The Effect of Lexical Accent on Perceived Japanese Vowel Length: Evidence from Croatian

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Abstract

The present paper examines the effect of Japanese lexical accent on the perception of Japanese vowel length in Croatian listeners. Lexical accent patterns of the two languages, both having phonologically distinctive length and pitch, are contrasted. A three-alternative choice identification test was conducted involving all combinations of three pitch patterns and two positions of a long vowel in bisyllabic words. Two groups of participants were Croatian students of Japanese and those without any prior knowledge. The results showed not only the effects of pitch pattern but also of the position of the long vowel (initial or final) and group. Participants had the highest error rates for pitch pattern LHL, followed by HLL, regardless of the group and position of the long vowel.

Keywords: vowel length, lexical accent, perception of long vowels, Croatian, Japanese

Povzetek

Prispevek preučuje vpliv japonskega besednega naglasa na zaznavanje dolžine japonskih samoglasnikov pri hrvaških naravnih govorcih. Primerjani so vzorci besednega naglasa obeh jezikov, katerih fonološka razlika je v trajanju in višini tona. Izveden je bil identifikacijski test s tremi izbori, ki je vključeval vse kombinacije med vzorci tonske višine in položaji dolgega samoglasnika na primeru dvozložnih besed. Sodelovali sta dve skupini udeležencev, hrvaški študenti japonščine in tisti brez predhodnega znanja japonščine. Rezultati so pokazali, da na pravilnost zaznavanja ne vpliva le tonski vzorec besede, ampak tudi položaj dolgega samoglasnika (na začetku ali na koncu) ter predznanje japonščine. Udeleženci so imeli najvišje stopnje napak pri višinskem vzorcu LHL, sledil je HLL in sicer ne glede na skupino in položaj dolgega samoglasnika.

Ključne besede: trajanje samoglasnika, besedni naglas, zaznava dolgih samoglasnikov, hrvaščina, japonščina

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1 Introduction

This paper investigates how the lexical accent of the Japanese language influences the perception of Japanese long vowels in bisyllabic words by Croatian listeners. Both Croatian[1] and Japanese belong to pitch-accent languages[2] and have phonologically distinctive vowel length.

Japanese vowel length often poses difficulty to foreign learners: they do not always make a distinction between long and short vowels in their production, nor do they always notice the difference between them in the spoken language (Toda, 2003, p. 70) and references therein (Hirata, 2015, p. 726).[3] Some Croatian students of Japanese also make errors in their production articulating a long vowel instead of short, e.g. 従業 *#juugyoo* 'performing duties' instead of 授業 *jugyoo* 'class'. Also, length is sometimes omitted, e.g. ビル *#biru* 'building' instead of ビール *biiru* 'beer', or pronounced on the wrong vowel, e.g. *#yoote* instead of 予定 *yotee* 'plan'. It is well known that L2 production is closely related to perception (Toda, 2003, p. 71), so this may be one of the reasons for the errors in production.

In the area of L2 acquisition and cross-linguistic speech perception, there are studies investigating the perception of length contrast in foreign learners of Japanese e.g. native speakers of Modern Standard Arabic (Tsukada, 2012), Thai, English, Italian (Tsukada et al., 2014). Importantly, previous research has established that the perception of Japanese vowel length in foreign learners may be influenced, among other factors, by lexical accent of the Japanese word. Specifically, Minagawa-Kawai et al. (2002) investigated the effects of Japanese lexical accent on the perception of vowel length in Korean and English learners of Japanese. As far as we are aware, there has not been any research concerning the effects of lexical accent on the perception of Japanese vowel length, or perception of Japanese vowel

[1] Standard Croatian, the official language of Croatia, is a South Slavic language, belonging to the Indo-European group of languages. It is a variety of Standard Štokavian which is also used in the neighboring countries of Bosnia, Montenegro, and Serbia. Croatian is unrelated to Japanese, which is classified as belonging to the Japonic language family.

[2] Pitch-accent languages are languages where each accented word includes a distinctive high tone (Mandić, 2007, p. 88). In Croatian, a high tone can be associated with only one mora, whereas in Japanese, a high tone can be spread to multiple morae (Mandić, 2007, p. 88).

[3] For the pronunciation of moraic nasal /N/ by Croatian students, see Špica (2021).

length contrast in Croatian learners (or any other variety of Standard Štokavian), or contrastive studies into pitch-accent systems[4] of the two languages (Srdanović & Špica, 2022, pp. 114-121). Hence, the present paper aims to shed some light on these problems. The findings can be relevant not only for Japanese language acquisition, but also for contrastive linguistics, cross-linguistic speech perception, and broader area of phonetics.

The following section of the present paper briefly describes the lexical prosody of Japanese and Croatian focusing on vowel length and pitch accent and offers a contrastive account of the two languages. Section 3 introduces the relevant previous research after which Section 4 lists the research questions regarding the expected error rates in identifying vowel length and research method. Analysis and discussion are presented in Section 5, while Section 6 offers a conclusion.

2 Lexical accent in Japanese and Croatian

In this chapter, we offer a contrastive analysis of the Japanese and Croatian lexical accent patterns, with a focus on monosyllabic and bisyllabic words. It will help us draw inferences on the error rates, i.e. extent of difficulty the Croatian students face in identifying a long vowel.

2.1 Prosodic units and phonological length

Mora is a basic unit of Japanese prosody. Importantly, it is different from syllable since a syllable may contain one or two morae: e.g., 琴 *koto* 'koto, type of a music instrument' has two syllables ko-to and two morae *ko.to*, whereas 孤島 *kotoo* 'isolated island' also has two syllables ko-too but three morae *ko.to.o*.[5]

In Croatian, the basic unit of prosody is a syllable. A long vowel is assumed to include two morae (Inkelas & Zec, 1988; Mandić, 2005). Thus, the accented syllable in *more* /môre/ [mô:re] 'sea' or *soda* /soda/ [sŏ:da] 'soda' is considered to have 2 morae. A major difference between the two languages is that Japanese is a mora-timed language (Otake, 2015, p. 493),

[4] As for literature in Japanese, Hattori (1981) discusses the 4 prosodemes in Serbo-Croatian.

[5] A dot is used to mark a boundary between morae, and a dash between syllables.

whereas Croatian is considered to be a syllable-timed language (Josipović, 1994, p. 35).

