Acquisition of English Word Stress by Japanese Learners

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1. English word stress and Japanese accentuation

Archibald (1997) argues that Japanese learners store the English stress lexically and do not compute metrical structures. This paper, based on the results of two stress assignment tests by university students, argues that they develop a computation system by modifying their native loanword accentuation system, which happens to be quite similar to the English stress system, i.e., no final stressing, heavy penult stressed and if penult is light, then antepenult stressed. One difference between the two systems lies in the final unit to be ignored in the computation. In the native system it is either a light syllable (below, CV, where C stands for a consonant and V stands for a vowel) or a syllable with coda nasal (below, CVN), while in English it can be a syllable with one or more coda consonants (e.g., CVO, CVN, CVNO, CVOO, where O stands for an obstruent). The difference reflects the difference of permissible coda consonants between the two languages.

This paper tries to clarify how learners modify the native system to accommodate the difference in syllable structures. In this section, loanword accentuation system within Optimality Theory (Prince and Smolensky 1993) proposed in Katayama (1995) will be presented and in section 2 and 3, experimental results will be presented that lead us to a discussion of the final phenomena to be ignored in stress computation. In section 4, implications for the stress acquisition process will be discussed.

On the basis of the constraints on foot formation given in (1), Katayama (1995) proposes three constraints as in (2) in the following ranking order for Japanese loanword accent as in (2): NonFinality >> Accent-to-Head >> Rightmost.

(1) Constraints on moraic trochee foot formation
Foot binarity: Feet must be binary at some level of analysis (Mora, Syllable).
(P&S 1993:47, ref. in Katayama 1995:3)
Align (PrWd, R, Ft, R): Align the right edge of every prosodic word with the right edge of some foot.

(2) Constraints on Accent Assignment (Katayama 1995:3)
H-tone-NonFinality (NonF): Accent H-tone does not fall on the word-final PCat (Pcat=Foot, Syllable)
Accent-to-Head (AH): Accent H-tone falls on the head of a foot.
Rightmost (H)(RM): Prominence (H-tone) lies at the right edge of the word.

Applying this Japanese system to the English words *agenda* and *venison*, for example, gives penultimate and initial stress respectively, as desired. Below, S stands for a syllable, H a heavy syllable and L a light syllable.

(3) SHS

agenda		NonF	AH	RM
a.	a .(gen.)da			**!
b. ☞	a.(ge'n.)da			*
c.	a.(gen.)da'	*!		

(4) SLS

venison		NonF	AH	RM
a. ☞	(ve'.ni.)(son)			**
b.	(ve.ni'.)(son)		*!	*
c.	(ve.ni.)(so'n)	*!		

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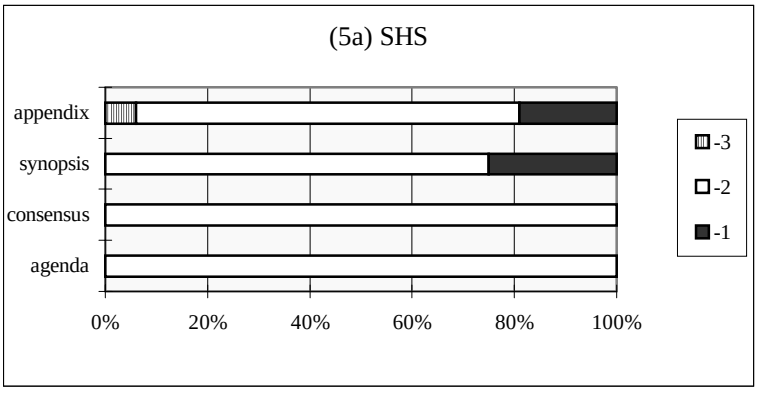
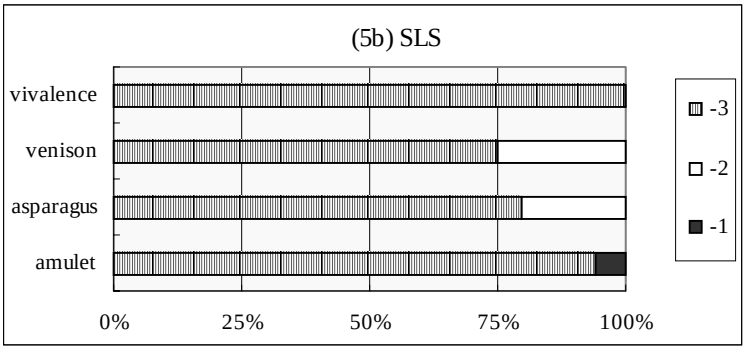
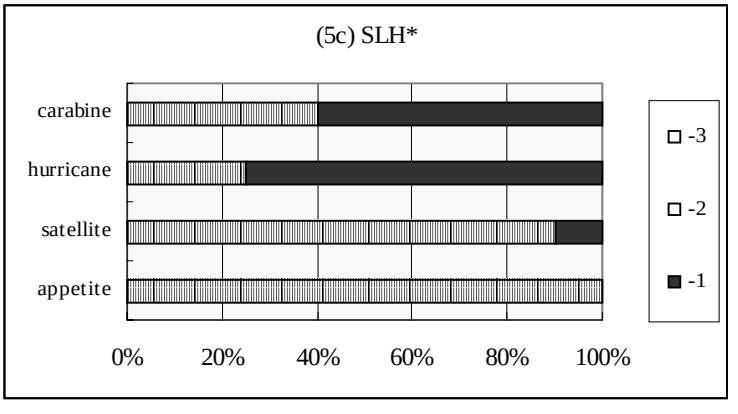
However, the Japanese system doesn't work on words with coda obstruent syllables (CVO), like *synopsis* and *amulet*, because the system is intended for native Japanese syllables, which permit only nasals in coda (CVN). In the following section, we will see how Japanese students assign stress first to English lexical items and then to English nonsense words, which will give us insights into their treatment of foreign codas in penult and final syllables.

