English Stress Placement by Japanese Students: Effects of Syllable Structure and Noun-Verb Stress Differences

Keiichi Ishikawa

Abstract

Stress or accent plays an important role in the production of spoken language. Identifying the factors which affect stress placement is crucial to better understanding of how people process native and nonnative language. This study examined how Japanese learners of English deal with English word stress. Experiment 1 investigated the effect of the general noun-verb stress difference in English on stress judgment of English words by Japanese students. Experiment 2 tested the effect of syllable structure on the placement of primary stress in novel words. The results indicate that Japanese students of English have different knowledge of stress patterns between nouns and verbs and that their stress placement was influenced by vowel length, number of consonants, and the phonotactic legality of intervocalic consonants in words.

1. Introduction

A great deal of research has established the importance of prosody in the acquisition, perception, and production of spoken language. Prosody appears to be the principal property of the first language acquired by infants. Human newborns pre-

fer their own mother's voice to those of other females, and female voices to male voices. Further, newborn babies prefer stories previously read by their mother during pregnancy to new stories read by the same mother (DeCasper & Spence, 1986). They seem to remember prosodic cues such as the temporal characteristics of pitch, intensity, as well as duration and the rhythmic structure of syllabic beats in their mother's speech that they have experienced in uteri. English-learning 5-month-old infants can discriminate languages based on the rhythmic classes of those languages (Nazzi et al., 2000). Jusczyk et al. (1993) demonstrated that 9-month-old American infants listened longer to lists of items that conformed to the predominant strong/weak stress pattern of English words than to lists that showed the iambic stress pattern. Kajikawa & Masataka (2000) showed that Japanese 8-month-olds are able to segment and memorize words in songs.

Stressed syllables also play an important role in adulthood. English-speaking people utilize strong syllables in identifying actual words in a stream of speech (Cutler & Butterfield, 1992; Cutler & Norris, 1988) and when dividing words into smaller units (Ishikawa, 2002, 2006a; Ishikawa & Nakamura, 2006).

Languages differ in their prosodic properties. For instance, English uses stress accent while Japanese relies on pitch to make lexical distinctions. The way people perceive speech sounds seems to depend on the prosodic structure of their native language. It has been demonstrated that native speakers of Japanese have difficulty in dealing with English stress and its stressed timing (Ishikawa, 2006b; Mochizuki-Sudo & Kiritani, 1991; Nakano, 1997; Takefuta & Black, 1977; Watanabe, 1988). Ishikawa (2006b), for example, found that Japanese learners of English lack sensitivity to the alternation of strong and weak syllables in English sentences compared with native speakers of English.

Although the role of stressed syllables in language processing is well recognized, it is not clear yet what factors contribute to the decision of stress position and how this is done. Indeed, little research has been conducted to investigate the knowl-

edge of stress assignment by second language learners. This article reports on a piece of research designed to explore universal and language-specific aspects of how people recognize and produce stressed syllables. Specifically, it addresses the question of how Japanese learners of English deal with English word stress. Do Japanese EFL learners respond to the same factors that English speakers respond to? The factors that will be investigated here are the noun-verb stress asymmetry and syllable structure, both of which are believed to affect English stress placement.

2. Noun-verb stress differences

When engaged in language comprehension, people must assign words to the correct grammatical categories, such as noun and verb. This task needs to be done quickly and accurately for smooth speech communication to occur. In general, semantic and syntactic cues have been cited as the primary information for grammatical class assignment. Semantically, nouns tend to denote concrete objects, whereas verbs tend to denote perceived actions. Syntactically, English nouns can appear in the structure "I like a _____", while verbs can appear in the sentence "I like to _____." Although the importance of semantic and syntactic information for grammatical categories has been admitted, the role of phonology has been explored to a lesser degree. It is well accepted that when homographs have different pronunciations, their meanings or word classes change very often (e.g., *bow* as a weapon for shooting arrows or as an act of bending the head, or *conduct* as a noun or a verb with different stress positions).