In Japanese, vowel length is contrastive, as shown in the minimal pair 琴 *koto* 'koto, music instrument' and 孤島 *kotoo* 'isolated island'. Vowel length is contrastive in Croatian as well, 1-syllable words, e.g. *tek* /tȅk/ [têk] 'only' vs. *tek* /têk/ [tê:k] 'appetite'; bisyllabic words, e.g. *duga* /dȕga/ [dûga] 'barrel stave' vs. *duga* /dúga/ [dŭ:ga] 'rainbow'; trisyllabic words, e.g. *kupiti* /kȕpiti/ [kûpiti] 'collect' vs. *kupiti* /kúpiti/ [kŭ:piti] 'buy'.

Notably, the functional load of the vowel length contrast in Standard Croatian is lower than in Japanese – there are only a handful of examples where only length is contrastive in Croatian between different lexical words. However, there are many cases where the accent plays a role in morphology. Such words may include a distinctive length which is often combined with another prosodic feature, i.e. different pitch and/or post-tonic length (see Section 2.3 below). For example, *žena* /žèna/ [žěna] 'woman (nom. sg.)' involves short-rising accent (see Section 2.3 below) on the initial, stressed, syllable while *žena* /žénā/ 'women [žě:na:] (gen. pl.)' involves long-rising accent on the initial, stressed syllable and post-tonic length on the final syllable; *sjedi* /sjèdī/ '(s)he sits' has short-rising accent with post-tonic length whereas *sjedi* /sjȅdi/ 'sit (imperative)' has short-falling accent; *zelen* /zèlen/ [zělen] (SR) 'green' adjective, nom. sg. masc., contrasts with *zelen* /zèlē̵n/ [zêle:n] 'vegetables (for soup)' noun.

2.2 Lexical accent in Japanese

Word accent is free. Every mora in a word has either high (H) or low (L) pitch. Accent is placed on the high mora after which the pitch falls, i.e. H the sequence H˥L. Accented ones include accent nucleus, i.e. the sequence HL. Once the pitch falls, it does not rise again in the same word. Words in which the pitch does not fall are unaccented or flat. Unaccented words are sometimes marked by a small circle at the end of a word (see Labrune, 2012) and such notation will be followed here to avoid ambiguity, e.g. 飴 *a.me*° 'candy' LH. For accented words, ˥ marks the last high mora in a word, e.g. 雨 *a˥.me* 'rain' HL. The first two morae putatively have a different pitch – either HL, when the accent is on the first mora, or LH (the latter characteristic is called the initial lowering rule (Haraguchi, 1977, cited in Tsujimura, 2014, p. 30)). Hence, it follows from the above that patterns *LLH, *HHL, *HLH cannot be found in Japanese (i.e. Tokyo dialect).

The difference between the pitch of the first low and second high mora (LH) is not prominent and can be clearly perceived only if a word is pronounced in isolation. Furthermore, this difference in pitch is virtually inexistent when the first two morae comprise a long vowel, i.e. have the form (C)V+V. Kawahara (2015, p. 449) states that when the initial syllables contain a long vowel e.g., 東京 *To.o.kyo.o*° LHH 'Tokyo', they can be pronounced with HH without initial lowering (Tsujimura, 2014, p. 86; Kubozono, 2018, p. 157). Description of the same effect is found in the prescriptive dictionary of Japanese accent (NHK, 2016, p. 9). Hence, a word-initial LH with a long vowel can be considered as equivalent to HH.

As for the nouns, McCawley (1968, p. 138) (quoted in Kawahara, 2015, p. 448) points out that the number of their accent patterns is n+1, where n is the number of morae in the word. For example, the monomoraic word *ha* has two meanings depending on the pitch: 葉 *ha*° L 'leaves' vs. 歯 *ha*˥ H 'teeth'. The pitch of a monomoraic word (generally speaking) cannot be determined unless e.g. a nominative particle *ga* is added: 葉が *ha.ga*° LH (flat) 'leaves-NOM'), unaccented, vs. 歯が *ha.˥ga* HL 'teeth-NOM', accented. The following bimoraic bisyllabic words have 3 different pitch patterns: 牡蠣 *ka.ki*° LH 'oyster' vs. 柿 *ka.˥ki* HL 'kaki-fruit', vs. 垣 *ka.ki˥* LH 'fence' (cf. *ka.ki˥-ga* LHL 'fence-NOM'). Three-moraic words have 4 types of pitch accent: unaccented 空手 *ka.ra.te*° 'karate' accent on the first mora 花火 *ha˥nabi* HLL 'fireworks', accent on the second mora 心 *ko.ko.˥ro* LHL 'soul', and accent on the third mora 頭 *a.ta.ma˥* LHH 'head' (cf. *a.ta.ma˥ga* 'head-NOM'). As for verbs and adjectives, pitch patterns are more restricted, and will not be of concern here.

2.3 Lexical accent in Croatian

Croatian lexical accent is basically free, although it is rarely found in the final position. It is closely related to high pitch. A high pitch can be on the accented syllable, toward its beginning, in which case it is realized as a falling accent. Alternatively, if the pitch on the first syllable after the accented one is high, the accented syllable is rising. The four prosodemes combine the rising or falling tone pattern with the length (short or long). They are traditionally called short-falling (SF), long-falling (LF), short-rising (SR), and long-rising (LR). Apart from the four prosodemes, traditionally described as four accents on the stressed syllable, there is post-tonic or post-accentual length.

There is extensive body of research on the accent system of Standard Štokavian, including phonetic measurements (Lehiste & Ivić, 1963; Lehiste & Ivić, 1986; Ivić, 1994; Langston, 1997; Pletikos, 2003, 2008; Škarić, 2007; Kapović, 2015; Pletikos Olof & Bradford, 2019b; Martinović, 2020; Rajle et al., 2020; Martinović et al., 2021; Pletikos Olof et al., 2023; Kapović, 2023). Some studies also provide an account of Croatian accent from the viewpoint of sociolinguistics (Kapović, 2018).

The four prosodemes are shown in Table 1 below, including examples, traditional diacritics, and IPA notation.

Table 1: The four Croatian prosodemes

SF (short-falling)	LF (long-falling)	SR (short-rising)	LR (long-rising)
koma	more	kasa	soda
kòma	môre	kàsa	sóda
[kôma]	[mô:re]	[kằsa]	[sŏ́:da]
‘coma’	‘sea’	‘register’	‘soda’

Phonologically, short-falling accent *koma* /kòma/ [kôma] ‘coma’ is H.L, while long-falling *more* /more/ [mô:re] ‘sea’ is HL.L. On the other hand, however, researchers do not necessarily agree on what the most suitable phonological representation would be for the rising accents. Some approaches contend that the accent is a rising accent when the high tone is on the first syllable after the accented one, i.e. in rising accents, a high tone comes only after the low one. For example, a word including a long-rising accent *glava* /gláva/ [glă̋:va] ‘head’ is analyzed as LL.H (Mandić, 2007, p. 79). The same approach would analyze a bisyllabic word involving a short-rising accent *kasa* /kàsa/ [kằsa] ‘register’ as L.H. Other approaches contend that the high tone spreads from the syllable under the rising accent to the next one (e.g. Kapović, 2023, p. 244).[6] Thus, the two approaches would represent a long-rising accent, e.g. *soda* /soda/ [sŏ́:da] ‘soda’ (LR), as LL.H and HH.H respectively. For the purpose of this paper, the latter stance provides a somewhat more convenient viewpoint.

