(Article)

The interaction of specialist accent and compounding structure in Japanese loanwords*

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Abstract

This study focused on the competing relationship between the specialist accent and compound accent rule, which are both viewed as post-lexical processes in Tokyo Japanese. An acceptability rating with six levels using audio stimuli of varying conditions was conducted to test how native Tokyo Japanese speakers evaluated unaccented simplex words and compound words. The rating scores for the compounds and simplex words were significantly different and showed an interaction with the accent, indicating that compound words were rated as less natural when being deaccentuated compared to simplex words. This supports the hypothesis that specialist accent is applied prior to or simultaneously with the compound accent rule. The effect of syllabic structure is also observed, demonstrating that syllable structure also affects naturalness evaluation when a word is deaccentuated.

Keywords: Japanese accent, compound accent, specialist accent, naturalness rating, perception experiment

日本語外来語における専門家アクセントと複合構造の

交互作用

──音声知覚実験からの示唆──

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1. INTRODUCTION

The computation of pitch accent at the word level and its interaction with the morphological structure of words, such as compound structure, remain obscure in many languages, including Japanese. Most Japanese dialects, including Tokyo Japanese, are pitch accent languages, in which the pitch accent is distinctive; for example, /ha'si/ differs from /hasi'/ in Tokyo Japanese. There are also other prosodic changes that occur as words undergo morphological processes. The compound accent rule and specialist accent are two of them, which are the targets of the present study. Both of these processes are post-lexical and result in reverse output, one with an extra accent and the other with the accent removed. This paper focused on two controversial processes using an audio experiment and aimed to reveal how the two processes interact with each other and affect the subjective evaluation of the speakers.

The compound accent rule applies to non-simplex words. When two or more morphemes combine, the position and presence of the accent of the compound are computed by this rule. The accent of compounds in Tokyo Japanese is determined by the phonological length of the head in the compound, the lexical stratum to which the head component belongs, and lexical information (McCawley, 1968). Despite the existence of some cases in which the accentual type of the head component in a compound is simply preserved, some cases result in an accentual fall that does not exist in the original accent of the components. In the latter case, compound words require an accent nucleus that acts as a marker. (Kubozono, 1995; Tanaka, 2001) In other words, the compound accent rule assigns an accent to a compound in many cases, even when the head component in the compound does not contain any accent fall, as shown in (1):

(1)	NT. 1			T.1 . T
(1)	Newly assigned	accent nuclei ir	1 compositings of	Tokvo Japanese
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a. [shiritsu-] + [daigaku-]	\rightarrow	[shiritsu da'igaku]
		'private university'
b. [minami-] + [amerika-]	\rightarrow	[minami ame'rika]
		'South America'

In (1a) and (1b), both components are unaccented (marked with a hyphen at the word-end); however, they result in an accented word in which the accent fall is marked with an apostrophe. The accent fall newly added to the output is regarded as a marker of the boundary of the compound.

Being applied in the same domain, the other prosodic process seen in Tokyo Japanese is the specialist accent (*Senmonka akusento*; 専門家アクセント). A specialist accent refers to a deaccentuating process of words that originally had an accent. This process is observed within certain speech communities (Akinaga, 1985; Labrune, 2012). Frequently used words are more likely to undergo

-66-

The interaction of specialist accent and compounding structure in Japanese loanwords

specialist accent. For example, musicians may pronounce "guitar" or "drum" with a deaccentuated variant, as shown in (2):

(2) Examples of specialist accents

a. [do'ramu]	\rightarrow	[doramu-]	'drum'
b. [gi'taa]	\rightarrow	[gitaa-]	'guitar'

The specialist accent rule has also been considered a sociolinguistic variation based on factors such as age and speakers' place of origin (Inoue, 1998; Kato, 1999). The theoretical analysis of this kind of deaccentuation has not been clarified; however, between-person and within-person variations have been observed. Speakers are likely to have more than one accent variation, depending on the listener, or different lexical items. In terms of the specialist' accent's application scope, the specialist accent applies not only to simplex words but also to a part of compound words, as shown in (3).

