

Second language phonology and perceptual assimilation of English sounds by Japanese learners of English

Adrian Wagner

Introduction

A foreign accent is usually considered to be the most easily apparent marker of non-nativeness for the casual observer of a language user. While it is debatable whether second language learners can achieve native-like ability in other language areas such as syntax or semantics, second language phonology is often a big hurdle for language learners and a contentious issue for second language acquisition researchers. Numerous theories to account for the existence/nonexistence/rarity of examples of native-like second language pronunciation exist, overlap, compete and coincide. While age of onset is still seen by many, such as Abrahamsson and Hytlenstam (2009), as a key factor in this field of study, other researchers are focusing on the phonological system of the learner's L1 and its influence and interference on that of the L2.

According to Carey (2002), many errors in second language pronunciation are caused by transfer. "When a language learner attempts to produce L2 sounds, their relative success at approaching the target is reliant on their ability to disassociate their L2 utterance from their repertoire of L1 phonemes and allophones" (Carey, 2009, para. 2). Learners rely on their native languages' phonological systems to interpret foreign sounds. For successful assimilation and pronunciation of non-native sounds it is necessary for these foreign sounds to be conceptually separated from the sounds in their L1.

Typical pronunciation errors by Japanese L1 learners of English are addition of vowels, characterised as "Katakana English" and difficulty with English vowel and consonant contrasts such as /æ/, /ɑ/ and /ʌ/, /b/ and /v/ and the infamous /l/ and /r/ distinction. Consonant clusters also provide difficulty. Regarding vowels, the Japanese inventory is substantially smaller than that of English. Consonant clusters are limited in the onset and do not occur in the coda. The only non-vowel that can occur in the final position of a coda is the nasal /n/ and its allophones /m/ and /ŋ/.

The majority of studies in the subject of second language phonology

initially focused on only production. L2 learners' perception of foreign sounds, separated from production, is now an established field in second language acquisition. This essay will review prominent theories regarding second language phonology, and examine recent studies about the development of perception of English sounds by L1 Japanese learners.

1. Prominent Theories in Second language Phonology

Second language phonology has often been assessed through the prism of age constraints. Generally, the age of onset of L2 acquisition was seen as the most important factor. The existence and tenacity of foreign accents, taken as evidence of imperfect second language acquisition, have often been used to support the Critical Period Hypothesis (Lenneberg 1967) and the less extreme hypothesis of a sensitive period for language development. In an inconclusive study assessing arguments for and against a critical period hypothesis, Hakuta and Bialystok and Hakuta (1999) write that, "Informal observation irrefutably shows children to be more successful than adults in mastering a second language," (p.178). It is widely thought and observed that despite the apparent learning advantages such as the experiential knowledge and advanced cognitive ability of adults, it is children who seem to excel in the rapid and smooth acquisition of language. Neville (1995) showed persuasive evidence of neurological differences between child and adult second language learners.

The emergence of the Critical Period Hypothesis into linguistics is usually accredited to Lenneberg, who in 1967 focused on first language acquisition. He compared the biological limitations on first language learning to other phenomena and abilities in the animal world that could only occur and be learned during the early developmental stages of an animal's life. He noticed that disruption of the natural acquisition of a child's first language could not be rectified later in life, and he attempted to discover at what age it actually became too late to learn a language fluently. In his work, he posited that there is a cut off point for human first language acquisition and that point is around puberty. In summarizing Lenneberg, Shouten (2009, p. 2) writes that, "... the ages between the onset of language development during infancy and the restructuring of brain functions during puberty represented a window inside which a first language could be acquired." Lenneberg's theory is based on neurological plasticity of the brain during childhood, which is lost as

maturation occurs.

Applying this theory to second language acquisition is a logical concept. Most adults do find second language learning a difficult and frustrating experience. In contrast, few children have trouble acquiring their native language. As Bley-Vroman's (1990) Fundamental Difference Hypothesis argues, "Adult language learning of an L2 as opposed to an L1 is characterized by widespread failure" (Shouten, 2009, p.2).

Whether or not there is a critical period, the majority of researchers believe that age does influence second language phonology and an early start is much more likely to lead to success.