[6] There are also approaches according to which rising tones are characterized by the fact that post-tonic syllables have a higher tone than post-tonic syllables in the falling tones (see Pletikos, 2003).

Another remark regarding the phonetic properties of the rising accents is in order. Words with SR or LR accent pronounced in isolation or at the end of a sentence often have the final tone lowered. Inkelas and Zec (1988, p. 240), introduce the Final Lowering rule which neutralizes the difference between short-falling and short-rising, e.g. *vatra* /vȁtra/ 'fire' and *voda* /vòda/ 'water', when the latter is in citation form. As the pitch on the second syllable in such case can be considered to be lower than the one on the previous syllable, it would be more accurately represented as H.L, e.g. *kasa* /kàsa/ 'register' than H.H. Similarly, the long-rising accent, e.g. *soda* /soda/ [sŏ:da] 'soda' in isolation would be, arguably, more accurately represented as HH.L than HH.H[7]. As will be discussed in Subsection 2.5, the long-rising pattern HH.L may bear resemblance to one of the patterns of Japanese test words used here.

As mentioned above, the distinction in quantity is reflected not only in a stressed syllable but also in syllable(s) that follow. Distinctive post-tonic length (or post-accentual length) is marked by macron in dictionaries: *idem* /ȉdēm/ [idě:m] 'I go', *kolač* /kòlāč/ [kǒla:č] 'cake'. A word can have multiple post-tonic lengths, e.g. *beskrajnost* /bȅskrāj̄nō̄st/ [bêskra:jno:st] 'infinity'. If enclitics are counted, there can be as many as five (Kapović, 2023, p. 244). There is no length before the stressed syllable in the Standard Štokavian.

The four accents and post-tonic length can occur on any of the five vowels /a e i o u/ and syllabic /r/. The accent is basically free, but rising accents cannot occur in the final position.

Many speakers of Croatian (especially in urban areas such as Zagreb or Rijeka) do not use Standard Croatian pitch accent described above, but dynamic stress accent instead. It does not involve tone, and it is often even without length contrast. Even though the stress accent does not conform to the accent norm of Standard Croatian, it has higher prestige. Reportedly (Pletikos Olof & Bradfield, 2019b, p. 1), it is assessed that 40-50% of speakers use a pitch accent system with four accents, e.g., in the regions of Slavonia and Dalmatia.

[7] The rising pitch in SR words is seen e.g. when they are inflected, e.g. in *kasama* /kàsama/ 'register' (dat. pl.) H.H.L, but trisyllabic contexts are out of the scope of this paper.

2.4 Phonetic measurements of long vowel duration

Regarding phonetic measurements of the duration of each of the four Croatian accents and post-tonic length, Pletikos (2003, p. 321) reports that a stressed vowel with SF accent lasts from 80 to 140 ms (115 ms on average), whereas SR lasts around 109%, LF 234%, and LR 243% of the duration of SF.[8] As for bisyllabic words, the boundary for the category of short-falling accent is reported to be at 118 ms, whereby durations of up to 108 ms are perceived as belonging to the correct SF category, and durations of 128 ms as too long (Pletikos Olof et al., 2023, pp. 361-362, quoting Bakran, 1988).

More recent studies show different measurements. Regarding the duration of each of the prosodemes in the pitch-accent (tone) system as opposed to the dynamic system, it is reported (Pletikos Olof & Bradfield, 2019b, p. 3) that the speakers who use tones have the greatest length contrast, averaging 161 ms for LF and 150 ms for LR compared to 110 ms for SF/SR. It follows that, according to this study, long-falling is 1.46 longer than short-falling or short-rising, while long-rising is 1.36 times longer. The same research reports that dynamic speakers with length have significantly shorter long vowels than speakers with tones.[9] This fact is important because it indicates that, in Croatian, the presence or absence of the tone has an effect on vowel duration.

As for Japanese, the duration ratio between phonemically long and phonemically short vowels in the corpus is said to be smaller than in laboratory experiments (Shaw & Kawahara, 2017). Laboratory speech recordings claim that this ratio is between 2.4 and 3.2 (Han, 1962; Hirata, 2004; Tsukada, 1999; quoted in Shaw & Kawahara, 2017). However, the corpus study discovered that long vowels are just between 1.6 (for /a, e, u/) and 1.9 times longer (for /i, o/).[10]

[8] A phonological post-tonic short vowel lasts around 40-80% of the duration of a stressed vowel, and a long post-tonic vowel lasts 80-180% of the duration of a stressed vowel (Pletikos, 2003, p. 321).

[9] As for the boundary between LF and SF, it occurs at 147 ms, whereas in bisyllabic words, the boundary is at 118 ms (Pletikos Olof et al., 2023, p. 1, citing Mildner & Lisker, 1987, and Bakran, 1988).

[10] For a more detailed overview of research in Japanese phonetics and phonology, the reader may refer to Labrune (2012), Kubozono (2018), Kubozono (2015), and others.

Compared to the ratio of short and long vowels in Japanese, i.e., 1.6 for /a, e, u/ and 1.9 for /i, o/ mentioned above, it is observed that according to the reference above (Pletikos Olof & Bradfield, 2019b, p. 3), the highest ratio of long and short in Croatian (1.46) is lower than the lowest in Japanese (1.6).

2.5 Pitch patterns of the two languages contrasted

In this subsection, we will consider lexical prosodic properties of Croatian bisyllabic words and contrast them with lexical accent patterns in Japanese.

Short-falling accent (SF): can be found on the initial syllable of bisyllabic words as in *koma* /kòma/ [kôma] 'coma'. Words with such lexical accents are perceptually quite similar to the Japanese, as they have a pitch pattern H.L, e.g. 独楽 *ko.ꜜma* 'top (children's toy)'. SF in monomoraic words involves a falling contour, unlike Japanese monomoraic words which are rather flat. In bi- or multimoraic words, the stressed syllable has high tone. Hence the similarity to H.L in Japanese. As for distribution, SF rarely occurs occur in the word-final position.

The following example has post-tonic length on the second syllable: *vidi* /vìdī/ [vîdi:] '(s)he sees' (3rd person present) H.LL.[11] It has a tone pattern resembling that of the Japanese 技能 *gi.ꜜno.o* H.LL 'skill', with two morae in a low tone.