(3) Examples of compounds to which specialist accents apply.

a. [niji'kai]	~ [nijikai-]	'second party'
b. [kesho'osui]	~ [keshoosui-]	'toner'

Despite the existence of compound words to which a specialist accent applies, the examples are limited. The number of existing cases are insufficient to make a clarification in terms of the application order of the two processes. There are few existing cases to which the specialist accent or compound accent rule apply, and show a considerable difference among individuals and social communities; thus, research with a corpus seems difficult. Theoretically, both specialist accent and compound accent rules may be post-lexical; both processes refer to one or more lexical items that are assumed to have a phonological representation from the lexicon. Unlike the compound accent rule, which adds an accent as a marker in some cases, the specialist accent rule removes the accent nucleus from the word. As both processes apply at the word level, these two phonological processes can be considered to compete with each other. Therefore, it would be interesting to compare the naturalness ratings of compound and simple words when they are accentuated to determine whether the morphological structure affects the application of specialist accent. The main goal of the present study was twofold: First, this paper aimed to reveal the relationship between and application of the specialist accent and the compound accent rule and whether these two processes interact with each other, which can be clarified using a behavioral experiment. Second, according to previous studies on Japanese accents, phonological factors such as syllable structure can also influence the percentage of deaccentuation. In this experiment, the effect of syllable structure was also added to the statistical model as a fixed factor, and thus, can be verified. To achieve the above aims, an experiment with a

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factorial design is necessary to observe the interaction of the specialist accent and compound accent rules, using naturalness rating tasks with simple and compound words, with compound and specialist accents, respectively. The naturalness rating task is one option for observing the target processes. As the specialist accent and compound accent rules are post-lexical, they can be assumed to apply to words after the components are retrieved from one's lexicon. Subsequently, the post-lexical processes were computed. If there is a linear order for the application of the two processes, the process that is applied later would be closer to the final item of production. When the latter process is incorrectly applied, we would probably observe a lower naturalness score compared to the condition in which the other process is incorrectly applied.

Besides the compounding status and accent type, the syllabic structure—in particular the final two syllables—may have an effect on deaccentuation (Ito and Mester, 2016). According to Ito and Mester (2016), four-mora foreign words ending with four light syllables or a heavy syllable plus two light syllables are more likely to be unaccented than words ending with a heavy syllable. In their analysis, words that end with a heavy syllable tend to be unaccented because the final heavy syllable is unfooted, and thus, prefers an accented form. If this argument also holds true for items that are longer than four morae in this experiment, we may predict a similar tendency that words ending with two heavy syllables have a lower naturalness than words ending with HLL or LLL and so forth. In the statistical model of this experiment, the syllable structure was also analyzed as a factor.

2. EXPERIMENT

2.1 Method

To determine the interaction between the compound and specialist accents, a six-level naturalness rating experiment with four conditions was conducted using PsychoPy 1.82. Participants listened to each audio stimuli for twice and judged the naturalness by pressing the correspondent key on a keyboard. All tokens were existing words in Japanese, randomly presented as sound stimuli, and fully randomized. Two factors are accentedness (accented and unaccented) and compoundness (simplex and compound). The four conditions are shown in (4) (the hashmark represents the morphological boundary of the components).

(4)		Simplex	Compound
	Accented	Condition A e.g. [paina'ppuru]	Condition B e.g. [toire # ta'nku]
	Deaccentuated	Condition C e.g. [painappuru-]	Condition D e.g. [toire # tanku-]

2.2 Materials

The items used in this experiment were all originally accented, and some were manipulated as unaccented. Conditions A and B are the control groups, which are the baseline and are assumed to be natural in Japanese. Condition A is an accented simple word, whereas Condition B is a compound word that is properly applied with the compound accent rule. Conditions C and D are counterparts of Conditions A (simple words) and B (compound words), both of which are applied with the specialist accent.

The items were composed of Japanese foreign simplex words with six syllables, and compound words made up of two trisyllabic foreign words. The reason why only three-mora words of the foreign lexical stratum were selected is because native words in Japanese are, on average, less than five morae, and it is more likely for four-mora words of any lexical stratum to be pronounced without any accent (Akinaga, 1985). On the other hand, Sino-Japanese words have a theoretical issue in terms of the vagueness of morphological boundaries. (See Ito and Mester, 2015 and Kurisu, 2000 for further discussion). Foreign words are selected to avoid the possible effect mentioned above. Syllable structure was also analyzed in the statistical model.

A total of 25 simplex words and 25 compound words with accents in modern Tokyo Japanese were selected based on a pilot survey that targeted two Tokyo Japanese speakers and referred to the NHK accent dictionary. Unaccented versions of these 50 words, which were applied with a specialist accent, were created and evaluated along with their counterparts. Additionally, 20 unaccented fillers and their accented counterparts were inserted. Participants listened to each stimulus once and judged its naturalness on a six-level acceptability scale by pressing a number on the keyboard. All stimuli were presented in a completely random order, which was added as a random factor in the follow-up statistical model.