Otega, (2009) states:

Unlike subtle morphosyntactic knowledge, which may be difficult to evaluate outside of the laboratory, foreign accents are so conspicuous that they can be detected by the untrained ear. Thus, we tend to think that, if there are sensitive periods for some areas of L2 learning but not others, then phonology must be one of these areas. (p. 22)

It should be noted that some examples of L2 language learners who have achieved native-like pronunciation do exist and have been documented in the studies of Bonegaerts, Van Summeren, Planken and Schils (1997). Overall, these examples have mostly been discovered in typologically related languages such as native Dutch learners of L2 English or among certain extraordinary individuals (Ioup, Boustagoui, Tigi and Moselle, M., 1994).

Scovel, (2009) maintains that phonology is the most sensitive of aspects of second language acquisition to age constraints. He singles out speech as the only area of language wholly susceptible to age constraints by suggesting that a change in the brain which occurs around puberty is responsible for foreign accents and, "that a CPH is tenable only for speech (a native accent) and does not ultimately affect other areas of linguistic competence" (pp. 214-215).

Flege (1987, 1985 & 1999) also notes phonology as less likely to be improved by instruction and practice than other aspects of language. His 1999 study of L1 Korean EFL learners showed that the effects of the amount of schooling and L2 use had a much greater influence on morphosyntactic improvement than on pronunciation among the learners (Flege, Yeni-Komshian and Lui, 1999).

Flege's rationale for this differs from Scovel's. In what he would later refine into the Speech Learning Model (SLM) (1995), he asserts the impediments to perfect acquisition of L2 phonology are not due to any neurophysical maturation but are psychoperceptual. According to the SLM, even to adulthood, people maintain the same capacity as infants for language learning, including the ability to develop correct L2 phonetic categories and, theoretically, native-like pronunciation in a second language. However, the L1 phonetic system will have an influence on the development of the L2 system. In the introduction to a study which explored the predictions of the SLM by investigating the perception of English vowel contrasts by L1 speakers of Italian, Flege and co-author Mackay assert that the more similar a foreign sound is perceived to be to a sound in the L1, the less likely it is that a new sound category will be formed. (Flege and MacKay, 2004, p.56). According to the SLM, perception of unfamiliar foreign language sounds without an L1 equivalent is troublesome and likely to be wrongly categorised initially; however, with time and exposure, listeners can form a new phonetic category, particularly if a new sound is completely outside the phonological space of the learner's native system. Once perception of foreign speech sounds is accurately established, this perception provides a foundation for accurate production.

In regard to similar sounds, Flege has developed what is called *equivalence classification* (Flege, 1995). According to this principle, foreign sounds will be assimilated to the L1 sound which they are most similar to. With repeated exposure, the learner may become aware of acoustic differences and begin producing a sound more similar to the foreign sound but with the native equivalent acting as an intermediary. According to the theory of equivalence classification, interference of the intermediary native sounds limits the extent to which the new sound can be accurately perceived and produced according to the norms of the L2. As for age constraints, the SLM posits that as the L1 phonetic system develops with age, the influence of the L1 system, with its categories and distinctions will exert a stronger influence on the developing L2 system.

Another perception-based theory regarding second language phonology, posited and developed by Best (1995), is known as the Perceptual Assimilation Model (PAM). According to PAM non-native sounds will be categorised by

the listeners according to similarity or difference to sounds existing in their native phonological space. A useful aspect of this model is that it proposes models for patterns of incorrect and correct perception of L2 sounds. When heard, a foreign sound will be perceptually assimilated by the listener in one of three following ways:

1. Assimilated to a native category
2. Assimilated as an unrecognisable speech sound
3. Not assimilated to speech (nonspeech sound) (Best, 1995, p.194)

Aside from this basic distinction in perception, Best also develops a detailed model to account for successful and unsuccessful differentiation of foreign sound segments, divided into six categories. For example, the English phonemes /t/ and /d/, seemingly easily assimilated and distinguished by Japanese learners, could be described as, *Two-Category Assimilation (TC TYPE)*, “each non-native segment is assimilated to a different native category, and discrimination is expected to be excellent” (Best, 1995, p.195). Both segments are similar enough to sounds which exist in Japanese and are different enough from each other to be differentiated and assimilated separately.