Long-falling accent (LF): In bisyllabic words such as *more* /môre/ 'sea' HL.L we find a long-falling accent on the first syllable. Japanese words such as 経費 *ke.ꜜe.hi* HL.L 'expenses' have a similar prosodic structure. LF is not common at the final position of a word, i.e. on the second syllable of bisyllabic words, but nonetheless there exist some, especially among loanwords – e.g. *tablo* /tablô/ L.HL 'tableaux'. Its contour has similarities to Japanese 化粧 *ke.shoꜜ.o* L.HL 'makeup'.

Short-rising accent (SR): In a non-isolated bisyllabic word with SR, e.g. *voda* /vòda/ 'water', high tone spreads from the first to the next syllable so the pitch is H.H, especially in the context of a sentence. However, the acoustic impression of this pattern is quite different from the unaccented pattern in Japanese (また *mata*° 'again' L.H) due to the effect of other factors, such as stress.

[11] According to Kapović (2023, p. 246), such length after SF is preserved in Osijek, Split, Zadar, and Šibenik, but in many other urban areas it is mainly lost.

Long-rising accent (LR): We will consider Croatian bisyllabic words with LR, such as *duga* /dúga/ [dŭ:ga] (LR) 'rainbow', *ruka* /rúka/ [rŭ:ka] (LR) 'hand' in the context where their final syllable is lowered, i.e. HH.L. It is contended that this pattern is phonetically similar to the Japanese pattern LH.L with a long vowel in the first syllable due to the fact that the initial long vowel in accentless is also flat, and can thus be represented as HH.L as well. Incidentally, bisyllabic words with a long vowel on the initial syllable and and with a pitch pattern LH.L do not exist in Japanese. Thus, in the present research, pseudo words are used instead, as did Minagawa-Kawai et al. (2002).

Table 2 shows lexical accent patterns of Japanese bimoraic bisyllabic words (i.e. without length) contrasted with Croatian.

Table 2: bisyllabic words with 2 morae

	Pitch pattern	Japanese	Croatian
1	L.H	また ma.ta° 'again'	/
2	H.L	独楽 koˈ.ma 'top'	*koma* /kǒ.ma/ [kôma] 'coma'

Table 3 shows the lexical accent patterns of Japanese bisyllabic words with the long vowel in the word-initial position (long vowel initial: LVI) compared to Croatian. The underlined part of the pattern indicates the position of a long vowel in a word (LH.H means that the long vowel is in the initial syllable).

Table 3: bisyllabic trimoraic words with the long vowel in the word-initial position (LVI)

	Pitch pattern (LVI)	Tone type	Japanese	Croatian
1	LH.H	flat	氷 ko.o.ri° 'ice'	/
2	HL.L	contour	賞美 shoˈ.o.bi 'prise'	*more* /mô.re/ [môre] 'sea'
3	LH.L	flat	そうだ* so.oˈ.da*	*soda* /só.da/ [sŏ:da] 'soda'

*pseudo-word, used to fill the gap

Next, Table 4 shows the lexical accent types of Japanese bisyllabic words with the long vowel in the word-final position (long vowel final: LVF) compared to Croatian.

Table 4: bisyllabic words with the long vowel in the word-final position (LVF)

	Pitch pattern (LVF)	Tone type	Japanese	Croatian
1	L.HH	flat	多幸 ta.ko.o° ‘fortunate’	/
2	H.LL	flat	理性 ri.˥se.e ‘ratio’	*vidi* /vidȉ/ [vîdi:] ‘she sees’
3	L.HL	contour	化粧 ke.sho˥.o ‘makeup’	*tablo* /tablô/ [tablô:] ‘tableaux’

Of the six patterns presented in Table 3 and Table 4 above, two with flat accent (LH.H and L.HH) do not exist in Croatian and one (LHL) does not exist in Japanese.

Pitch patterns of monosyllabic words in Japanese and their possible counterparts in Croatian are of relevance, too. Monomoraic words in Japanese have only a flat tone, either high or low, e.g. 葉 *ha*° L ‘leaves’ or 歯 *ha*˥ H ‘teeth’. On the other hand, Croatian monomoraic words necessarily involve a short-falling accent i.e. a falling contour, e.g. *pas* /pȁs/ ‘dog’ (SF). Notably, a short-falling accent placed on monomoraic words is different from SF on bisyllabic bimoraic words such as *kuća* /kùća/ ‘house’ HL, where two distinct syllables have different pitch and neither of them separately involves a contour, much as it is the case in Japanese, e.g. 独楽 *ko.˥ma* ‘top (children’s toy)’ HL. Japanese bimoraic words with a long vowel may be accentless as 能 *no.o*° ‘Noh drama’ LH, or accented as 党 *to˥.o* ‘political party’ HL. As 1-syllable words in Croatian involve only falling accents, when the vowel is long, the accent is long-falling, e.g. *to* tô [tô:] ‘it, that’ (LF). The pitch pattern of Japanese 党 *to˥.o* ‘political party’ is virtually the same as *to* tô [tô:] ‘it, that’ (LF) in Croatian. These facts may play a role in the perception of Japanese vowels by Croatian listeners. Namely, in Japanese monosyllabic words, a falling contour HL implies the presence of two morae, whereas in Croatian this is not necessarily the case. Accents patterns of 1-syllable words are presented in Table 5 below, showing that three Japanese flat patterns do not have their counterparts in Croatian, whereas Croatian SF does not have its counterpart in Japanese.

Table 5: 1-syllable words contrasted

No. of morae	Tone type	Japanese	Croatian
1	Flat, L	ha° 葉 ‘leaves’	/
1	Flat, H	haˀ¹ 歯 ‘teeth’	/
1	Contour, HL	/	pȁs [pâs] ‘dog’ (SF)
2	Flat, LH	no.o° 能 ‘Noh drama’	/
2	Contour, HL	toˀ¹.o 党 ‘political party’	tô [tô:] ‘that’ (LF)

In fast speech though, there seems to exist a context, where the accent pattern of a Japanese mora is perceived as quite similar to Croatian SF. An example is *pa* in the loanword *suruˀ¹upasu* スルーパス [sɯrɯ:pasɯ̟] LHLLL ‘through pass (a type of a passing technique in soccer)’. The example is presented from a Youtube video.[12]

3 Previous research

Findings from the previous research show that Japanese lexical accent of Japanese words influences the perception of words. Minagawa-Kawai et al. (2002) investigated Japanese language learners whose native language was English or Korean and revealed that both groups of students showed similar effects of pitch and syllable position. Namely, when the long vowel was in the final position, the error rates were the highest for pattern HLL, followed by LHL, while LHH had the least errors in both groups. On the other hand, when the long vowel was in the initial position, the error rates were highest for pattern LHH, while rates for HLL and LHL were quite similar. The major finding was that HLL with length at the end of the word had the most errors by far, more than 40% for Korean and Almost 50% for English listeners,

[12] The relevant word is found in Panda bros. (2022, December 31) at 3:25-3:27 minutes in the sentence: こういう風に滑らしてスルーパスとか出したりとか。 *Kō iu fū ni suberashite, surū pasu toka dashitari toka*. ‘You make (the football) roll like this and shoot a through pass’.

whereby in all other pitch patterns combined with the two positions, the error rates did not exceed about 20%. This is shown in Figure 1 below.

