# EFFECT OF MULTI-LINGUALISM ON THE PERCEPTION OF SHORT AND LONG VOWELS IN ARABIC AND JAPANESE

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## ABSTRACT

This study compared cross-language speech perception of vowel length contrasts in Arabic and Japanese by two groups of listeners whose first language (L1) was either Cantonese (C) or Korean (K). Unlike Arabic or Japanese, C and K do not use vowel length contrastively. One group (CK+J) had experience learning Japanese as a foreign language while the other (CK) did not. The question of interest was if Japanese learning experience separated the two groups in their perception of Arabic as well as Japanese vowel length contrasts. The effect of learning Japanese was negligible for CK+J who participated in this study. Further, it appeared that learning Japanese had a somewhat negative effect on the listeners' perception of Arabic contrasts. The pattern of results obtained may reflect a temporary and transient nature of listeners' interlanguage and has implications for adults' speech learning capabilities.

**Keywords:** multilingual, cross-language speech perception, vowel length, Cantonese, Korean

## 1. INTRODUCTION

Japanese and Modern Standard Arabic (Arabic, hereafter) have 5 (/i e a o u/) and 3 (/i a u/) vowels, respectively, and each of them can be either short or long, i.e., the length contrast is phonemic in both languages [3, 7, 9]. Non-native adult learners are known to face difficulty in perceiving Japanese vowel length contrasts [3]. Recent studies examined whether and to what extent native speakers of these quantity-sensitive languages might be able to utilize their L1 phonology and process vowel length contrasts in each other's language efficiently despite lack of knowledge of the target language [8]. A series of perception experiments demonstrated that the extent to which listeners' L1 knowledge is invoked depends on the experimental task among others.

Another question of interest and importance from the perspective of second (L2) and foreign language speech learning is the plasticity of individuals' long-term cognitive representations. In this study, we report how listeners who share their L1s (i.e., C or K) but who differ in their experience with a quantity-sensitive language (i.e., Japanese) identified the short and long vowels in Arabic and Japanese. C and K were selected as the subjects' L1s, because it is known that, unlike Arabic or Japanese, they do not use vowel length contrastively [4, 6, 10]. It was thus of interest to examine if learning Japanese influenced the listeners' cross-language speech perception measurably. Specifically, if CK+J learn to identify short and long vowels accurately in Japanese, one might expect the same listeners to exhibit this learning when they process length contrasts in an unfamiliar language (i.e., Arabic). Alternatively, their speech processing skills may only apply to the specific language they have learned. Results from native Arabic (NA) and Japanese (NJ) listeners as control subjects are also presented [8].

## 2. METHODS

### 2.1. Stimuli

Twelve pairs of Arabic words and 15 pairs of Japanese words contrasting in vowel length were used as stimuli in the identification experiment. The specific words recorded for this study are shown in Tables 1 and 2, respectively.

Due to phonotactic differences in the two languages, Arabic and Japanese tests words differed in their syllable structure. While this discrepancy is not desirable, the occurrence of the CVC sequence is quite limited in Japanese unlike Arabic. Furthermore, given that vowel length is neutralized in open syllables, including in word-final position [8], it was not an option to use CVCV words in Arabic to match the syllable structure across the two languages. Japanese uses two rhythmic units, i.e., *mora* and syllable. While

all the Japanese test words have two syllables, the test words containing a long vowel (or a moraic nasal 「ん」) have an extra mora compared to the test words containing a short vowel.

**Table 1:** Arabic words used in this study.

| V | Short | | | Long | | |
|---|---|---|---|---|---|---|
| | | | gloss | | | gloss |
| /i/-/iː/ | دِن | din | large jug | دين | diin | religion |
| | رِق | riq | slavery | ريق | riiq | saliva |
| | سِب | sib | swear | سيب | siib | leave |
| | زِر | zir | button | زير | ziir | large jar |
| /a/-/aː/ | بن | ban | coffee (beans) | بان | baan | to appear |
| | دم | dam | blood | دام | daam | to keep on |
| | سب | sab | to curse | ساب | saab | to leave |
| | شب | shab | young man (colloq.) | شاب | shaab | young man (standard) |
| /u/-/uː/ | دُب | dub | bear | دوب | duub | melt |
| | حُر | hur | free | حور | huur | women with beautiful eyes |
| | رُح | ruh | go | روح | ruuh | spirit |
| | سُم | sum | poison | سُوم | suum | negotiate the price |

