

Phonetic variations of F0 range in L1 and L2:
a comparison between English and Japanese native speakers

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This study investigated the possible motivations behind differences in fundamental frequency (F0) range between first (L1) and second (L2) language speakers of English and Japanese.

Background In the literature, a number of studies have found significant differences in pitch range across languages (Ohala, 1983). With regard to L2 productions, several studies (Zimmerer *et al*, 2014; Mennen *et al*, 2012; Busà & Urbani, 2011; Ullakonoja 2007) have examined how F0 varies in L1 and L2 speech. They have identified that non-native speakers of a language consistently use a narrower pitch range than native speakers of that language. However, some other studies suggest that this L2 pitch range reduction does not always occur. Zimmerer *et al.* (2015) found that pitch range is not reduced in L2 productions of German and French. Furthermore, Aoyama & Guion (2007) found that Japanese L2 speakers of English utilize a wider pitch range than native English speakers.

Research question The object of this study was to carry out an analysis of the F0 range excursion in English and Japanese. The F0 range of native speakers was compared to productions uttered by English-speaking learners of Japanese (EJ) and Japanese-speaking learners of English (JE). We considered two competing hypotheses in investigating these cross-language pitch range differences. Our first hypothesis was that pitch range reduces in L2 speech regardless of the L1/L2 combination, possibly for reasons of a psychological nature (e.g., L2 productions might be influenced by uncertainty, speakers are too cautious when speaking L2). Our second hypothesis was that a speaker's L2 pitch range may transfer from their L1, which would imply that the differences in the pitch range used by speakers might be related to language-specific features of the speakers' native and target languages.

Methodology 10 L1-English/L2-Japanese speakers (5 male and 5 female) and 18 L1-Japanese/L2-English speakers (11 male and 7 female) took part in this study. Each speaker read 25 sentences consisting of declarative statements and four types of questions in both English and Japanese. Participants produced these sentences from both sound and written prompts. We analyzed the pitch of these productions with two measures: pitch level (median F0) and pitch range (the difference between 95th and 5th percentile) in semitones.

Results Data were analyzed by mixed-effects models. Results show that English speakers produced a significantly lower median F0 than Japanese speakers, while the F0 range did not differ significantly between the two languages. With respect to L2 production results, the analysis revealed that there was a significant interaction between Native language and Task language. The F0 range of English sentences produced by Japanese learners (JE) was significantly smaller than for English L1 speakers, and JE F0 range was also significantly smaller than Japanese L1 F0 range. However, the F0 range of native English speakers was wider in Japanese than in English--a finding which contradicts the hypothesis that speakers always contract their F0 range in an L2. It seems like the general pattern here is that L2 speakers are shifting their pitch range to be more like that of the L1 pitch range. A linear mixed-effects model investigated to what extent hearing a native speaker had an effect on pitch patterns produced by the L1 and L2 speakers. Results show that pitch range is expended when listeners respond to spoken prompts, rather than written prompt. This result can be explained by phonetic accommodation (Babel, 2009), and it can help explain some of the conflicting results in the previous literature (Zimmerer, 2014; Zimmerer, 2015; Aoyama & Guion, 2007).

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