According to Sherman (1975), in Old English, word-initial stress patterns predominated. In modern English, approximately one homograph with identical stress on the noun and verb shifts every two years toward the contrasting pattern with the trochaic stress on nouns. Although 80% of current noun-verb homographs have trochaic stress patterns (e.g., *accent, contrast, progress, rescue*), homographs

with iambic stress patterns like *report, debate, career, romance* are predicted to become stress distinct with the noun versions bearing first-syllable stress at some time in the future.

The category-based explanation for word stress seems to be challenged by the existence of denominal verbs (verbs formed from nouns). The creation of denominal verbs allows nouns to be used as verbs, keeping stress pattern intact (Clark & Clark, 1979). Examples of this are:

The government has *shelved* the idea until at least next year. (OALD, 2000)
We were *bussed* from the airport to our hotel. (OALD, 2000)
Mother absent-mindedly *sugared* her tea. (NODE, 1998)
Jane *blanketed* the bed. (Clark & Clark, 1979)

Sereno and Jongman (1995), however, showed that even these denominal verbs have sound cues such as duration and amplitude which signal the differences between noun and verb categories. For example, when English speakers read the word "handle" in isolation as a noun, the first syllable was stressed with longer duration and greater amplitude than when they read it as a verb, regardless of the same stress position.

It has been shown that native speakers of English are sensitive to the noun-verb stress asymmetry. For example, Kelly (1988) demonstrated that when English listeners hear disyllabic pseudowords (ex., *conzee, peltact*) that differ in stress and are asked to use each of these words in a sentence, they use words with first-syllable stress more often as nouns, and words with second-syllable stress more often as verbs.

3. Syllable structure

The syllable is a linguistic unit composed of one or more phonemes. A number of linguists argue that there is a correlation between stress and syllable structure in English (e.g., Giegerich, 1992; McMahon, 2002; Roach, 1991). As a rule, stress placement depends crucially on the weight of the syllable. A syllable with a long vowel or diphthong, or a short vowel with a coda, is heavy, and a syllable with a short vowel and no coda is light. A heavy syllable is more likely to be stressed than a light syllable. The number of coda consonants also seems to play a role in stress placement. Roach (1991; 89) states that, in the case of two-syllable verbs, if the second syllable ends with more than one consonant, that second syllable is stressed (e.g., *attract, assist*). These principles predict that vowel length and number of consonants in syllables can affect how people stress English words. Guion et al. (2003) demonstrated that stress assignment for pseudowords by native speakers of English was affected by syllable structure, most notably vowel length. Syllables with long vowels (C<u>VV</u>CVCC and CVC<u>VV</u>C) were more likely to bear stress than syllables with short vowels (C<u>V</u>CVCC and CVC<u>V</u>C). They did not find consistent effects of number of coda consonants (CVCV<u>CC</u> vs. CVCV<u>C</u>). The effects of number of onset consonants were not examined in their study.

On the other hand, phonotactic legality of intervocalic consonant clusters influences the shape of syllables to be formed (Treiman & Zukowski, 1990; Ishikawa, 2006a). The legality principle (Hooper, 1972; Selkirk, 1982) states that the beginnings and ends of syllables in a language must be legal at the beginnings and ends of words in that language. There are three classes of phonotactic legality. Class 1: Clusters are illegal both word-initially and word-finally (e.g., *husband*: There are no English words starting or ending with [zb]). Class 2: Clusters are legal only word-finally (e.g., *campus*: There are no English words starting with [mp]). Class 3: Clusters are legal only word-initially (e.g., *petrol*: There are no English words ending with [tr]). If the legality principle predominates, consonant clusters

should be syllabified in such a way that they correspond to the beginnings and ends of English words (e.g., *hus/band, camp/us, pe/trol*). Accordingly, in the case of two-syllable words, Class 1 has heavy syllables in both syllables, Class 2 has a heavy syllable with two consonants in the first syllable, and Class 3 has a heavy syllable with two consonants in the second syllable. If the weight of a syllable affects English stress placement, words in Class 2 would have more first-syllable stress than the other two Classes, and those in Class 3 would attract more second-syllable stress than the other two.