2. Final CVVN: First stress production test

A stress production test a la Archibald (1998) was given to 17 university students, whose partial results are given in (5). Items in (5a) are with heavy penultimate syllables (SHS), those in (5b) contain light penults (SLS), and those in (5c) have light penultimate and superheavy final syllables (SLH*). Antepenultimate stress is designated as [-3], penultimate as [-2], and final stress as [-1]. The percentage shown is the ratio of each group of instances against the grand total, which is 68 in this test.







Stress in (5a) falls mostly on [-2], while in (5b) and (5c) on [-3], except *hurricane* and *carabine*. This shows that (i) subjects are sensitive to the structural difference in the penultimate syllables, which in turn indicates that they are doing metrical calculation, and (ii) in most cases, final-syllable types of CVO (*amulet, synopsis*), CVNO (*vivalence*[1]) and CVVO (*satellite*, *appetite*) fail to attract stress to themselves, just like final CV (*agenda*) and CVN (*venison*). This indicates that CVO, CVNO, and CVVO behave as if they are invisible in stress computation. In OT terms, this indicates that NonFinality blocks stressing on these final syllables and yields initial or penultimate stressing, depending on the weight of the penult syllables**.**

Very peculiar is the stress assignment of the words in (5c). When ending in obstruents (*satellite)*, superheavy final syllables in (5c) don't attract stress, while they do attract stress when ending in /n/ (*hurricane)*. This indicates that final CVVO is invisible in the metrical calculation but CVVN is not. One simple way to deal with this difference is to introduce a new constraint, the Weight-to-Stress Principle (WSP) as in (6).

(6) The Weight-to-Stress Principle (WSP)[2]: Heavy syllables and superheavy syllables must be stressed.

When WSP is ranked higher than NonFinality, it will ensure stress on the final syllable, which is the case of *hurricane,* as in (7a). When WSP is ranked lower than NonFinality, it will produce stress on the initial syllable, as in (7b). This is the case for most of the items in (5), where initial stress is expected.

(7a) SLH*

hurricane		WSP	NonF	AH	RM
a.	(hu'.rri.)(cane)	*!			**
b.	(hu.rri'.)(cane)	*!		*	*
c. ☞	(hu.rri.)(ca'ne)		*		

(7b) SLH*

satellite		NonF	WSP	AH	RM
a. ☞	(sa'.te.)(llite)		*		**
b.	(sa.te'.)(llite)		*	*!	**
c.	(sa.te.)(lli'te)	*!			

Although WSP is not included in the Japanese accentuation system in Katayama (1995), it is nevertheless necessary there, because Japanese has words with accent on a final superheavy syllable, like *harike'en* (hurricane), *kameru'un* (Cameroon). With only the constraints given in (1) and (2), there is no way in Japanese to assign final accent to these words. Introduction of WSP with minimal reranking is, therefore, not an extra cost but a necessity for the Japanese accentuation system as well as for the interlanguage system of the learner.

The question remains as to why only words with final CVVN trigger reranking, and whether there are other types of final syllables that trigger reranking. In the next section, test results with nonsense words will be presented, providing more data that bear on this issue.

