



# Age effects on late bilingualism: The production development of /ɹ/ by high-proficiency Japanese learners of English

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## ABSTRACT

The current project examined whether and to what degree age of acquisition (AOA), defined as the first intensive exposure to the target language, can be predictive of second language production attainment and nativelikeness of word-initial /ɹ/ by late English–Japanese bilinguals. Productions of /ɹ/ were elicited from 88 high-proficiency Japanese learners of English and comparison groups of 10 native English speakers and 10 low-proficiency Japanese learners of English. Tokens from word reading, sentence reading, and timed picture description tasks were assessed through listener judgements and acoustic analyses. The results demonstrated that AOA significantly predicted the attained performance of /ɹ/ at a spontaneous (picture description) but not a controlled (word and sentence reading) speech level, and with respect to third formant frequencies as determined by labial, palatal, and pharyngeal constrictions. In contrast, most Japanese learners exhibited ceiling effects regardless of AOA profiles with respect to second formant frequencies and transitional duration of first formants as determined by the degree and rate of tongue retraction. The results suggest that, whereas AOA continues to be a driving factor in the degree to which late bilinguals can benefit from additional input and interaction, such age effects may depend on different levels of phonetic processing.

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## Introduction

Over the past 40 years, second language acquisition (SLA) researchers have extensively examined the role of age of acquisition (AOA), defined as the age at which a learner's first period of intensive exposure to the target language begins, in the ultimate attainment and nativelikeness of second language (L2) pronunciation abilities. Whereas researchers have generally agreed on a negative correlation between AOA and the end state of L2 pronunciation proficiency, as is the case with early bilinguals who arrive in an L2 country before puberty, there is far less consensus on whether and to what degree AOA is predictive of L2 pronunciation attainment in the case of late bilinguals whose intensive exposure to the L2 begins after puberty

(e.g., Birdsong, 2005 vs. DeKeyser & Larson-Hall, 2005). To examine this topic further, the current project aims to examine age effects on late bilingualism in the context of the production development of word-initial /ɹ/ by late Japanese learners of English (AOA  $\geq$  16 years).<sup>1</sup>

## Background literature

### Age effects and late bilingualism

In the field of L2 speech acquisition, several theories have been proposed to explain how the first language

<sup>1</sup> In this paper, participants labeled as “bilinguals” are those who have already reached the upper limits of SLA (cf. rate of learning), and thus several key terminologies—plateaued and asymptotic L2 performance, end and final state of L2, ultimate attainment, and bilingualism—will be used interchangeably throughout the manuscript, following research conventions in age-related SLA literature.

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(L1) phonetic system interferes with adult second language acquisition (SLA) processes, especially at the *initial* and *mid* phases of L2 learning (e.g., Best, McRoberts, & Goodell, 2001 for Perceptual Assimilation Model [PAM]; Flege, 1995 for Speech Learning Model [SLM]). Scholars in this vein of L2 phonetics research have also worked to identify the factors that co-interact to mediate such L1 influence and thus *ultimately* lead certain learners to nativelike (or near-nativelike) proficiency at the *end* state of L2 production development, which occurs after several years of exposure to L2 input and interaction with native speakers. The variables that have been examined include (a) attitude and aptitude (e.g., Ioup, Boustagi, El Tigi, & Moselle, 1994), (b) motivation (e.g., Bongaerts, Van Summeren, Planken, & Schils, 1997), (c) level of education (e.g., Derwing & Munro, 2005), and (d) ethnic identity (e.g., Gatbonton & Trofimovich, 2008).

Among these variables, researchers have paid by far the most attention to learners' AOA as a relatively strong predictor of the end state of SLA: The earlier they arrive, the better their ultimate L2 performance tends to be, and the more likely it is to fall within a nativelike range. Such claims have been tested by many relevant studies which have pooled bilinguals with various AOA profiles (e.g., 0 year < AOA < 40 years), and have shown evidence for age effects, especially for early bilinguals (AOA < 16 years) in the domain of L2 phonology (Flege, Munro, & MacKay, 1995; Flege, Yeni-Komshian, & Liu, 1999; Patkowski, 1990) and L2 morphosyntax (Abrahamsson & Hyltenstam, 2008; DeKeyser, 2000; Johnson & Newport, 1989). With respect to late bilinguals (AOA > 16 years) (the focus of this paper), however, previous studies have generated much disagreement, which has resulted in a great deal of theoretical discussion in regards to the nature of the SLA processes underlying early and late bilingualism. In what follows, I will review two competing theoretical accounts and their different predictions as to age effects on post-pubertal ultimate attainment and nativelikeness: the Critical Period Hypothesis (CPH) and the Cognitive Aging Hypothesis (CAH).