2.3 Participants

In total, 17 native Japanese speakers studying at the University of Tokyo participated in this experiment. All participants were born and raised in the Tokyo Metropolitan Area, including Tokyo, Chiba, Saitama, and Kanagawa. The participants finished the experiment in a booth of the Sound Lab at the University of Tokyo.

2.4 Predictions

Assuming that these two prosodic processes occur in linear order, the process that is applied later would be closer to the output. If a specialist accent is applied before the compound accent rule, there will be a difference between deaccentuated compounds and simplex words and would show an interaction between the following two factors in this experiment: accentedness and compoundness. If the compound accent rule is a process applied later than a specialist accent, the items that are

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deaccentuated may result in a lower rating of naturalness than the deaccentuated simple words. On the other hand, if a specialist accent is applied before or simultaneously with the compound accent rule, there could be no interaction between the two factors, and both unnatural conditions (namely the deaccentuated conditions: Conditions B and D) would not show a difference.

3. RESULTS

3.1 Analysis

Statistical analyses were conducted using R4.1.2. The dependent variables in this experiment were the participants' naturalness scores and reaction time. Fixed factors were compoundness (simplex words/compound), accent type (accented/deaccentuated), and syllabic position, while random factors included the intercepts of subjects, items, and order. All fixed factors were contrast-coded, and the effect of syllabic position was dummy-coded with the baseline HH (heavy syllable and heavy syllable).

3.2 Naturalness rating

As for the rating scores, the statistical model was constructed using cumulative link-mixed models with ordinal logistic regression. The rating scores were treated as equidistant ordered variables. The optimal model was found to be minimal. The average scores and graph of the naturalness rating for all conditions are shown in (5) and (6) (error bars in the graph indicate the standard errors).

(5) Average naturalness ratings by condition

	Simplex	Compound
Accented	Condition A 5.75	Condition C 5.61
Deaccentuated	Condition B 2.21	Condition D 1.73





The main effects of both compoundness and accentedness are significantly different. The accented conditions, which served as congruent conditions, achieved a significantly higher naturalness score than the deaccentuated conditions (accented [baseline] > unaccented, *Estimate* = -8.95, *SE* = 0.29, *z-value* = -30.54, *p* < .001). The main effect of compoundness was also significant, indicating that the naturalness scores of the compound conditions were significantly higher than those of the simplex word conditions (compound [baseline] > simplex, *Estimate* = 0.49, *SE* = 0.19, *z-value* = 2.53, *p* < .05). An interaction between accentedness and compoundness was also observed (*Estimate* = 0.50, SE = 0.21, *z* = 2.40, *p* < .05). Syllabic structure showed a significant difference between the models. Comparing the baseline structure, which is a word ending with two heavy syllables (hereafter, HH, and L stands for a light syllable in the following results), words ending with HL, LH, and LLL were less acceptable than the baseline (HH > HL, *Estimate* = -0.84, *SE* = 0.39, *z-value* = -2.1, *p* < .005; HH > LH, *Estimate* = -1.19, *SE* = 0.46, *z-value* = -2.58, *p* < .05; HH > LLL, *Estimate* = -1.18, *SE* = 0.41, *z-value* = -2.89, *p* < .005). No difference between words ending with HH and words ending with HLL (*Estimate* = -0.58, *SE* = 0.51, *z-value* = -1.13, *p* = .26).

3.3 Reaction time

While the participants rated the naturalness of each item, the reaction time was also recorded. The results of the four conditions are shown in (7), where the error bars indicate standard errors, as in the previous graph.

(7) Graph of reaction time by condition



Reaction times were analyzed using linear mixed models. The fixed factors include accentedness, compoundness, the interaction of these two, and syllabic structure. Random factors include intercepts of order, item, and subject. A marginal significance was found in the main effect of compoundness, showing that the reaction time of compound words is likely to be longer than that of simplex words (*Estimate* = -0.22, SE = 0.12, t value = -1.91, p = .058); however, there was no significance shown in the main effect of accentedness, although it was close to the boundary of marginal difference (*Estimate* = 0.17, SE = 0.10, t value = 1.63, p = .104). Further, no difference was found in the statistical sense of the syllable structure. However, the interaction between accent type and compoundness was significant (*Estimate* = 0.42, SE = 0.15, t = 2.88, p < .005).