As a first step toward investigating the universal and language-specific effects of noun-verb stress differences and syllable structure on stress production, two preliminary experiments were conducted with Japanese college students learning English as a second language. Experiment 1 examined their knowledge of stress differences between nouns and verbs, and Experiment 2 tested syllable structure of novel words to be stressed.

4. Experiment 1

4.1 Method

Forty disyllable English words were used in the experiment, with 10 words assigned to each condition created by crossing the factors of grammatical category (nouns or verb) and stress (trochaic or iambic). These words were selected with reference to those used in Davis and Kelly (1997), in which the participants classified the words as a noun or a verb. They were also checked with the MRC Psycholinguistics Database at its website (http://www.psy.uwa.edu.au/mrcdatabase/uwa_mrc.htm) and the Francis and Kucera (1982) frequency norms. Their word frequencies ranged from 1 to 130 occurrences per million words. All the materials used in the present study are listed in Appendix 1. Words that can be used as both a noun and a verb (e.g., *record*) were not included.

Forty-four Japanese students of English at Kyoto Women's University took part

in the experiment. Participants were instructed to read each word on the sheet silently and to put a stress mark to indicate primary stress on each word. The words were randomly arranged on the sheet across conditions. The number of words whose stress positions were incorrectly identified was counted.

4.2 Results and discussion

Figure 1 shows the proportion of words whose stress positions were judged wrongly by participants.

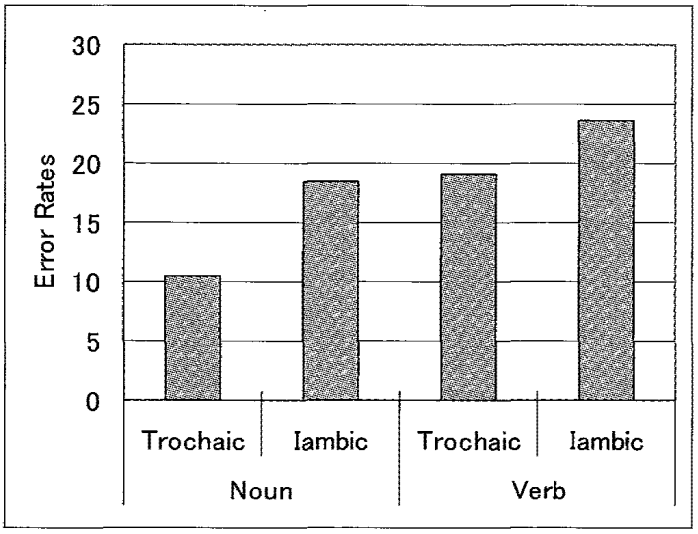

Figure 1. Error rates in stress placement for English nouns and verbs.

Analyses of variance were conducted to examine the effects of grammatical class (noun or verb) and stress pattern (trochaic or iambic). The analyses showed a significant effect of grammatical class ($F(1,43)=23.55$, $p<0.0001$) and stress pattern ($F(1,43)=8.64$, $p<0.01$). The interaction was not significant ($F(1,43)=0.85$, $p>0.10$). Japanese students made more errors in stress placement for verbs than for nouns. For example, more students wrongly judged the verb "borrow" as having second-syllable stress than the students who misjudged the stress position of the noun "concept" as having stress on the second syllable.