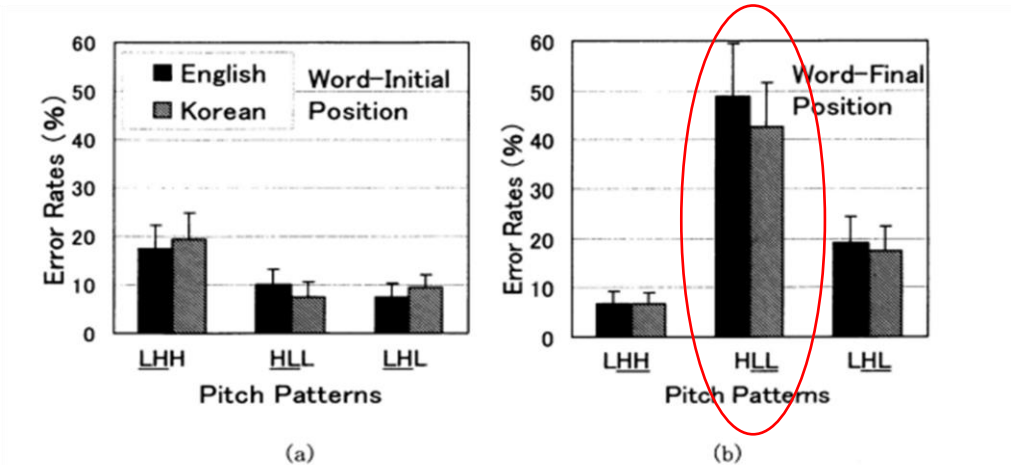

Figure 1: Korean and English JPL (Minagawa-Kawai et al., 2002, p. 89)

There is an important difference in the methodology used in the present experiment, and the one conducted by Minagawa-Kawai et al. (2002). Namely, in Minagawa-Kawai et al. (2002), the test words were pronounced by actual speakers, whereas in the present research they were artificially synthetized, which arguably made them more difficult to perceive and identify the long vowel. As for the present study, the values for long vowels in the initial position were 190–230 ms, and 230–310 ms in the word-final position.

Minagawa-Kawai et al. (2002) used thirty-six test words, thirty of them including a long vowel (five words for each of the six combinations) and six without. Out of thirty-six words, thirteen were pseudo-words, eight of which were used to check if the familiarity of a test word would influence the result. As for the measurements, the test words had a duration of about 210–240ms in word-initial long vowels, and about 250–300 ms in word-final long vowels.

4 Outline of the experiment

4.1 Research questions

We will now formulate the hypotheses about the Croatian listeners' perception of long vowels in Japanese to be tested.

1. Pitch pattern HLL will have the highest error rates compared to all five remaining patterns because the length is on the low pitch.
2. A flat long vowel in the initial position e.g. *そうだ *so.o*˥*.da* (LHL=HHL), will have higher error rates than one that involves a contour e.g. 経費 *ke˥.e.hi* (HLL) 'expense', will be easier to identify compared to a flat long vowel, due to general perceptual bias which causes the listener to perceive contour longer than a flat tone.
3. A long vowel in the final position will be easier to identify if it involves a contour e.g. 化粧 *ke.sho˥.o* (LHL) 'makeup' than if it involves a flat long vowel with a low tone as in 技能 *gi.˥no.o* (HLL) 'skill' due to general perceptual bias which causes a listener to perceive contour longer than a flat tone, especially when it is low.
4. Regardless of the pitch pattern, a long vowel in the initial position will generally have higher error rates because, in Japanese, a long vowel is usually articulated with longer duration compared to non-final long vowels (in case hypothesis 1 above regarding HLL is true, it would be an exception).
5. Error rates of a long vowel in a final position will be higher when the vowel is realized in a low pitch (HLL) compared to the one in a high pitch (LHH).
6. A group with experience in learning Japanese is expected to have fewer errors than one with no prior knowledge of this language, regardless of the pitch pattern and syllable position.
7. Table 3 and Table 4 in Section 2 above showed that flat pitch patterns LHH and LHH, found in Japanese, are not found in Croatian. A prediction could be made that these patterns would be difficult for Croatian listeners to identify.

4.2 Method

The aim of the experiment was to investigate the perception of bisyllabic Japanese vowel length in Croatian native speakers – students (i.e. learners) of Japanese (JPL) and students without any prior knowledge of this language (NonJPL), thirty in each group. The factors observed were pitch pattern, the position of a long vowel in a word, having experience of learning Japanese, and whether participants' speech involves a tone or a dynamic accent system.

The experiment was conducted following the methodology used in Minagawa-Kawai et al. (2002). It was paper-based and administered during the class. JPL participants involved students of the 1st, 2nd, and 3rd year. For analysis, thirty answer sheets were chosen randomly, eighteen from the 1st year and six from the 2nd and 3rd year respectively. As a bisyllabic word long vowel can be in the initial or in the final syllable and can thus execute three different pitch patterns, it follows that there are altogether six possibilities (morae including the long vowel are underlined): LHH, HLL, LHL; LHH, HLL, LHL.

Participants were presented with a paper that included thirty-six bisyllabic test words: thirty with a long vowel and six without. For each pitch pattern with a long vowel, five words were used. Stimuli involving only short vowels were the only two possibilities, LH and LH, three of each pattern. For some of the pitch patterns, there are no actual bisyllabic words in Japanese (for pitch patterns LHL, and LHH when the long vowel is *i*). Pseudo-words were used to fill in the gap.