Conversely, the English segments /ɹ/ (alveolar approximant as in “red” and “rip”) and /l/ (alveolar lateral approximant) are confused and categorised according to the PAM as: “Single Category Assimilation (SC Type) Both non-native sounds are assimilated to the same native category, but are equally discrepant from the native “ideal” ...Discrimination is expected to be poor...” (Best, 1995, p.195).

The English sounds /ɹ/ and /l/ are indeed very close to each other. Both are voiced and share place and manner of articulation. The only variation between them is that /l/ is a lateral sound while /ɹ/ is central. Even though they are essentially different from each other and their nearest Japanese equivalent, both of these sounds are perceptually assimilated as the Japanese /ɾ/, which is an alveolar flap.

Unlike the SLM and the Critical Period Hypothesis, which are in opposition to each other, the PAM and SLM can be seen as complimentary. Both place primary importance on the learner’s L1 phonological system as accounting for either success or failure of accurate perception of foreign language sounds. A key difference between the two is that the SLM poses new category formation as an important part of the development of second language phonology.

2. Significant Studies in Perception of English Sounds by Japanese Learners

An extensive study into the perception of English vowels was conducted by Strange et al. in 1998. The study contained three major research questions, but for the purposes of this paper only one will be assessed. That is, “How do Japanese listeners perceptually assimilate the L1 American English vowels to the five vowel qualities of the Japanese phonological inventory?” (Strange et al., 1998, p.317).

The participants of the study were 13 females and 11 males with a mean age of 20 years old. All were university undergraduates who had studied English as a foreign language in junior high and high school focusing on reading and writing. The participants had spent no significant time abroad and no significant time speaking English with native English speakers.

The participants in the study were played recordings of sounds from various speakers of American English and asked to select which of 18 sounds represented by katakana the English sound most resembled. They were then asked to supply a “goodness rating” by rating the sound on a scale of 7 (Japanese-like) to 1 (not Japanese like). All of the sounds contained the sound token of /h/ plus one of the following vowels /i:, ɪ, ʌ, ε, æ, ɑ:, ʌ, ɔ:, ɔʊ, ʊ, u:/. These sounds were presented in both sentence and di-syllabic form.

To measure what the authors referred to as spectral assimilation, the possible katakana responses were divided into 5 clusters, “high front”, “mid front”, “low”, “high back,” and “mid back,” based on the quality of the first vowel in the /hV(V)/ syllable types. For example, /hi/ and /hii/ were classified as “high front” while /he/ /hee/ and /hei/ were classified as mid front. After analyzing the results in this way, the authors conclude that the results, “indicate that the AE vowels were most often assimilated to their phonetically-similar J counterparts, as defined by the traditional features of tongue height and backness” (Strange et al., 1998, p. 321). For example, the participants categorised the English mid low central vowel /ʌ/ as fitting into the Japanese low categories. There were differences, however, in how consistently the vowels were categorised. The vowels /i,a,u,u/ were categorised with a consistency of over 90% in both sentence and di-syllabic conditions. The vowels /ɪ, ε, æ, ʌ, ɔ/ were consistently categorised less than 75% of the time in one or both categories.

The listeners' goodness ratings of how closely the AE vowels resembled the Japanese vowels were consistent. "The long vowels /æ/ and /ɔ/ were judged the least similar to any Japanese vowel. For both vowels, no single Japanese response alternative was chosen more than 50% of the time overall" (Strange et al., 1998, p. 339). Goodness ratings were also very low for these sounds. The AE sounds /i/, /a/ and /u/ were judged by all the participants as being the closest match to Japanese sounds.

The authors interpreted their results through the PAM framework. They conclude that no two AE vowels were assimilated equally well to Japanese vowel categories and therefore there were no *single category* assimilation pairs, which are the most difficult to differentiate.