Moreover, participants made more errors in stress judgment for iambic words

than for trochaic words. Japanese students may have a tendency to prefer the strong-weak stress pattern over the English lexicon. In order to see the effects of stress position in more detail, *t*-tests were run on error rates for nouns and verbs separately. Iambic nouns attracted more errors than trochaic nouns ($t(43)=3.20$, $p<0.005$). Considering the general tendency for English nouns to have first-syllable stress (Fudge, 1984), it appears that Japanese students used the knowledge of this trend to judge the stress position of nouns. This knowledge also led to the highest correct judgment (nearly 90%) for trochaic nouns. On the other hand, unlike the case of nouns, there was no significant difference in error rates between trochaic and iambic verbs ($t(43)=1.46$, $p>0.10$). Trochaic verbs contained as many errors as iambic verbs. This indicates that participants used different knowledge for verbs than for nouns. This may be knowledge about the tendency for disyllable verbs, compared with disyllable nouns, to receive stress on the second syllable.

5. Experiment 2

5.1 Method

Forty-five nonwords were created as stimuli. They consisted of two syllables with two intervocalic consonants. There were five types of stimuli in terms of syllable structure.

Type 1 acts as a standard type (e.g., *bopken*)

Type 2 has a long vowel in the first syllable (e.g., *boopken*).

Type 3 has a long vowel in the second syllable (e.g. *bopkeen*).

Type 4 has two consonants in the onset of the first syllable (e.g., *bropken*).

Type 5 has two consonants in the coda of the second syllable (e.g., *bopkend*).

Furthermore, the phonotactic legality of intervocalic two consonants was fac-

tored in as follows.

Class 1: Clusters are illegal both word-initially and word-finally (e.g., *bopken*).

Class 2: Clusters are legal only word-finally (e.g., *bompen*).

Class 3: Clusters are legal only word-initially (e.g., *boplen*).

All the stimuli are listed in Appendix 2.

The same forty-four students as in Experiment 1 participated in this experiment. Participants were asked to read each pseudoword on the sheet silently and to put a stress mark to indicate primary stress on each word.

5.2 Results and discussion

Figure 2 displays the proportion of first-syllable stress placement for all conditions.