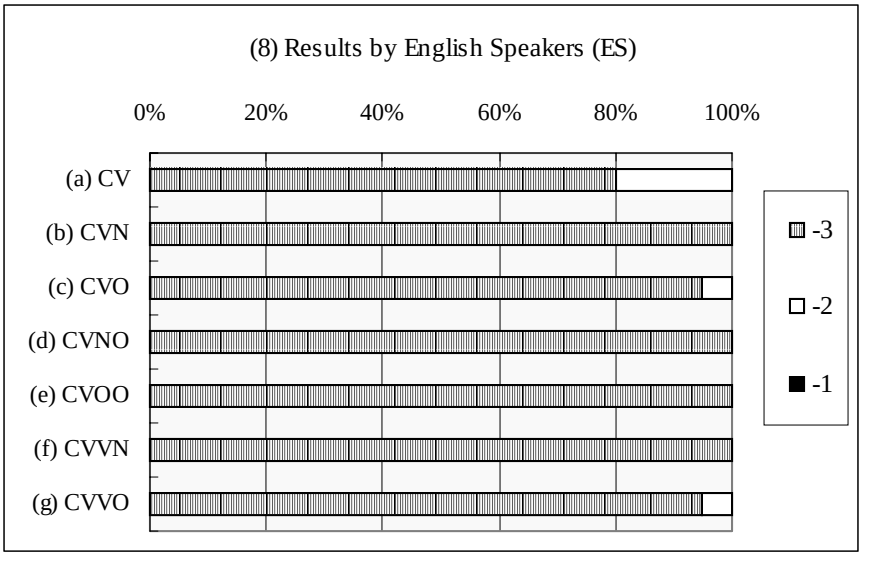
3. Final syllable stressability: Second stress production test

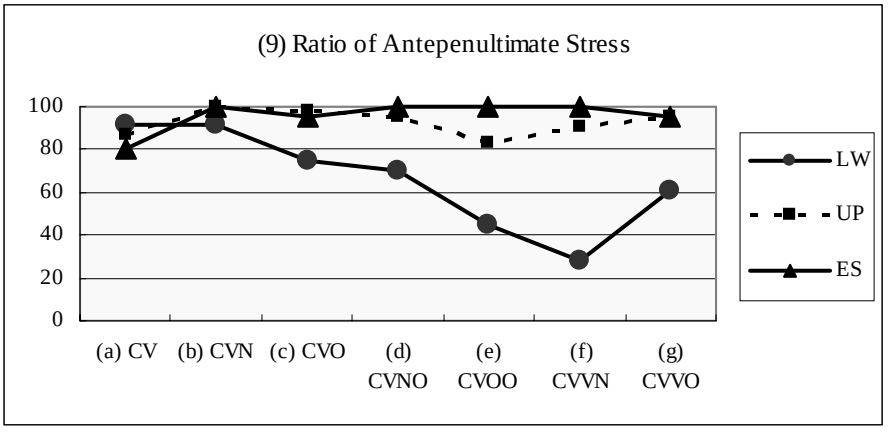
Results of the first test showed that so long as the penult is heavy, stress is assigned to it regardless of the metrical content of the final syllable. In OT terms, this indicates that (i) NonFinality, which forbids a final unit to be stressed, is ranked higher than the other constraints, and (ii) in the interlanguage system, the invisible final unit is not restricted to those with codas permissible in native Japanese words, but allows also those with non-native codas such as CVO, CVNO, CVOO, and CVVO. Superheavy final syllables with a nasal coda (CVVN), however, mostly receive final stress, which

[1] The item 'vivalence' is a nonsense word created from the lexical word "bivalence".
[2] This constraint is proposed in Hammond (1999:264).

suggests that NonFinality is not at work on them. Furthermore, closer examination of the results in (5) tells us that final stressing is also a possibility for certain final-syllable types, such as *synopsis* and *appendix*.

A second stress production test using nonsense words[3] was given to 38 university students and, as a control, to 10 native English speakers (below, ES). All items consisted of three syllables LLX, where L stands for a light syllable (CV) and X stands for one of the following seven syllable types: (a)CV (b)CVN, (c)CVO, (d)CVNO, (e)CVOO, (f)CVVO and (g)CVVN. Participants pronounced fourteen items, two for each syllable type, once in a sentence and once as a word list. Results by ES participants show that antepenultimate stress is preferred for all the items, as expected (Table 8)[4], so antepenultimate stress is considered the target stress pattern for the Japanese subjects. Therefore, based on the proportion of answers giving antepenultimate stress, Japanese subjects are divided into two groups, UP and LW, each with 19 subjects, UP having the better ratios. Table 9 shows the ratio of responses of antepenultimate stress for each item group by the ES, UP, and LW subject groups.