As for the choice of lexical items, attention was paid to choosing words that include two different vowels in each syllable. The general intention was to use items unknown to the students, although words 政治 *seeji* 'politics', 自由 *jiyuu* 'free(dom)' from the JLPT level 4 were included in the 2nd 3rd year curricula. Other words belonged to higher levels. Words of JLPT level N2-3 and not covered yet by the 3rd year students at the time of the investigation were: (氷 *koori* 'ice', 化粧 *keshoo* 'makeup', 通過 *tsuuka* 'passage', 始終 *shijuu* 'incessantly', 序数 *josuu* 'ordinal number'), JLPT level N1 (火星 *kasee* 'Mars', 経費 *keehi* 'expense', 理性 *risee* 'ratio, intellect', ムード *muudo* 'mood', 野党 *yatoo* 'opposition', 技能 *ginoo* 'skill', グレー*guree* 'gray') or not ranked by JLPT (左党 *satoo* 'left wing party', 多幸 *takoo* 'fortunate', 賞美 *shoobi* 'prize', カーゴ *kaago* 'cargo', ニート *niito* 'NEET, i.e. not in education, employment or training', 風化 *fuuka* 'banalize', 履修 *rishuu* 'enrol', 処遇 *shoguu* 'treatment', 五パー *gopaa* 'five percent'). In addition, there were 6 pseudo words (*みいご *miigo* LHH, *そうだ *sooda* LHL, *じいさ *jiisa* LHL, *ケール *keeru* LHL, *ナーギ naagi LHL, *ハート haato LHL). The reason why the focus was not on choosing unknown words exclusively was the fact reported in the previous research (Minagawa-Kawai et al., 2002, p. 90) that there was no difference whatsoever in the error rates between the words and non-words in the same type of test they conducted. As will be seen in the results, the effect of the group, i.e. experience in learning Japanese, has considerably lower statistical significance than the effect of pitch pattern and syllable position, implying

that students' familiarity with Japanese words and their meanings is not crucial for students' judgment.

At the beginning, the participants were asked to fill in the questionnaire including their year of study of the Japanese language, and their native variety, and to choose from the list the urban area to which they consider their native dialect is closest. Assessing the effect of the participants' dialect to their perception was not the main goal of this paper but the data were collected, nevertheless. The following cities were listed: 1.Bjelovar 2.Dubrovnik 3.Karlovac 4.Metković 5.Osijek 6.Pula 7.Rijeka 8.Sisak 9.Slavonski Brod 10.Split 11.Šibenik 12.Varaždin 13.Vinkovci 14.Vukovar 15.Zadar 16.Zagreb 17. Other (to be filled in). Before starting the test, the participants heard three pseudo words: with a long vowel on the initial and final position, and with no long vowel: *maa-ma, ma-maa,* and *ma-ma*. After that, they were given correct answers and were explained what to circle on the sheet.

Test words were generated by the Online Japanese Accent Dictionary (OJAD) with the permission of the authors.[13] Each of the thirty-six mp3 files was played to the students twice. There was a five-second pause between each test word to allow the time to answer. Prior to the experiment, the test was administered to two native speakers of Japanese from Kyoto, students of Japanese language education who resided in Pula temporarily. They answered without any errors. The experiment was held in the classroom, and the answers were submitted on a sheet of paper.

The two syllables of each word on the test sheet were written in capital letters, and, as the third possibility, *nema* 'none' was included. They were asked to circle the syllable they thought included a long vowel, or, in case they thought there was no long vowel, to choose 'none'. Figure 2 shows a part of the paper. For example, for the third test word below, *ke.sho*ˈ*.o* LHL 'makeup', they were supposed to circle SHO.

[13] For details about this resource, see Nakamura et al. (2013).

1	GI	NO	nema
2	JI	SA	nema
3	KE	SHO	nema
4	KA	SE	nema

Figure 2: Part of the test paper for participants of the experiment

As the test had three alternatives, there were two possible types of errors regarding long vowel perception: (1) when the length is not perceived and the participant chose 'none' and (2) when the length is perceived, but the wrong syllable is chosen. Only the first type of error, whereby the length was not identified in a word, was considered, after Minagawa-Kawai et al. (2002). The list of test words is in Tables 6, 7, and 8 below.

Table 6: Test words LVI (Long vowel in the initial position)

LHH	**HLL**	**LHL**
氷 ko.o.ri° 'ice'	経費 keˈ. e.hi 'expense'	*そうだ so.oˈ.da
* みいご mi.i.go°	賞美 shoˈ.o.bi 'praise'	*じいさ ji.iˈ.sa
風化 fu.u.ka° 'banalize'	ニート niˈ.i.to 'NEET'	*ケール ke.eˈ.ru
通過 tsu.u.ka° 'passage'	ムード muˈ.u.do 'mood'	*ナーギ na.aˈ.gi
政治 se.e.ji° 'politics'	カーゴ kaˈ.a.go 'cargo'	*ハート ha.aˈ.to

*pseudo-word

Table 7: LVF test words (Long vowel in the final position)

LHH	**HLL**	**LHL**
火星 kasee° 'Mars'	始終 shiˈ.ju.u 'incessantly'	五パー go.paˈ.a '5 percent'
多幸 takoo° 'fortunate'	野党 yaˈ.to.o 'opposition'	化粧 ke.shoˈ.o 'makeup'
履修 rishuu° 'enrol'	理性 riˈ.se.e 'ratio'	序数 jo.suˈ.u 'ordinal numeral'
左党 satoo° 'left-wing party'	サマー saˈ.ma.a 'summer'	自由 ji.yuˈ.u 'freedom'
処遇 shoguu° 'treatment'	技能 giˈ.no.o 'skill'	グレー gu.reˈ.e 'gray'

Table 8: Test words with short vowels only

LH	HL
籠 ka.go° ‘basket’	火事 ka¹.ji ‘fire’
宅 ta.ku° ‘home’	蛇 he¹.bi ‘snake’
杉 su.gi° ‘cedrus’	文字 mo¹.ji ‘letter’

5 Analysis and discussion

Figure 3 below shows the results of the experiment for all six combinations of pitch and syllable position. Blue color shows JPL, and orange NonJPL.