**Table 2:** Japanese words used in this study.

| V | Short | | | Long | | |
|---|---|---|---|---|---|---|
| | | | gloss | | | gloss |
| /i/-/iː/ | 汁 | shiru | soup | シール | shiiru | sticker |
| | 来た | kita | came | 聞いた | kiita | listened |
| | ビル | biru | building | ビール | biiru | beer |
| /e/-/eː/ | 席 | seki | seat | 世紀 | seeki | century |
| | 世間 | seken | world | 政権 | seeken | govern-ment |
| | 駅 | eki | station | 鋭気 | eeki | spirit |
| /a/-/aː/ | 下部 | kabu | lower part | カーブ | kaabu | curve |
| | 角 | kado | corner | カード | kaado | card |
| | 後 | ato | later | アート | aato | art |
| /o/-/oː/ | 横 | yoko | side | 洋子 | yooko | girl's name |
| | 女子 | joshi | girl | 上司 | jooshi | boss |
| | のど | nodo | throat | 濃度 | noodo | density |
| /u/-/uː/ | 主人 | shujin | my husband | 囚人 | shuujin | prisoner |
| | 父兄 | fukee | parents | 風景 | fuukee | scenery |
| | 手記 | shuki | memoirs | 周期 | shuuki | cycle |

Test words (all real words) were presented visually to native speakers of each language (See **2.2. Speakers**) on the computer screen one word at a time. All words were written using appropriate Arabic or Japanese script which explicitly encodes vowel length in the standard orthography, so there was no ambiguity as to how each word should be read by mature, proficient native speakers. The Arabic and Japanese speakers were asked to read the target words naturally at their normal speaking rate. All speakers recorded the target words twice in isolation and once in a short carrier sentence in a sound-treated studio. The target words (digitized at 44.1 kHz) were segmented and stored in separate files. Prior to the presentation in the vowel length identification experiment, each sound file was normalized to 50% of the peak amplitude following the procedures used in previous research [1, 2]. The mean durational values of the short and long vowels in the stimulus tokens presented to the listeners were 95 ms and 213 ms (short/long ratio: 0.45) for Arabic and 74 ms and 175 ms (short/long ratio: 0.42) for Japanese, respectively.

## 2.2. Speakers

Native speakers of Arabic (4 males, 3 females) with a mean age of 40 years and native speakers of Japanese (4 males, 4 females) with a mean age of 25.4 years participated in the recording sessions lasting between 45 and 60 minutes. They participated in the study on the basis of availability at the time of recording. The Japanese speakers were recorded in a sound-treated room in the Department of Linguistics, University of Kobe, Japan. With the exception of one participant who had lived in the US for 11 months, none had lived overseas for an extended period of time. These speakers primarily came from the Western part of Japan including Ehime, Fukuoka, Hyogo, Kagawa, Kanagawa, and Tottori prefectures. Vowel length is phonemic to all these speakers.

The Arabic speakers were recorded in the Audio-Visual recording studio or the Centre for Language Sciences (CLaS) recording studio at Macquarie University (MQ), Sydney. They were all born in Arabic-speaking countries and had lived in Sydney, Australia for 12 years on average at the time of recording. The Arabic speakers' dialectal backgrounds were Lebanese (n=4) and Saudi (n=3). Vowel length is phonemic to all these speakers. All speakers were paid $30 (or the equivalent amount in Japanese yen) for their participation.

## 2.3. Listeners

Two groups of listeners participated as experimental subjects. They were included in the study as speakers of a quantity-insensitive language and spoke either Cantonese (C) or Korean (K) (but not both) as their L1. The two

groups (CK+J, CK) differed in their Japanese language learning experience. All were undergraduate students at MQ. CK+J (1 male, 6 females) were enrolled in 300-level Japanese language units. CK (3 males, 8 females) participated in the study for course credit in Linguistics units. They were in late teens or in early twenties.

Results from two additional groups of listeners who participated previously are presented for the purpose of comparison [8]. Their L1s were Arabic (NA: 3 males, 2 females) and Japanese (NJ: 1 male, 10 females), respectively. The NA listeners were postgraduate students or staff members at MQ. The majority of the NJ listeners were postgraduate students in the MA in the Translation and Interpreting course at MQ. According to self-report, all 4 groups of listeners had normal hearing and did not have any language deficiency in their L1s. Participants were tested in a session lasting between 30 and 40 minutes in the CLaS Speech Perception Lab in the Department of Linguistics or in a quiet room in the Department of International Studies, MQ. Except for the Linguistics undergraduate students who received course credit, all the participants were paid $20 for their participation.

### 2.4. Procedures

The experimental task used in this study was a two-alternative forced-choice identification test. Arabic (n=144) and Japanese (n=180) test words were presented with distractors such that the listeners would hear 200 tokens per language. The listeners were given two options ("XXX (X)", "X (X)") to choose from on the computer screen. They were asked to click on the first option if they thought that the "word" they heard had a long vowel and to click on the second option if they thought that the "word" they heard had a short vowel. The presentation of the stimuli and the collection of perception data were controlled by the UAB software [5]. The stimuli were blocked by language (Arabic, Japanese) and the order of presentation was counterbalanced across listeners.

