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# Prosodic transfer in L2 relative prominence distribution: the case study of Japanese pitch accent produced by Italian learners

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## Abstract

Relative prominence distribution, one of the major factors characterizing speech rhythm, is largely determined not only by the position of word accent/stress (word accent, henceforth) but also by the treatment of the acoustic correlates involved in word accent production (e.g., duration, F0, amplitude). Languages differ in both aspects, and those differences are expected to cause prosodic transfer in L2 speech development. This study investigated the production of Japanese pitch accents produced by Italian learners of Japanese as a part of ongoing research on prosodic transfer in L2 word accent production, where languages that differ typologically in timing patterns are combined as L1 and L2. Four speech types, i.e., L1 Japanese, L1 Italian, beginning and advanced levels of L2 Japanese-L1 Italian, were examined, running production experiments. Results of the data analysis support general findings in earlier research on L2 Japanese-L1 English and L2 English-L1 Japanese: a) transfer patterns vary from correlate to correlate (in other words, correlates do not transfer collectively); b) L2 speakers face difficulties in learning phonetic patterns although they are able to produce native-like patterns at the phonological level.

## 1. Introduction

### 1.1. Typological considerations in L2 prosody research

The most important models of L2 speech learning have been mostly developed on the basis of segmental data, such as the Speech Learning Models [1], and the Perception Assimilation Model [2]. Recently, more effort has been dedicated to investigating prosodic aspects of L2 speech, which should help us to understand the nature of L2 prosody, evaluate the aforementioned L2 speech learning models, and develop a L2 prosody learning model eventually [3].

One of the goals of L2 prosody research is to understand how L1 prosodic features affect L2 prosodic patterns: i.e., *prosodic transfer* [4]. To reach the goal, it should be useful to compare transfer patterns of multiple L2 types within the same research framework, combining languages that differ typologically in prosodic characteristics, e.g., timing types (stress-, syllable-, mora-timing).

### 1.2. Prosodic transfer in L2 word accent production

*Relative prominence distribution* is one of the most essential factors of timing or temporal organization, i.e., a vast prosodic domain involving multiple factors [5]. Languages differ not only in the distribution of word accent/stress (word accent, henceforth), but also in the treatment of acoustic correlates in word accent production [5]. In English (*stress-timed* language), all three acoustic correlates (duration, F0 and amplitude) are actively involved [6]. In Japanese (*mora-timed* language), only F0 is active [6]. In Italian (*syllable-timed* language), the most reliable acoustic correlate is duration [7], [8].

When two of these three languages are combined as L1 and L2, how do L1 phonetic habits affect L2 prosody production? Do all L1 characteristics transfer collectively or separately? If separately, does a certain factor determine different transfer patterns of L1 phonetic habits? To answer these questions, Ueyama [4] investigated prosodic transfer in word accent production, comparing two L2 types: i.e., L2 English-L1 Japanese and L2 Japanese-L1 English. The results suggested the following general findings:

- Transfer patterns of L1 prosodic characteristics in L2 prosody can vary greatly from correlate to correlate, which means that different L1 phonetic habits do not transfer collectively.
- Different transfer patterns can be explained by a difference between L1 and L2 in terms of the phonological status of a relevant prosodic feature.

The present study will evaluate these findings, investigating the case of L2 Japanese-L1 Italian, focusing on the acoustic analysis of two of the three acoustic correlates of word accent, i.e., F0 and duration. As far as the author knows, the production of Japanese pitch accents produced by Italian speakers has not been examined in earlier research.

### 1.3. Word accent production in L1 Japanese, L1 English and L1 Italian

Relative prominence distribution can be determined both at the phonological and phonetic levels. At the phonological level, languages differ not only in the lexical distribution of word accents but also in pitch accent types assigned to word accents according to the autosegmental-metrical (AM) theory of intonational phonology [11]. At the phonetic level, as mentioned earlier, languages differ in the manipulation of the acoustic correlates relevant to word accent production. Figure 1 summarizes the treatment of F0 and duration and pitch accent types in a neutral declarative context in L1 Japanese, L1 English and L1 Italian.

