significant [$F(3,192) = 33.332$; $p < 0.0001$]. No three-way interaction was observed.

The absence of a significant group effect motivated us to check descriptive statistics. The mean identification accuracy was lower for Japanese teachers of English (Mean: 0.60985; SD: 0.25193) than for Japanese college students (Mean: 0.69413; SD: 0.22317). Distribution of the teachers' identification accuracy demonstrated that the teachers may be divided into two groups. Therefore, based on the teachers' average identification accuracy data, they were split into two halves, 16 upper-level teachers and 17 lower-level teachers, who were separately analysed hereafter.

The mean identification accuracy was higher for upper-level teachers (Mean: 0.826; SD: 0.066) than for lower-level teachers (Mean: 0.406; SD: 0.178) and Japanese college students (Mean: 0.69; SD:

Figure 1: The mean identification accuracy as a function of the number of consonants and position for Japanese college students (left) and for Japanese Teachers of English (right).

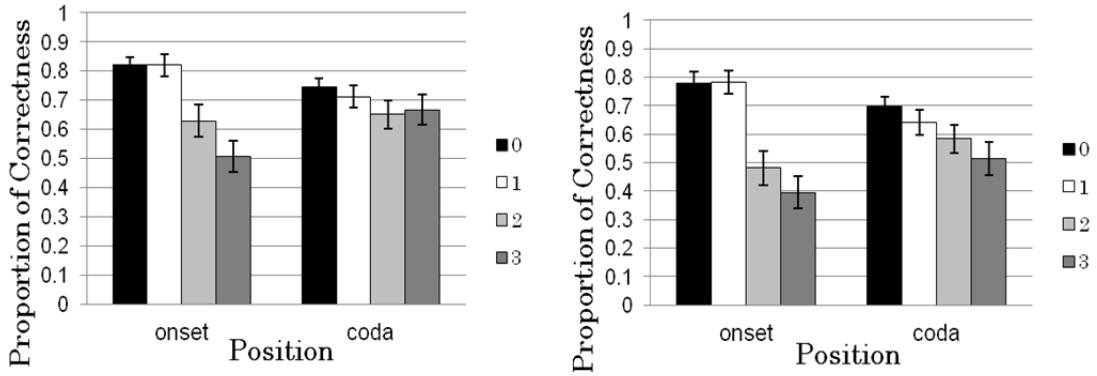
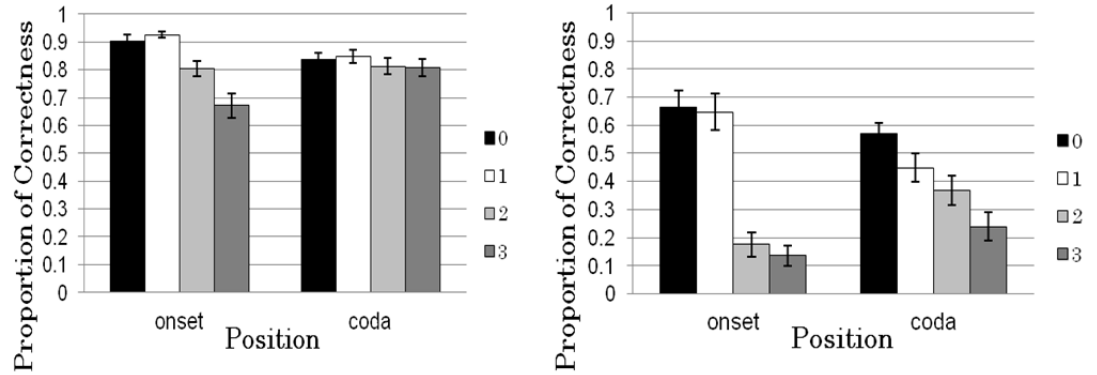


Figure 2: The mean identification accuracy as a function of the number of consonants and position for upper-level teachers (left) and for lower-level teachers (right).



0.223). Further, a group comparison between upper-level and lower-level teachers revealed that only among lower-level teachers, identification accuracy was significantly lower for 1-syllable stimuli (0.365) than for 2-syllable stimuli (0.446) [$t(16) = 2.790$, $p < 0.05$]. This means that lower-level teachers were affected by the number of syllables within words more strongly than upper-level teachers; this demonstrates a strong influence of Japanese phonology on lower-level teachers' performance, which may have contributed to the huge performance variability among the teachers.

Figure 2 shows the mean identification accuracy as a function of the number of consonants and position for upper-level teachers (left panel) and for lower-level teachers (right panel). The teachers' data were now separately analysed. The data of the upper-level teachers were submitted to a two-way ANOVA. The results showed that the main effect of number of consonants was significant [$F(3,45) = 12.406$; $p < 0.0001$]. The interaction between the number of consonants and position was also significant [$F(3,45) = 6.808$; $p < 0.001$]. When the number of consonants was either 0 or 1, the identification accuracy was significantly higher in onset position than in coda position whereas when it was 3, the opposite pattern emerged. In onset position, all but one comparison (0 vs. 1) were significantly different (0 = 1 > 2 > 3) whereas in coda position, none of the comparisons was significant (0 = 1 = 2 = 3).