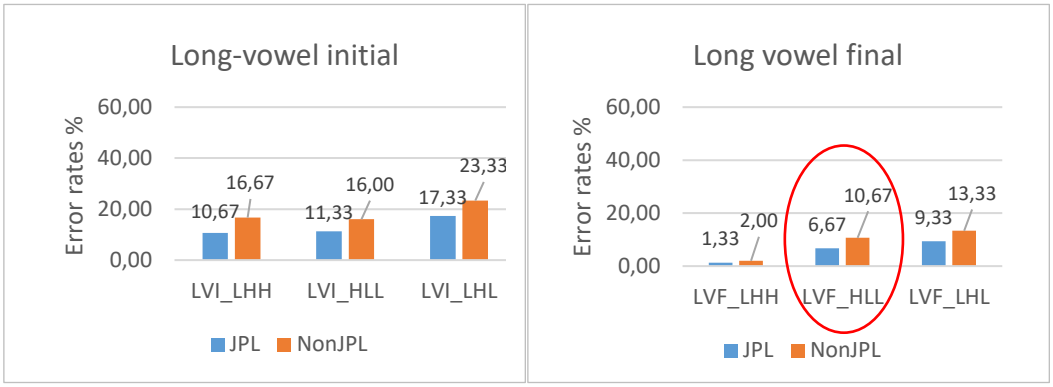

Figure 3: Errors rates of Croatian listeners

As for Hypothesis 1, that HLL will have the highest error rates, we can see it does not hold true. Figure 3 above shows that error rates for HLL were 6.67% for JPL and 10.67% for NonJPL, which is lower than error rates for LHL, which were 9.33% and 13.33% for both groups respectively. Further, error rates for HLL were even lower than rates for LHL, which amounted to 17.3% and 23.33%. Hence, the highest error rates were for pitch pattern LHL, for both positions of a long vowel, which is a striking difference from the previous research. A reason for this result could well be the presence of post-tonic length in Croatian, making it easier to identify the length of vowels with low tone.

As for Hypothesis 2, that a long vowel in the initial position would involve higher error rates when its pitch is flat than when it has a contour, the experiment showed that it holds true. Results have shown that JPL and

NonJPL had error rates of 11.33% and 16% respectively in words involving a contour HLL e.g. 経費 *ke˥e.hi* (HLL), whereas the two groups had error rates of 17.33% and 23.33% when the long vowel was flat *そうだ *so˥o.da* (LHL=HHL).

As for Hypothesis 3, in the final position, a long vowel will be easier to identify when it has a contour e.g. 化粧 *ke.sho˥.o* (LHL) 'makeup' than when it is flat and low 技能 *gi.˥no.o* (HLL), it does not hold true. As mentioned in the discussion about Hypothesis 1 above, one reason for faring well with pattern HLL is the presence of post-tonal quantity in Croatian. Interestingly, the error rates were higher for LHL than for HLL for both positions of the long vowel. This fact calls for an explanation. It could be the case that the HL sequence was confused with the short-falling accent in Croatian because it has a falling contour and because Japanese short vowels often sound shorter than short vowels in Croatian. Thus, a sequence of two Japanese short vowels might well sound like one short vowel to Croatian listeners with a dynamic accent, who is also shown to lack the length distinction (see Subsection 2.4. above).

Further, Hypothesis 4 is true: no matter the pitch pattern, a long vowel in the initial position has higher error rates than a long vowel in the final position. Figure 4 below shows that the error rates were higher in both groups when the long vowel was in the initial position for all three pitch patterns (LHH, HLL, LHL): JPL had 13.11% errors in LVI while NonJPL had 18.67%. In LVF, JPL had 5.78% and NonJPL 8.67, indicating that LVI was more difficult for both groups than LVF.

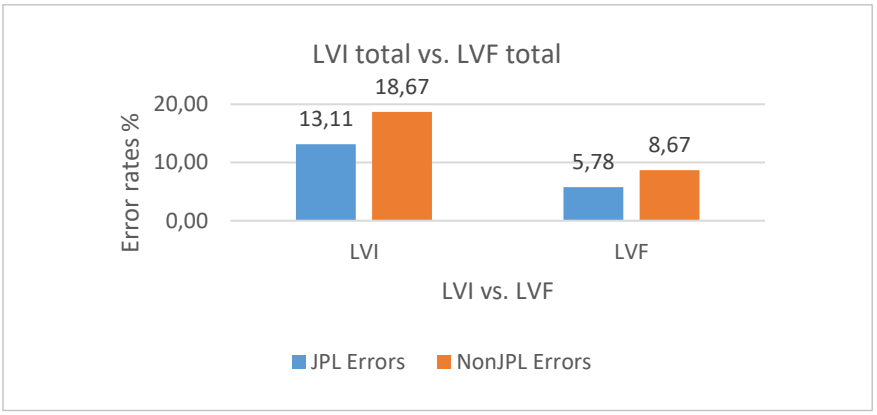

Figure 4: Total errors with respect to syllable position

Next, Hypothesis 5 has also proved to be true - error rates were higher for a long vowel in the final position with a low pitch (HLL) than a high pitch (LHH). One of the reasons would be the general perceptual bias which causes the listener to perceive high pitch as longer than low pitch of the same duration) i.e. 火星 *kasee* LHH 'Mars' is easier than 技能 *ginoo* HLL 'skill'.

Hypothesis 6, that learners of Japanese will fare better than those without experience, is true as well. Interestingly, the p-value, i.e. statistical significance of the group of < 0.05 is much lower than the significance of pitch and syllable position, both < 0.001. This means that, despite the fact that the two groups have quite different learning experiences, they have rather similar tendencies regarding error rates.

Finally, Hypothesis 7 proved not to be true. The patterns that do not exist in Croatian involving LHH and LHH were not the ones with the highest error rates. On the contrary, LHH had the least errors. The reason for this might be that other factors are at work. Notably, the above-mentioned general bias is that high-pitch vowels are perceived to last longer compared to low-pitch ones with the same duration. Both of these patterns involve high vowels, so the latter factor would presumably have a stronger effect on perception than unfamiliarity to the listeners. This is particularly clear from the fact that even those who never learned Japanese had a very small number of errors with LHH. This is shown in Figure 5 below. The error rates of words with pitch pattern LHH in both syllable positions. JPL has 10.67% in LVI position vs. NonJPL with 16.67%. LVF had low rates, below 2% for both groups, which means that LHH was the easiest pattern of all.

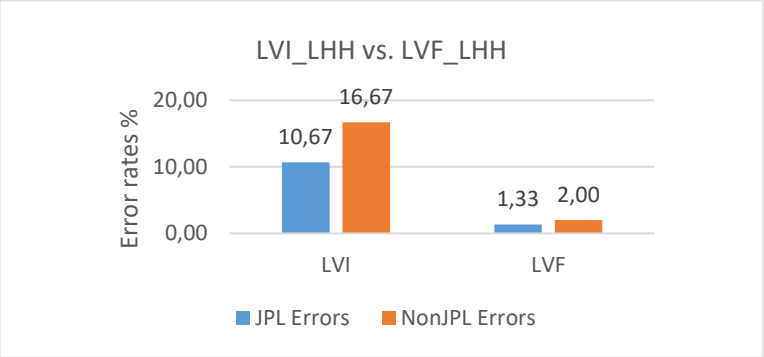

Figure 5: Errors for LHH in 2 syllable positions

Let us look at the data in more detail. Figure 6 below shows error rates of pitch pattern HLL in each syllable position. JPLs have 11.33% in the LVI position vs. NonJPLs with 16%. LVF had lower rates, 6% and 10.67%, for the two groups respectively, showing again that LVI was harder to identify.