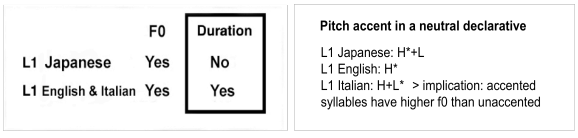


Figure 1: *Treatment of F0 and duration in the word accent production of L1 Japanese, L1 English and L1 Italian*

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In L1 Japanese, only F0 plays an active role in word accent production. With the assignment of H*+L to an accented mora (the smallest prosodic unit in Japanese), an accented vowel is systematically higher in pitch than an unaccented vowel [10], [11]. In contrast, in L1 English and L1 Italian, both F0 and duration are involved: accented syllables are systematically longer in duration than unaccented ones. As far as F0 is concerned, this correlate is active in both L1 types, but there is a difference in pitch accent types assigned to lexically accented syllables. In L1 English neutral declaratives, H* is assigned to an accented syllable, and accented syllables are higher in pitch than unaccented ones. In contrast, in L1 Italian neutral declaratives, H+L* is assigned to an accented syllable [12]. In this case, an accented syllable is aligned with a low tone preceded by a high tone; consequently, accented syllables are lower in pitch than unaccented ones.

### 1.4. Research questions on L2 Japanese-L1 Italian

Comparing the aforementioned characteristics of L1 Japanese and L1 Italian, the following research questions on the production of pitch accents in L2 Japanese-L1 Italian emerge:

- **F0**: do Italian learners of Japanese learn to make a native-like contrast between lexically accented and unaccented syllables, which should be followed by the phonological assignment of H* to the accented syllable?
- **Duration:** do Italian learners of Japanese learn how to suppress the duration contrast between accented and unaccented syllables?

In order to answer these questions, the effect of L1 phonetic habits on Japanese pitch accent production was investigated, running two experiments with the same method for two languages, Japanese and Italian.

## 2. Methodology

### 2.1. Participants

Production data were collected from two control groups (L1 Japanese and L1 Italian) and two experimental groups (two proficiency levels of L2 Japanese-L1 Italian, beginning and intermediate). All participants of the experimental groups study or studied Japanese at the Department of Interpretation and Translation of the University of Bologna.

- **L1 Japanese** (J1, J2): 2 female speakers from the Kanto area (Tokyo and Chiba)
- **L1 Italian** (I1-I4): 3 females (Marche, Emilia-Romagna, Umbria) and 1 male (Emilia-Romagna)
- **Beginning L2 Japanese-L1 Italian** (BJ1-BJ4): 4 female speakers who never visited Japan (more or less equivalent to CEFR* A2)
- **Intermediate L2 Japanese-L1 Italian** (AJ1-AJ3): 1 male and 2 females who studied in Japan for 6 months as exchange students (more or less equivalent to CEFR B1-B2) *CEFR (Common European Framework of Reference)

### 2.2. Materials

In both Japanese and Italian experiments, three minimal pairs of homophonous words that differ only in word accent position were used:

- **Japanese**: *kami* 神 ‘god’ vs. *kami* 紙 ‘paper’; *seki* 席 ‘seat’ vs. *seki* 咳‘cough’; *kiru* 切る ‘cut’ vs. *kiru* 着る ‘wear'
- **Italian**: *canto* 'song' *vs. cantò* 'sang'; *pero* 'pear tree' *vs. però* 'but'; *principi* 'princes' *vs. princìpi* 'principles'

For both languages, the target words were placed in frame sentences that the participants were instructed to pronounce as neutral declaratives without placing any emphasis on any particular part of the sentence:

- **Japanese**: *soshite* ____ *to iimasu* "And I said ____."
- **Italian**: *ho detto* ____ *stavolta* "I said _____ this time."