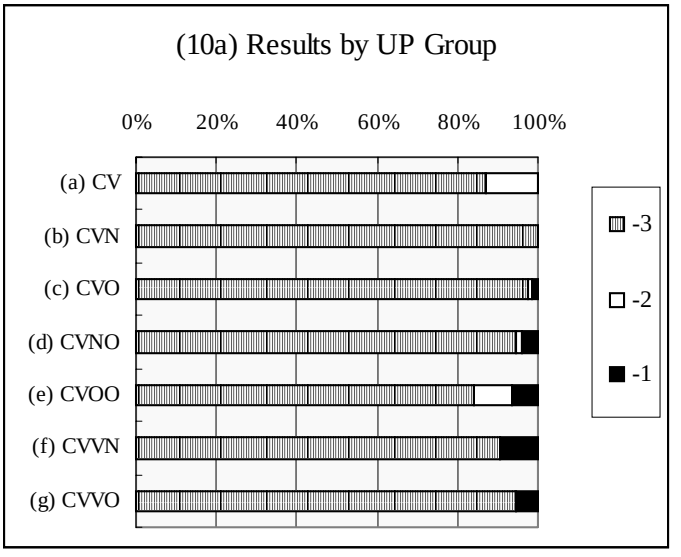


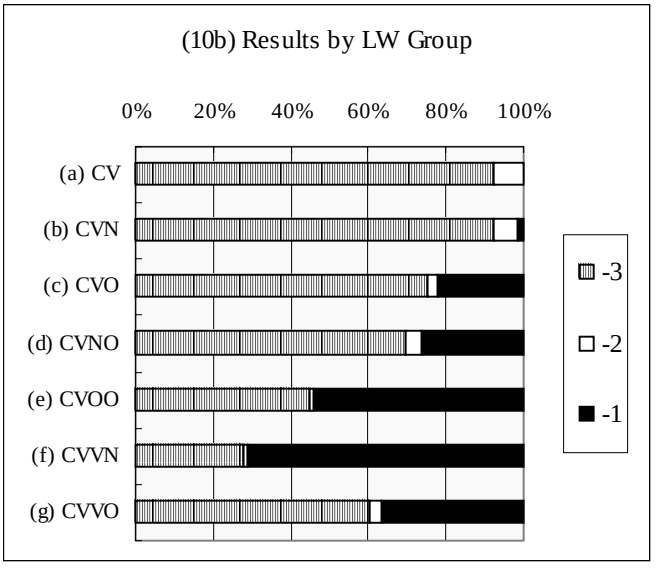


[3] Motivated by a comment from Dr. Archibald at the poster session, the second test was planned after the GASLA6 conference to confirm the data of the first test. Section 3, therefore, contains new data which did not exist at the time of the conference. For the detail of the second test, see Kawagoe (forthcoming).

[4] As shown in Table 8, 20% of ES participants assigned penultimate stress to group (a) words like *gadima*. It should be noted, however, that since the penultimate syllables are always pronounced with a tense vowel when stressed, they are no longer light syllables.

Table 9 shows that the results of UP and ES are similar, with a slight difference in the item group (e) (significant at the level of 0.05), while those of LW are quite different from both ES and UP in all item groups (significant at the level of 0.05). The results by UP and LW groups are given in (10a) and (10b) respectively.





In general, the results in (10a) and (10b) are not different from the results of the first test, although the grouping of subjects into LW and UP makes it clear that the final stressing mostly occurred in the LW group. Focusing on the results of the LW group, we see that not only the items with final CVVN but also the items with other final syllable types attracted stress finally. The ratio of occurrence of final stress is, however, significantly different among the item groups (significant at the level of 0.05). Final stress is assigned mostly to group (f) with final CVVN (*averane)*, followed by group (e) with final CVOO (*saralax)*. Group (g) with final CVVO (*lunacape*), group (d) with final CVNO (*lapotance*), and group (c) with final CVO (*tadinop*) form another cluster of groups with final stressing, but their chance of attracting stress is less than the former two groups. Group (b) with final CVN (*venipen*) gets final stress, but only marginally, and group (a) with final CV (*gadima*) never attracts stress to the final syllable. The observations are shown as a scale of final-syllable stressability in (11).

(11) Final-syllable stressability

CVVN > CVOO > CVVO > CVNO > CVO > CVN > CV

where S*i* > S*j* indicates S*i* is more likely to be finally stressed than S*j*.