The listeners were given 10 (5 Arabic, 5 Japanese) practice trials with feedback (i.e., as was intended by the native speakers who produced the words). This was intended to give the listeners an opportunity to "calibrate" the two length categories. The listeners had up to 3 seconds to respond to each token. When the listeners did not respond within 3 seconds, the message "Would you like to hear the previous stimulus again?" appeared on the screen. Thus, they were allowed to listen to each token as many times as they wished. However, they were cautioned not to use this option excessively, because listening many times would not always help and that they might get confused. They were asked to guess if they were unsure and no feedback was provided during the experimental sessions.

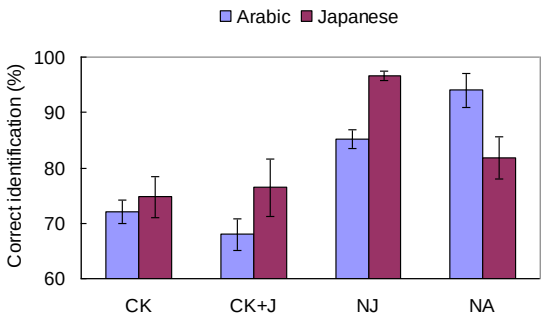
### 2.5. Analysis

Two-way repeated-measures analysis of variance (ANOVA) with Listener Group (CK+J, CK) as a between-subjects factor and Stimulus Language (Arabic, Japanese) as a within-subjects factor was conducted in order to compare listeners' identification accuracy for the vowel length category in the two languages. The dependent variable was the percentage of correct identification.

## 3. RESULTS

Figure 1 shows the mean correct identification scores by the CK with and without experience learning Japanese together with the results for the control NA and NJ listeners previously published.

**Figure 1:** Mean identification scores (%) by 4 groups of listeners for the Arabic and Japanese stimuli averaged across vowel types. The brackets enclose ± one standard error. NA and NJ listeners' data are from [8].




The control listeners were highly accurate in identifying the short or long vowels in their L1 (94% for NA and 97% for NJ), but less so in the unknown language (82% for NA and 85% for NJ). Somewhat surprisingly, CK+J did not show a clear advantage over CK in identifying the Japanese length category (76% vs. 75%). Furthermore, it appeared that learning Japanese had a negative effect on the CK+J group's perception of Arabic vowel length contrasts. Given that even the NJ

(85%) who are familiar with length contrasts identified the Arabic length category much less accurately than the NA (94%), this may simply indicate a limited transfer effect of L1 or L2 learning. However, it needs to be pointed out that the NA who had no knowledge of Japanese still outperformed the CK+J in identifying the Japanese length category (82% vs. 76%). Also, the finding that CK+J, but not CK, showed a clearly distinct pattern of responses to the two stimulus languages may reflect a developmental stage and a transient nature of their interlanguage.

As for a comparison between the CK+J and CK groups, only the main effect of Stimulus Language was significant [$F(1, 16) = 7.7$ $p < 0.05$]. As is seen in Figure 1, this was driven by the CK+J who identified the vowel length more accurately in Japanese (76%) than in Arabic (68%). The CK group's identification scores did not differ significantly according to the stimulus language (Arabic: 72% vs. Japanese: 75%).

## 4. DISCUSSION

This study compared how listeners who share the same L1 but differ in their previous linguistic experience identify short and long vowels in Arabic and Japanese.

The main finding was that native C and K listeners who learned a quantity-sensitive language (Japanese) did not have an advantage in identifying either Japanese or Arabic vowel length compared to listeners from the same L1 backgrounds who had never learned Japanese. This may be because CK+J were not experienced enough to acquire this difficult contrast yet. It is also possible that CK+J were not using the same cues as NJ and their incomplete knowledge of Japanese may have prevented them from outperforming CK who were free from foreign language "noise".

A question arises as to whether or not the between-group difference observed was due, specifically, to CK+J learning Japanese as the third language. In other words, if they had learned an additional language other than Japanese, would the pattern of results have been different? What if that additional language was Spanish, for example, which does not use vowel length contrastively? Another point for consideration is that the CK in this study were studying Linguistics, so they may have been more sensitive to different sound systems compared to other CK who had no experience with Japanese and/or Linguistics.

## 5. CONCLUSIONS

This study compared identification accuracy for short and long vowels in Arabic and Japanese by C and K listeners with and without knowledge of Japanese. While multilingual listeners with an additional foreign language may measurably differ from the listeners with the same L1 backgrounds, there was no evidence for a positive transfer effect in their cross-language speech perception. To gain a better understanding of plasticity in adults' speech perception and how it is related to their previous linguistic experience, it is necessary to examine many more listeners representing a wide range of language backgrounds.

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