The Japanese minimally paired words are disambiguated by orthography while the Italian ones were disambiguated by context sentences that were presented before the frame sentence with the target word. For example:

- *pero* 'pear tree': *Il nonno ha piantato il pero* 'The grandpa planted the pear tree"
- *però* 'but': *Però non mi piace pulire* 'But I don't like to clean"

### 2.3. Procedure

#### *2.3.1. Data collection*

For each experiment, sentences with target words were mixed with foil sentences. Sentences in each reading of the list were pseudo-randomized in different orders. One sentence was displayed at a time (preceded by a context for the Italian experiment), using Power Point. The participants read the sentence list 10 times. Prior to the recording, the participants familiarized themselves with all the stimuli, having a self-paced practice session. Their performances were recorded in a quiet room with MacBook Pro in 44khz and 16 bits, using the internal microphone of the computer.

#### *2.3.2. Data analysis*

The first and the last of the 10 repetitions of the sentence list were discarded, keeping only the ones in the middle for acoustic analysis. The first vowel of the target was segmented, labeled and analyzed for F0 and duration, using Praat, utilizing waveforms, wide-band spectrograms and pitch tracks. Measured values were automatically collected, using a script to take a duration value between the beginning and end of a target vowel and the F0 value of the middle point of a target vowel.

## 3. Results

### 3.1. L1 Japanese and L1 Italian

#### *3.1.1. L1 Japanese*

Results confirm more or less the expected L1 Japanese patterns for both F0 and duration. Both speakers (J1, J2) assigned the pitch accent H*+L to lexically accented syllables. Accented syllables were systematically higher in F0 than unaccented ones, as shown for one speaker in Figure 2, where means and standard deviations of lexically accented and unaccented vowels are plotted for each of the three analyzed vowels, /a, e, i/. We ran two-factor ANOVAs to see effects of the two independent variables, i.e., accent condition (accented and unaccented) and vowel type (/a/, /e/, /i/), for each speaker.

Results showed significant effects ($p < 0.0001$) for both variables with no interaction between accent condition and vowel type, confirming the systematic role of F0 in L1 word accent production.

In contrast, no systematic effect is observed for the duration correlate. Speaker J2 made no durational difference between the accented and unaccented conditions for all vowel types, as illustrated in Figure 3. This pattern is also observed in Speaker J1's production except for which the average duration of the accented version is significantly greater than that of the unaccented counterparts, as confirmed by post-hoc Tukey tests ($\alpha = 0.01$). Considering all this, it can be concluded that duration is not a systematic acoustic correlate of a prosodic contrast between accented and unaccented syllables, which is an expected L1 Japanese pattern.

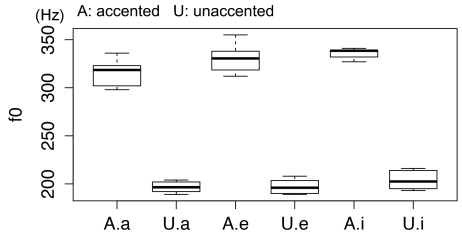


Figure 2: *F0 means and standard deviations of accented and unaccented vowels /a, e, i/ for Speaker J1 (L1 Japanese)*

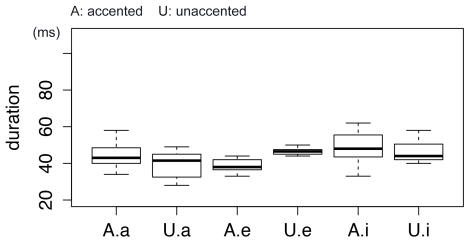


Figure 3: *Duration means and standard deviations of accented and unaccented vowels /a, e, i/ for Speaker J2 (L1 Japanese)*

### *3.1.2. L1 Italian*

Expected L1 patterns are observed also in the L1 Italian data. The pitch accent H+L* is assigned to accented syllables in a neutral declarative context in which the low tone preceded by the high tone is aligned to the lexically accented vowel. Consequently, accented vowels are systematically lower in F0, and systematically greater in duration. These general patterns are illustrated for a representative speaker in Figures 4 and 5, respectively.