4. DISCUSSION

The results of the experiment showed that not only the main effects of the two factors in the experimental design but also the interaction of accent and compounding status were significant. Compound words are rated less natural than simplex words when they are deaccentuated. In a theoretical model in which every process is applied in linear order, this result can be accounted for by the compound accent rule applied before the specialist accent. This can also be explained in a theoretical framework in which every morpho-phonological process is computed with constraints, such as Optimality Theory (Prince and Smolensky, 1993), in which it can be assumed that the set of constraints involved in the evaluation of a specialist accent can be located at a higher level than the constraints resulting in a compound accent.

The main effects of the accent type and compounding status were observed. The effect of the accent type was as the prediction shown in the previous section, because the conditions that are assumed to be natural belong to the same level in the factor. Accented words are supposed to be natural, whereas their deaccentuated counterparts varied in naturalness. However, the main effects of compounding require careful elaboration. Because the difference between the deaccentuated compounds and deaccentuated simple words is significant and the effect is large, the effect is also reflected in the main effect. However, in a sub-analysis of the control conditions that followed the proper accent rule, there was no significant difference found between the simple words and compounds (Condition A vs. Condition C). This result rules out the possibility that the experimental design is not proper, so that even the conditions that are assumed to be natural show a difference between each other.

The effect of syllabic structure was also observed, but was different from the expectations of Ito and Mester (2015). The results showed that the baseline (words ending with two heavy syllables; H stands for a heavy syllable, while L stands for a light syllable as mentioned above) was rated as more natural than words ending with HL, LHH, and LH. There was no significant difference found between the words ending with HH and HLL. The reason why the tendency is different from the previous study's analysis may be due to several reasons. First, the prosodic length; contrary to Ito and Mester (2016), who focused on existing simplex foreign words, the present study uses six-mora words, and this difference may have resulted in a different footing in terms of prosodic structure. Second, the differences observed in the present study may have biased the results. In this study, half of the items were compound words, and the other half were simple words. The compound words in this study comprised two three-mora components. Each component in the compound is a maximum of three morae, which indicates that words ending with HH are all simple words. In other words, the effect of syllable position may partially reflect the main effect of compounding status, which was proven significant in this study. To efficiently filter syllable effects, the experimental design should be revised.

The present study also analyzed the reaction time as the dependent variable. To test this difficulty, reaction time has been used in various experiments in linguistics. Reaction time was correlated with naturalness rating scores. The interaction of the factors was significant as the naturalness rating, but the two indices still showed a difference; in particular, the main effects of compoundness and accentedness were both without any significant difference. Although further research is required on the correlation and application scope of the reaction time in an audio experiment with naturalness rating, the results of this study imply that reaction time also serves as a valid cue to observe the interaction of some effects in such experiments.

Other factors, such as the lexical stratum and presenting order, may also affect the result of the naturalness judgment of deaccentuation. The foreign words used in this study have been regarded as

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lexical strata, in which words tend to be accented (Kubozono, 2006). On the other hand, Sino-Japanese words seem to be more likely to be unaccented and dependent on syllable structure (Kubozono and Ogawa, 2004). The order of presentation is another issue that should be further studied in the future. This was treated as a random factor in the statistical model. The effect of order was not significant in the model where order was added as an independent fixed factor. As specialist accent has been analyzed as a socio-variation in some communities, it is likely to correlate with frequency. However, the fact that the order effect was not significantly different may indicate that token frequency affects the naturalness of deaccentuation rather than type frequency. In the present study's experiment, every item was presented only once, despite the accent pattern being presented repeatedly. If the hypothesis that token frequency influences the naturalness of deaccentuation more robustly than type frequency is true, an experiment in which items are repeatedly presented may be efficient in observing such effects.

5. CONCLUSION

The present study investigated the naturalness ratings of simple words and compounds with and without a specialist accent. The results showed that there was a significant difference in the interactions between accent and whether a word was simplex or compound, showing that speakers rate unaccented compounds higher on an acceptability scale than unaccented simplex words, even though specialist accent applies to all of them. The results support the hypothesis that the specialist accent may be applied prior to or simultaneously with the compound accent rule in the post-lexical process. As for the syllabic structure, words ending with HH were rated as more acceptable than other structures, except for HLL. The reason for this difference may be due to sampling bias, because words ending with HH were simple words, which resulted in higher naturalness.

In conclusion, the present study shows that words with a complex morphological structure may result in a lower naturalness rating score than simple words. This result provides empirical evidence that specialist accents may be more likely to apply to words that have a simple morphological structure in foreign words, and can be simultaneously or before compound accent rules in the postlexical prosodic computation.

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The interaction of specialist accent and compounding structure in Japanese loanwords

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