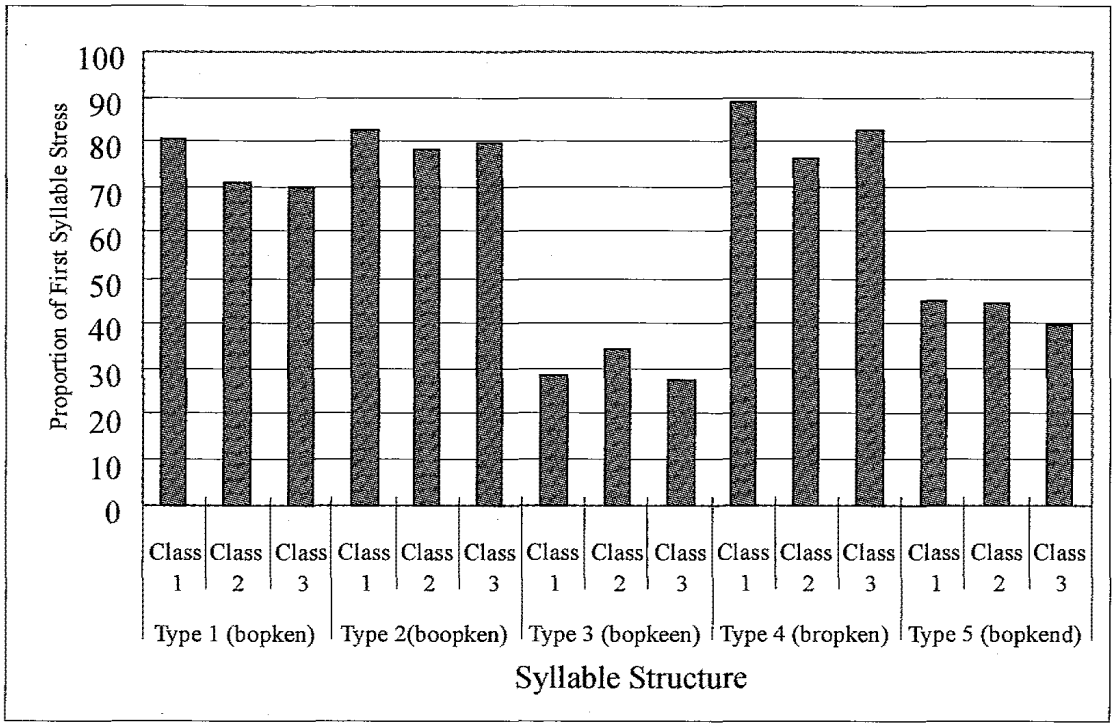

Figure 2. Proportion of stress on the first syllable in disyllable English pseudowords.

First, it was found from the results of Type 1 used as a standard type (no long vowel, no two-consonant onset or coda) that participants generally preferred to place main stress on the first syllable in two-syllable words. Seventy to eighty percent of their responses favored the trochaic stress pattern.

Next, analyses of variance were run to examine the effects of syllable structure (5 Types) and phonotactic legality of intervocalic consonants (3 Classes). The effect of syllable structure was significant (($F(4,172)=50.86$, $p<0.0001$), and the effect of phonotactic legality approached significance ($F(2,86)=2.76$, $p<0.10$). Their interaction was not reliable ($F(8,344)=1.41$, $p>0.10$). Post hoc test using Fisher's PLSD with a 0.05 significance level revealed the following comparisons. For the effect of syllable structure, Types 1, 2, and 4 were assigned stress on the first syllable more frequently than Type 5, which attracted first-syllable stress more often than Type 3. This result indicates that vowel length and the number of consonants affected stress placement by Japanese learners of English. In particular, long vowels in the second syllable attracted stress most frequently, followed by two consonants in the coda of the second syllable. Long vowels and two consonants in the first syllable (in Types 2 and 4) also showed a certain degree of effect, but the difference between these and Type 1 (standard type) was not significant, presumably because Type 1 had a high proportion of trochaic stress patterns, as already mentioned above.

Regarding the effect of the phonotactic legality of intervocalic consonants, Class 1 (illegal initially and finally) attracted first-syllable stress more often than Class 3 (legal initially). This also indicates that words in Class 3 were likely to attract stress to its second syllable. For instance, *boplen* had more second-syllable stress than *bopken*. This result can be interpreted as showing that *boplen* was divided as *bo/plen*, and that the two consonants in the onset of the second syllable in *boplen* attracted main stress. A similar trend was found in a syllabification study by Ishikawa (2006a). The second-syllable stressed word *neglect* was divided more

often as CV/CCVC (*ne/glect*) than the word *convect*, which has the same stress pattern, by both speakers of English and Japanese, probably because the phonotactic legality of their intervocalic consonants in the latter word did not allow syllabification as *co/nvect*. Accordingly, words whose intervocalic consonant clusters are legal only word-initially, like *boplen*, have two consonants in the onset of the second syllable, which may lead to more iambic stress patterns.

On the other hand, Class 2 (legal finally) did not differ significantly from either Class 1 or 3. One possible interpretation is that words in Class 2 were not divided according to their phonotactic legality (e.g., *bompen* was not divided as *bomp/en*), which did not create two-consonant coda in the first syllable. This tendency was also seen in Ishikawa (2006a). Syllabification of words like *campus*, whose medial consonant clusters are legal only word-finally, were not reliably different from that of words like *husband*, with clusters illegal both word-initially and word-finally. The above results show that how we divide intervocalic consonants, as well as the internal structure of the syllable in words, has an influence on English stress placement by Japanese students.

6. General discussion

Since Japanese language has no stress in its accent system, it is a primary concern to linguists whether native Japanese speakers learning English are sensitive to word stress patterns in the English lexicon. It is, therefore, essential to determine the extent to which Japanese learners of English respond to English stress patterns. The aim of the present study was to identify the factors which contribute to stress placement by Japanese students of English.