Next, the data of the lower-level teachers were submitted to a two-way ANOVA. The results showed that the main effect of number of consonants was significant [$F(3,48) = 126.806$; $p < 0.0001$]. The interaction between the number of consonants and position was significant [$F(3,48) = 17.744$; $p < 0.0001$]. When the number of consonants was either 0 or 1, the identification accuracy was significantly higher in onset position than in coda position whereas when it was either 2 or 3, the reverse pattern was obtained. Furthermore, in onset position, all but two comparisons (0 vs. 1 and 2 vs. 3) were significantly different (0 = 1 > 2 = 3) whereas in coda position, all but one comparison (1 vs. 2) were significantly different (0 > 1 = 2 > 3).

Finally, both groups of teachers were separately analysed with Japanese college students. A three-way ANOVA with the data of students and upper-level teachers demonstrated significant main effects of number of consonants and group [number of consonants: $F(3,141) = 29.072$; $p < 0.0001$; group: $F(1,47) = 5.317$; $p < 0.005$]. Further, the interaction between the number of consonants and position was

significant [$F(3,141) = 19.09$; $p < 0.0001$]. None of the interactions with group was significant. This means that the effect of the number of consonants and position affected identification accuracy in a similar manner between students and upper-level teachers.

Another three-way ANOVA was conducted with the data of Japanese college students and lower-level teachers. The results showed significant main effects of number of consonants and group [group: $F(1,48) = 21.208$; $p < 0.0001$; number of consonants: $F(3,144) = 108.896$; $p < 0.0001$]. The mean identification accuracy was significantly lower for lower-level teachers than for Japanese college students. Moreover, the interaction between the number of consonants and position was significant [$F(3,144) = 30.241$; $p < 0.0001$]. Focusing on the interactions including group, a two-way interaction between group and number of consonants [$F(3,144) = 15.209$; $p < 0.0001$] and a three-way interaction among group, number of consonants and position [$F(3,144) = 5.129$; $p < 0.005$] were significant. Multiple comparisons revealed that when the number of consonants was either 0 or 1, the identification accuracy was significantly higher in onset position than in coda position whereas when it was either 2 or 3, the reverse pattern emerged. When the number of consonants was either 0 or 1, both groups performed similarly. When it was either 2 or 3, however, the identification accuracy was higher in coda position than in onset position, which was significant only for lower-level teachers. This means that the asymmetry effect of onset vs. coda was stronger for lower-level teachers than for Japanese college students. Furthermore, identification accuracy as a function of number of consonants showed the pattern [0 = 1 > 2 = 3] in onset position and [0 > 1 = 2 > 3] in coda position for lower-level teachers, and [0 = 1 > 2 > 3] in onset position and [0 = 1 = 2 = 3] in coda position for Japanese college students. This means that the number of consonants had a stronger effect on lower-level teachers than on Japanese college students.

4. DISCUSSION AND CONCLUSION

This study attempted to answer two questions. The first question was to investigate whether the onset-coda asymmetry, which was reported in previous studies ([10][11][12][13]), was confirmed with another group of Japanese adult participants, namely, Japanese teachers of English. As in the previous studies, a consonant cluster affected identification accuracy significantly more in onset position than in coda position for the participants of the current study. However, further analyses based on two separate teacher groups revealed that in addition to the onset-coda asymmetry, Japanese phonological constraints affected lower-level teachers more strongly than upper-level teachers. For lower-level teachers, the identification accuracy in onset position was drastically lower when number of consonants was either 2 or 3 than when it was either 0 or 1, suggesting the strong influence of the structural differences in syllables between English and Japanese. Also, the effect of the number of consonants in coda position was stronger among lower-level teachers [0 > 1 = 2 > 3] than among upper-level and Japanese college students [0 = 1 = 2 = 3]. Altogether, this study provided further evidence to support the onset-coda asymmetry.

The second question to be answered was whether Japanese teachers of English identified the number of syllables within spoken English words better than Japanese college students. Statistical analysis demonstrated a non-significant group effect between Japanese college students and Japanese teachers of English, mainly caused by their high performance variability. However, when Japanese teachers were divided into lower-level and higher-level teachers, interesting differences emerged. Upper-level teachers performed the syllable-counting task significantly better than Japanese college students whereas lower-level teachers performed significantly worse than upper-level teachers and Japanese college students. Also, lower-level teachers misperceived the number of syllables more with 1-syllable stimuli than with 2-syllable stimuli. This phenomenon was not observed among upper-level teachers and Japanese college students. The results mean that in principle, Japanese teachers of English generally identify the number of syllables better than Japanese college students, whereas some of the English teachers did significantly worse than Japanese college students.

This paper falls short of demystifying why lower-level teachers misidentified syllables in spoken English words significantly more than Japanese college students, why they were poor at identifying 1-syllable stimuli, and how English proficiency is correlated with the syllable identification ability in spoken English words. The answers to those questions are left for future research.

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