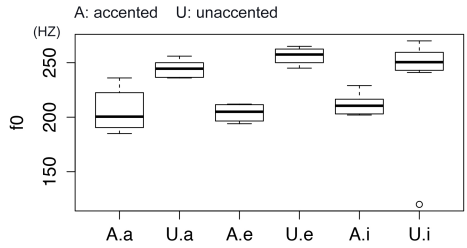


Figure 4: *F0 means and standard deviations of accented and unaccented vowels /a, e, i/ for Speaker I2 (L1 Italian)*

However, results of two-way ANOVAs and post-hoc Tukey tests show a difference between the two acoustic correlates in terms of stability of the effect. For all four L1 Italian speakers, the duration pattern is the same for all vowel types: accented vowels are significantly longer than unaccented ones. In contrast, unaccented vowels are significantly greater in F0 for all the vowel types only in the speech of two of the four speakers, i.e., Speaker I1 and I2. Thus, our L1 Italian data confirm the findings of the earlier studies [9], [10]: duration is the most stable correlate of Italian word accents.

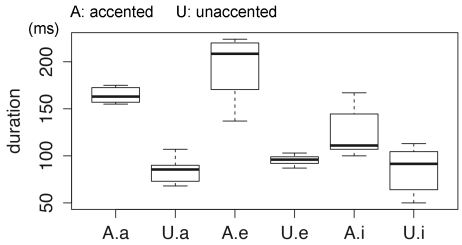


Figure 5: *Duration means and standard deviations of accented and unaccented vowels /a, e, i/ for Speaker I2 (L1 Italian)*

## 3.2. L2 Japanese-L1 Italian

### *3.2.1. F0 patterns*

At the phonological level, all the seven Italian learners of Japanese succeeded in assigning the right pitch accent, H*+L, to accented syllables, with the author's help in the practice session. Since the purpose of the current study is to investigate how L1 acoustic characteristics transfer to L2 word production, it is important to ensure the native-like assignment of pitch accents. At the phonetic level, all seven Italian learners of Japanese pronounced accented vowels significantly higherr than unaccented vowels for all 3 vowel types, as shown for a representative speaker in Figure 6. This pattern is confirmed by results of two-way ANOVAs and post-hoc Tukey tests conducted for each speaker ($p < 0.001$). These results suggest no negative transfer of L1 Italian patterns to L2 Japanese word accent production.

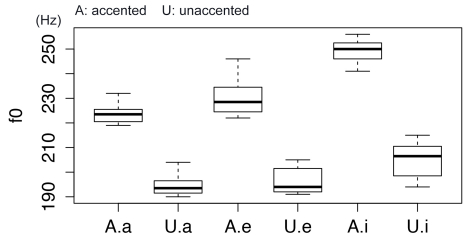


Figure 6: *F0 means and standard deviations of accented and unaccented vowels /a, e, i/ for Speaker BJ2 (L2 Japanese)*

To compute F0 contrast between the accented and unaccented conditions, F0 ratios of accented and unaccented vowels were calculated for each speaker by dividing the F0 value of each accented vowel token by the one of the corresponding unaccented token for each repetition of each vowel type. For each speaker, obtained ratios were pooled across all vowel types and repetitions. Results are summarized in Figure 7. The L1 Japanese ratio is approximately 1.5 (1.45 and 1.62 for Speaker J1 and J2, respectively). L1 Italian ratios are smaller than 1 for all four speakers, ranging from 0.81 to 0.9. L2 Japanese ratios show two non-native patterns: 1) exaggerated contrast (2 and 1.7 for AJ2 and BJ2, respectively); 2) insufficient contrast (1.1 to 1.2

for BJ1, BJ2, BJ4). Note that there is no correlation between F0 ratios and L2 Japanese proficiency levels.