The scale indicates that the items with CVVN syllables, like *averane*, are most likely to attract final stress, while the items with final CV syllables, like *gadima*, are least likely. Looking at the results in (10a), we find that a similar tendency holds for the results of the UP group. There, final stressing shows a lower ratio in groups (e), (f) and (g)--final syllables of CVOO and CVVN, and CVVO--all of which are high on the scale given in (11).

4. Stress acquisition as a reranking process

In section 2, we saw that items with final CVVN quite often attract stress to their final syllables. In OT terms, this means that WSP, which stresses heavy and superheavy syllables, is at work in stress computation, and minimal reranking of WSP and NonFinality takes place for the items with CVVN. The second stress production test with nonsense words, however, revealed that not only items with final CVVN are likely to attract stress finally, but also ones with final CVOO, CVVN, and CVVO. Moreover, the error pattern of the learners shows that items with final-syllable types other than CV also have a chance to attract stress finally, although their chances are not as high as the others. In both Table 5 and Table 10, no final stressing is seen for items in group (a), with final CV. This result is a natural consequence of this system, because the CV syllable has no chance of getting stress by WSP.

These results give us a complete picture of the stress computation system of the Japanese learners, in which WSP ensures stress for all heavy and superheavy syllables, and final stressing takes place unless blocked by NonFinality, reranked to a higher position than WSP. Whether reranking of WSP and NonFinality occurs or not depends primarily on the coda type of the final syllable, but it also depends on the learner's level of computation strategy. The tableaux in (12) show cases where WSP ranked higher than NonFinality, and those in (13) show NonFinality higher than WSP.

(12a) CVOO

	averane	NonF	WSP	AH	RM
a. ☞	(a'.ve.)rane		*		**
b.	(a.ve'.)rane		*	*!	*
c.	(a.ve.)ra'ne	*!			

(12b) CVVN

	saralax	NonF	WSP	AH	RM
a. ☞	(sa'.ra.)lax		*		**
b.	(sa.ra'.)lax		*	*!	*
c.	(sa.ra.)la'x	*!			

(13a) CVOO

	averane	WSP	NonF	AH	RM
a.	(a'.ve.)rane	*!			**
b.	(a.ve'.)rane	*!		*	*
c. ☞	(a.ve.)ra'ne		*		

(13b) CVVN

	saralax	WSP	NonF	AH	RM
a.	(sa'.ra.)lax	*!			**
b.	(sa.ra'.)lax	*!		*	*
c. ☞	(sa.ra.)la'x		*		

Summing up, this paper investigates stress computation strategies used by Japanese learners of English. The results of two stress production tests, inspired by the test in Archibald (1997), have shown that (i) the stress patterns produced by Japanese learners reflect the weight of the penultimate syllables, and (ii) stress errors by the learners mainly result from erroneous processing of English coda consonants in the final syllable. The first observation tells us that Japanese learners compute English stress using a system sensitive to penultimate syllable weight, which is likely to be the Japanese loanword accentuation system (McCawley 1968). The second observation indicates that some syllable types in word-final position have a tendency to attract stress to themselves. The syllable type CVVN is the most conspicuous in this respect, but others, like CVOO, CVVO, attract stress as well. Since final stressing takes place only when the final syllable is heavy or superheavy, the new constraint WSP is introduced. When WSP is ranked higher than NonFinality, final stress is produced, and when it is located lower than NonFinality, final stress is blocked.

In the second stress production test, a large difference in error rate among the learners is seen,

which motivates the dividing of the subjects into two groups; UP with fewer errors and LW with more errors. Interestingly, although each group has exactly the same number of subjects, most of the errors are committed by LW members, while UP members generally follow the pattern of English native speakers, although their errors show the same pattern as group LW, on a much smaller scale.

If the introduction of WSP and minimal reranking is in the right direction, then what seems to emerge as an acquisition process is that learners start with the ranking of WSP higher than NonFinality and then they rerank the two constraints minimally. Whether reranking takes place or not depends on the final-syllable types, as seen in (11). Adjusting the constraint rankings one by one following the final-syllable stressability scale in (11), acquisition ends by ranking NonFinality above WSP for all English final syllables, which is the ranking used by English native speakers.

The test results above have shown that error patterns are not uniform across all learners. Some put stress initially, some penultimately, and some finally. Moreover, the error rate for each stress pattern varies depending on the subject group. Facing this diversity of error patterns, the theory must offer a system which produces diversity, yet one which defines what are and are not possible error patterns. In this respect, stress acquisition seen as a reranking process is one plausible approach to an interlanguage system.

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