#### *Critical period hypothesis*

Certain researchers (Abrahamsson, 2012; DeKeyser, 2000; DeKeyser & Larson-Hall, 2005; Granena & Long, 2013; Patkowski, 1990; Scovel, 2000) hold the view that any linguistic performance by late bilinguals is constrained by a loss of plasticity resulting from neural maturation after adolescence. Thus, these learners' acquisitional processes are fundamentally and qualitatively *different* from those of early bilinguals, who learn L2 automatically through mere exposure to natural input (very similarly to L1 acquisition processes). According to this theoretical position, bilinguals' access to an assumed language-specific implicit learning mechanism seems to gradually decline from early childhood (i.e., a robust AOA effect on early bilingualism), and then disappears after the mid teens (i.e., a discontinuous AOA effect on late bilingualism). In this regard, the Critical Period is defined as "the concept of an endpoint, a point beyond which learning becomes difficult or impossible" (DeKeyser & Larson-Hall, 2005, p. 97).

As a result, post-critical period SLA relies on general cognition learning processes that are intentional and explicit rather than language-specific cognition processes that are incidental and implicit (see Abrahamsson, 2012, p. 189). In the cognitive psychology literature, general skill learning (e.g., the learning of algebra, geometry, and computer programming) is characterized as the gradual proceduralization of declarative knowledge through practice and feedback, and its improvement (i.e., a decline in error rate and reaction time) follows the power law (e.g., Anderson, 1993). From a neurolinguistic perspective on SLA, mature L2 learners tend to learn an L2 in an effortful and conscious manner, drawing on metalinguistic knowledge declaratively represented in the left temporal area. This is assumed to compensate for the lack of their procedural memory sustained in Broca's area and the basal ganglia, which are mainly responsible for implicit and automatic L1 acquisition (Paradis, 2009; Ullman, 2004).

Previous researchers have indeed noted a general tendency for adult L2 learners to demonstrate quick improvement over the first few months of residence (LOR), and then proceed to level off, despite additional practice and environmental input (for a review, see DeKeyser & Larson-Hall, 2005). Unlike early bilingualism, which is strongly tied to AOA, final state quality and the possibility of attaining nativelike proficiency in late bilingualism is assumed to be related to learners' individual differences, such as language learning aptitude, regardless of learners' AOA profiles. In L2 morphosyntax development, DeKeyser found that a significant predictor for near-nativelike performance of oral grammaticality judgment tests by late Hungarian learners of English was not their AOA, but their high analytical aptitude scores (see also Abrahamsson & Hyltenstam, 2008).

#### *Cognitive aging hypothesis*

In contrast to the CPH, other researchers argue that language learning capacity used in successful L1 speech acquisition remains active even after puberty and can be applied to late bilingualism (Bialystok, 1997; Flege, 1995). According to this position, the generally more salient foreign accents of older learners, compared to younger learners, could be ascribed mainly to L1 influence and the differential quality and quantity of environmental input. That is, not only does post-pubertal L2 speech learning take place in a common phonological space partially or fully organized by L1 restrictions (Best et al., 2001; Flege, 1995), but late learners also tend to have less, poorer quality interaction with native speakers than early learners (Jia & Aaronson, 2003). This suggests that adult L2 learners are able to continue to learn new sounds as long as they can intentionally or incidentally access some of the social and educational environments that bilingual children likely experience (Bialystok, 1997), such as those where the L2 can be used with native speakers on a daily basis (Flege & Liu, 2001).

Whereas late SLA is free of maturational constraints, another characteristic of this position is that AOA may continue to predict the quality of ultimate attainment and the incidence of nativelikeness over one's life span without a cutoff point. According to major L2 speech learning

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