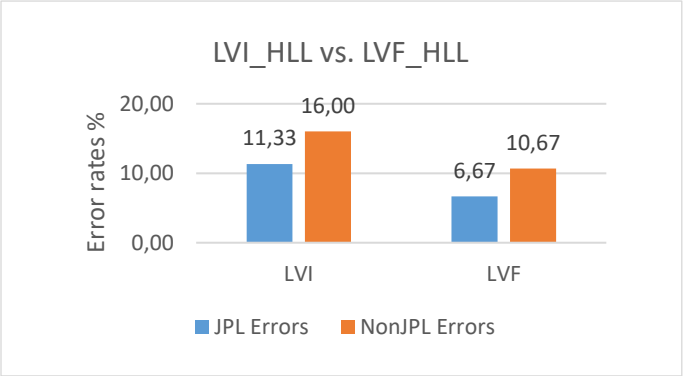

Figure 6: Errors for HLL in 2 syllable positions

Figure 7 below shows the error rates of words with pitch pattern LHL in both syllable positions. In the LVI position, JPLs have 11.33% vs. NonJPL with 16%. LVF had lower rates, 6.67% in JPL, and 10.67% in NonJPL, indicating the same tendency as in the cases above.

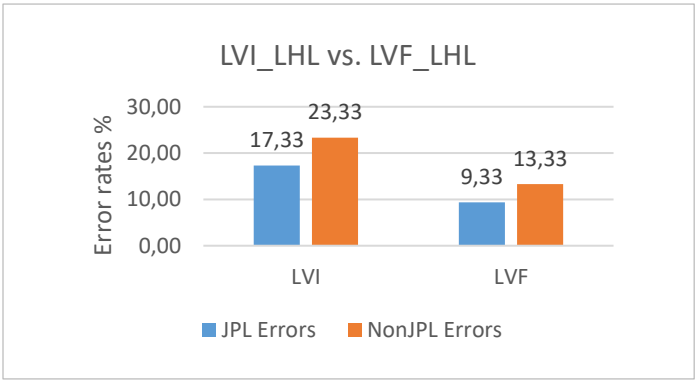

Figure 7: Errors for LHL in 2 syllable positions

Table 9 gives an overview of the total errors and error rates by groups. Expectedly, JPL had less incorrect answers than NonJPL. Out of 900 tokens, 85 were erroneously identified in JPL whereas the same number for NonJPL is 123, with a standard deviation of 2.9 for JPL, and 2.7 for NonJPL.

Table 9: Error rates by student groups

Total answers	900	Errors %	St.dev.
JPL errors	85	9.4%	2.9
NonJPL errors	123	13.6%	2.7

The results of the 4-way ANOVA test showed that syllable position has a highly significant effect on the score with $p < 0.001$, indicating a strong association. The statistical analysis showed that pitch is significant with $p < 0.001$. Also, the effect of group, i.e. JPL vs. NonJPL, is significant with a *p*-value less than 0.05. This suggests that the group variable has a significant main effect on the score, but not as significant as the pitch and position in a word. Students without any prior experience in Japanese had a very similar pattern of errors as Japanese language students.

As the fourth variable, the influence of the vernacular of the Croatian participants was observed. The differences in accent patterns in Croatia were not the major concern of this paper[14]. However, it might have been the case that the participants with a pitch accent (as opposed to a stress accent) in their native dialect identified Japanese vowel length better[15]. The analysis revealed, however, that with a *p*-value > 0.55 (0.6819), the presence of the pitch accent in one's native dialect or its absence did not have a significant main effect on the score. A more detailed investigation on this point should be conducted in the future though.

[14] Recent research shows that these two groups of Croatian listeners exhibit differences in the perception of Croatian words (Pletikos et al., 2023). It is assessed that more than half of the people in Croatia have a dynamic accent. However, in terms of the areal distribution, the majority of Croatia does have a pitch accent, as can be seen in the map showing the accent system distribution (Kapović, 2015, p. 50).

[15] It has also been established in the literature that apart from tone and dynamic, there is also a transitional accent system (without a short-rising accent) (Pletikos Olof & Bradfield, 2019a). However, in this research, the transitional type was not considered separately, one of the reasons being that the absence of an SR accent still leaves the speaker with tones and distinctive length.

6 Conclusion

This research offered an account of the perception of Japanese long vowels and the effects of lexical accents on perception. In the first part, the paper offered a contrastive analysis of lexical accents in the two languages with a focus on bisyllabic words. It was established that for the six possible patterns of bisyllabic words with length, five are found in Japanese (six if pseudo-words are included), and four in Croatian as it does not have unaccented prosodic words.

In contrast to the previous research, the present paper revealed that the pattern HLL did not pose the highest degree of difficulty for the Croatian listeners. The considerably lower error rates, both in Croatian JPL and NonJPL, are probably related to the existence of the post-tonal length. Even though it is disappearing, especially from urban centers, it is still perceived and as such presents an important factor in the research in sociophonetics and sociolinguistics in general.

Further, one of the most striking findings is that it was more difficult for both groups of Croatian listeners, in all three pitch patterns, to identify a long vowel in the word-initial position than in the final. The most difficult pattern, regardless of the length position, for both groups was LHL. The difficulty in identifying long vowels in the initial position, especially for LHL, can be explained by two factors. First, the long vowel in the initial position measured a shorter duration than the ones in the final position. Second, the contour has different meanings in the two languages. In Japanese, the falling contour (HL) implies a long vowel, whereas in Croatian, it can be found both in short and long vowels. This might have affected the Croatian listeners' perception. The findings related to JPL are relevant not only for L2 acquisition but also for studies in cross-language speech perception.

The results also suggested that there was no statistically significant difference between the students who have pitch accents and those who do not. However, given a relatively small number of participants, this result needs to be taken with caution. In addition, whether the accent for each student was tonic or dynamic was determined solely based on their self-report in the questionnaire, hence, a more detailed investigation into this question needs to be performed in the future. Also, the patterns involving trisyllabic and other multisyllabic words should be investigated.

Finally, it should be mentioned that the experiment might have yielded different results if the test words were not synthetized but pronounced by

actual speakers, and if a larger number of words with more variations in vowel combinations had been used for priming the participants before the main part of the experiment. Further research may shed some light on these issues.

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Abbreviations

H	high
L	low
SF	short-falling
LF	long-falling
SR	short-rising
LR	long-rising
LV	long vowel
LVI	long vowel initial
LVF	long vowel final
JPL	Japanese language learners
NonJPL	Non- Japanese language learners

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