Longitudinal acoustic analysis of /ɹ/ among Japanese returnee children

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Abstract

Japanese returnee children exhibit variations in their pronunciation of the English consonant /ɹ/ over a five-year period. Changes in their language environment are likely to influence early language acquisition. This study involves eight Japanese returnee children who were asked to describe the picture book "Frog, Where Are You?" The research compares the third fundamental frequency (F3) of the consonant /ɹ/ at three different times: immediately after the return, one year later, and five years later. The findings indicate that there is no positive correlation between changes in F3 and the duration of time since their return.

Keywords: Japanese returnees, acoustic analysis, longitudinal study

Introduction

Returnees are speakers who move (back) to their first language (L1) environment after having lived abroad for a certain period in an L2 majority language (Flore, 2010). This return migration typically constitutes a drastic reduction in exposure to the L2 and may lead to L2 attrition, as dominance in the second language diminishes in favor of the first language (Flores & Snape, 2021).

Native Japanese speakers often struggle to distinguish between the /ɹ/ and /l/ sounds in English. According to the Perception Assimilation Model (PAM) proposed by Flege in 1995, this difficulty can be attributed to the fact that both /ɹ/ and /l/ are assimilated into the Japanese /ɾ/ category, as their F3 frequency overlaps with those of the English /ɹ/ and /l/. Previous studies have reported a positive correlation between F3 frequency and /ɹ-l/ phoneme contrast. (Aoyama et al., 2004; Flege et al., 1995; Iverson et al., 2005; Shinohara & Iverson, 2021). In 1995, Fledge found that native Japanese speakers could not produce the distinction between /ɹ/ and /l/ as clearly as native English speakers, who had an average F3 frequency of 1750 Hz for /ɹ/ and 2854 Hz for /l/. In contrast, Japanese speakers did not show clearer F3 distinction, with an average of 2261 Hz for /ɾ/ and 2944 Hz for /l/. Furthermore, some studies explored the factors leading to the loss of contrast. Aoyama (2004) emphasized the age effect, discovering that children typically perform better than adults in

distinguishing the /ɹ-l/ contrast. In addition to age, prior research has also identified the influence of language environment. Kuhi et al. (2016) suggested that prolonged exposure to the Japanese language environment diminishes sensitivity to the critical F3 distinction for English /ɹ/ and /l/. More recently, Shinohara et al. (2021) employed a training method that demonstrated a positive effect, helping Japanese speakers improve their F3 distinction between /ɹ/ and /l/. Looking back on previous research it remains unclear how heritage children and returnees experience changes in their F3 distinction of the /ɹ-l/ contrast. This leads us to our research question:

How does F3 frequency change in the production of the English /ɹ/ in the *frog* among Japanese-English bilingual returnee children over five years? We hypothesize that there would be a correlation between F3 frequency and duration of return: the longer returnees have been back, the more their production of /ɹ/ may deviate from the standard F3 frequency, because of the L2 attrition. F3 values of /ɹ/ for the returnees would increase over time as they moved back to the Japanese environment and gradually lost phoneme contrast compared with the native speakers.

Methodology

For this study, we analyzed audio recordings from eight returnee children reported by Laméris et al. (2024). The audio recordings for these eight participants, measured at three-time points, consistently included the word "frog" across all recordings. The speech materials for analysis comprised 24 tokens (8 returnees × 3-time points). All their recordings were automatically saved as .mp3 files. We imported the relevant audio files and TextGrid files into Praat (Boersma and Weenink, 2019), and then extracted the F3 frequency of/ɹ/ in word *frog*.

All analyses were performed in R 4.2.2 (R Core Team, 2022). The independent variable in this study was the duration since the participants' return to Japan, categorized into 3-time points: immediately after return, one year after return, and five years after return. The dependent variable was changes in F3 frequency. A Pearson's correlation coefficient was computed to assess the relationship between time of return and F3 frequency across participants. The analysis revealed a Pearson correlation coefficient (r) of 0.035, indicating a very weak positive correlation. This correlation was not statistically significant, with a p-value of 0.868. The 95% confidence interval for the correlation coefficient ranged from-0.373 to 0.433. Figure 1 displays the individual changes in F3 values over time

Conclusion

The overall analysis showed no significant correlation between the duration of return to Japan and the F3 frequency of the /ɹ/ sound among Japanese returnee children. In future studies, we could increase the sample size and extend the duration of the experiment.

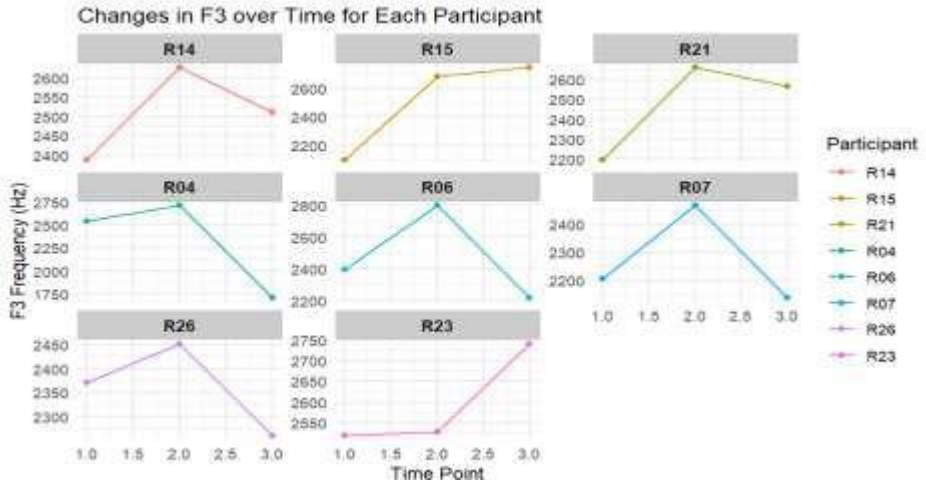

Figure 1. Changes in F3 Over Time Each Participant.

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