In English, the grammatical category of the words plays a crucial role in stress assignment. The distinction between nouns and verbs in English can be seen in its phonology in such a way that disyllable nouns are more likely than verbs to receive main stress on the first syllable. In Experiment 1, Japanese students were

required to put a stress mark on English nouns and verbs printed on a sheet. Their error rates were then calculated. Students made more errors on iambic nouns than on trochaic nouns. This suggests that Japanese learners of English use their knowledge of disyllable nouns tending to bear stress on the first syllables. On the other hand, they made as many errors on trochaic verbs as on iambic verbs. The different results between nouns and verbs indicate that participants applied distinct stress patterns to nouns and verbs separately. They seem to have different knowledge of English stress patterns for verbs than for nouns. This kind of knowledge about English stress patterns may be easy to acquire even if exposure to English begins in adulthood.

Syllabic structure also plays a part in stress assignment in English. It is assumed that heavy syllables are capable of bearing stress, while light syllables are not. Besides, the number of consonants in words arguably influences stress position. Experiment 2 tested the effects of syllable structure, including the phonotactic legality of medial consonant clusters in disyllable English pseudowords. Both vowel length and the number of consonants impacted on Japanese participants' stress assignment such that both factors attracted primary stress. Furthermore, the phonotactic legality of intervocalic consonant clusters influenced stress placement in such a way that words whose medial clusters are legal only word-initially tended to bear stress on the second syllable. Guion et al. (2003) demonstrated that English stress placement by native speakers was affected by vowel length as well as the number of consonants in words. However, they did not investigate the effect of the number of consonants in the onset of syllables. Nor did they investigate the effect of the phonotactic legality of intervocalic consonants, because their stimuli had single intervocalic consonants.

The above results suggest that Japanese students of English also have knowledge of the noun-verb stress asymmetry that is very similar to the one native speakers of English possess. It seems reasonable to consider that Japanese students

have, to some degree, learned this kind of knowledge through much exposure to English vocabulary inside and outside the English classroom. It is also suggested that vowel length and the number of consonants in words are universal factors affecting English stress placement, though the effects of onset consonants and the phonotactic legality of intervocalic consonants on native speakers of English need to be examined in future research.

In conclusion, the present research demonstrated that, despite the lack of word stress in their native language, Japanese college students of English tend to use knowledge, whether conscious or unconscious, of the noun-verb stress difference when they place stress on English words and that their stress placement is influenced by vowel length, the number of consonants, and the phonotactic legality of intervocalic consonants in words. This study serves as a first attempt to investigate the knowledge of English stress patterns acquired by second language learners.

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Appendix 1: Stimuli used in Experiment 1

	Trochaic	Iambic		Trochaic	Iambic
Noun	basket	bamboo	Verb	borrow	achieve
	closure	career		cherish	adore
	concept	cigar		conquer	conceive
	cottage	estate		enter	condense
	failure	giraffe		finish	confound
	human	hotel		furnish	explode
	justice	raccoon		manage	infer
	mercy	routine		ponder	outgrow
	uncle	success		punish	subdue
	zebra	taboo		suffer	unlock

Appendix 2: Stimuli used in Experiment 2

	Phonotactic legality of intervocalic consonants		
Syllable structure	Illegal ini. & fin.	Legal finally	Legal initially
Type 1 (standard)	bopken datlop pebmis	bompen daptop pektis	boplen dakrop petris
Type 2 (long vowel in the 1st syllable)	boopken doutlop peebmis	boompen douptop peektis	booplen doukrop peetris
Type 3 (long vowel in the 2nd syllable)	bopkeen datloap pebmoos	bompeen daptoap pektoos	bopleen dakroap petroos
Type 4 (two consonants in the onset of the 1st syllable)	bropken dratlop plebmis	brompen draptop plektis	broplen drakrop pletris
Type 5 (two consonants in the coda of the 2nd syllable)	bopkend datlosp pebmisk	bompend daptosp pektisk	boplend dakrosp petrisk