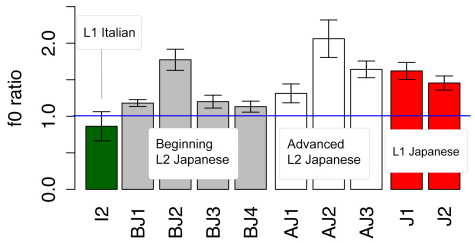


Figure 7: *Average F0 ratio of Japanese accented/unaccented vowels*

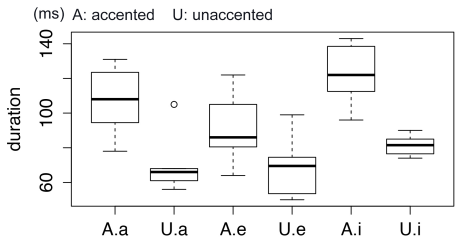


Figure 8: *Duration means and standard deviations of accented and unaccented vowels /a, e, i/ for Speaker BJ4 (L2 Japanese)*

### *3.2.2. Duration patterns*

On the other hand, the L2 duration data show the negative transfer of the L1 Italian pattern, i.e., a significant duration contrast between accented and unaccented vowels, as observed in Figure 8, where duration means and standard deviations of accented and accented vowels are plotted for Speaker BJ4. This non-native pattern was produced by four out of the seven Italian learners of Japanese: AJ1, BJ1, BJ3 and BJ4.

Duration ratios of accented to unaccented vowels were computed with the same procedure as for the F0 ratios. Results are summarized in Figure 9. L2 Japanese ratios range from 1.03 to 1.05. This is smaller than the L1 Italian ratios (1.74~2.37), falling within the range of L1 Japanese ratios (1.02~1.19). These patterns suggest that all seven Italian learners of Japanese including those producing a significant duration contrast between the accented and unaccented conditions managed to suppress their L1 Italian contrast. There is no correlation between duration patterns and L2 Japanese language proficiency levels.

## 4. Discussion and Conclusion

Several general points emerge from the data analysis. First, we observed negative transfer not in the F0 results but in the duration results, which suggests that transfer patterns vary greatly from correlate to correlate. Note that more difficulties in duration control were also observed in the case of L2 Japanese-L1 English and L2 English-L1 Japanese [4]. Second, L2 prosody does not develop in a parallel manner for different correlates: e.g., Speaker BJ2 and AJ2 showed non-native-like F0 contrasts but native-like duration contrasts. Finally, there are difficulties in learning native-like phonetic patterns, although phonological patterns are produced successfully, as shown in the F0 patterns of L2 Japanese, where we observed both exaggerated and insufficient contrasts between the accented and unaccented conditions.

These general patterns support Ueyama's [4] findings. Considering the two studies together, we investigated three L2 types, i.e., combinations of three languages that differ typologically in terms of prosodic characteristics: i.e., L2 English-L1 Japanese, L2 Japanese-L1 English, L2 Japanese-L1 Italian. Results show more difficulties in learning phonetic patterns than phonological features in L2 word accent production. This matches with what earlier research has uncovered regarding segmental aspects of L2 speech [13]. In a long run, the observed difference in learning difficulties at the two levels of L2 production should be further investigated, examining more prosodic features for more L1-L2 combinations, in order to achieve a better understanding of L2 prosody development.

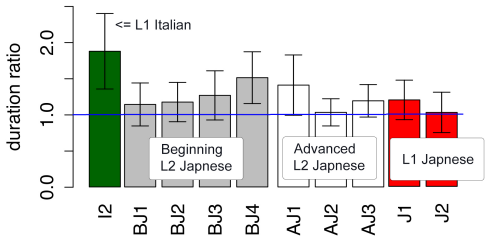


Figure 9: *Average duration ratio of Japanese accented/unaccented vowels*

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