They identify the vowel pairs /i:/-/ɪ/, /u:/-/ʊ/, /ɑ:/-/æ/, /ɔ:/-/o/ and /ɑ:/-/ɔ/ as being construed by the PAM as "category goodness" or "categorizable/noncategorizable" (Best, 1995, p. 195) pairs and assert that, "These pairs would be expected to be of intermediate perceptual difficulty, while other pairs which constituted two-category assimilation patterns would be differentiated with greater ease" (Strange et al., 1998, p. 340). They also note that the environment in which the sounds occur, as well as individual speaker difference, account for more uncertainty and problems with consistent assimilation.

Morrison (2002a) investigates the perception of English high-front vowel sounds by L1 speakers of Japanese. Most dialects of English, including Canadian English which is used for this study, have two high front vowels, namely /i/ (tense) and /ɪ/ (lax). The Japanese vowel inventory also contains two high front vowels which are /i/ and /i:/, the properties of which are set to differ only in vowel length. Informed by models of cross language perception such as SLM and PAM and a comparison of the vowel inventories, the author investigates the influence the Japanese phonemic system and its inherent categorical divisions will have on the perception of English sounds. While English /i/ and /ɪ/ are not differentiated by length, their lengths may vary depending on whether the preceding consonant is voiced or unvoiced. Morrison writes that, "...the state of phonemic voicing in the post-vocalic consonant has the potential to affect Japanese listeners' perception of English vowels" (Morrison, 2002, p.1). The author predicts that the Japanese will perceive and assimilate the English high front vowels, not by their tense/lax distinction but by length differentiation as they do in Japanese.

The results of the Japanese were compared to those of Mexican Spanish speakers (matched to the Japanese participants for length of time in Canada). The Mexican participants were chosen because Spanish has a five vowel system similar to Japanese, but Spanish has no length distinction between the high-front vowels. The addition of the Mexican participants to the study and the differences in their results helps clarify a cause and effect relationship between the Japanese phonological system and their assimilation of English vowels.

In addition to determining what influence Japanese had on the perception of English sounds, the author also investigated whether this would change over time. The longitudinal element is important in testing the prediction of the SLM that new categories develop over time.

The results after the first test, conducted when the Japanese and Mexican participants had been in Canada for one month, showed of the Japanese that, "The predominantly duration-based identification pattern was radically different to the almost exclusively spectral identification pattern used by the native English speakers" (Morrison, 2002, p. 80). Nevertheless, this duration based identification method seemed to be somehow effective, resulting in a correct distinction rate of 85%. On the other hand, Spanish participants scored only 65%, and after finding a lot of variation between individual results, Morrison remarks that, "No individual Spanish listener was found to have categorical perception of English /ɪ/ and /i/" (Morrison, 2002, p. 91).

A second test was conducted 5 months later and yielded different results. All the participants had remained in Canada for this period and were engaged in studies of subjects in English at university. None were receiving formal EFL/ESL pronunciation training during this period. The finding from the second test produced results consistent with the SLM and the writer's original predictions. "Six months (compared to one month) living in an English speaking society had no effect on the Japanese listeners' perception of English /I/ and /i/. In contrast, the Mexican listeners' responses changed drastically in the five months (Morrison, 2002, p. 105).

This finding validates the SLM's prediction of new category formation and shows the profound influence one's native phonological system has on perception of foreign sounds. The Japanese participants' initial perceptual assimilation of English high front vowels had impeded the formation of new categories. Unimpeded by this, the Mexican Spanish speakers were able to

develop a new perceptual category.

The study of Aoyama, Guion, Akahana-Yamada and Yamada, T (2004) examines whether perception of English /r/ is more susceptible to progress in perceptual assimilation than /l/ and posits that the Japanese perception of English /l/ and /r/ is an instance of two category assimilation, with both the English sounds being assimilated as instances of the Japanese /ɾ/. While both sounds are assimilated to the same category, they are not perceived as being equal. "Specifically, English [ɹ] may be more dissimilar phonetically from Japanese [ɾ] than English [l] is..." (Aoyama et al, 2004, p. 234).

The authors use this perceptual imbalance to test a key hypothesis of the SLM which is that foreign language sounds that are less similar to sounds that already exist in the learner's L1 will eventually be subject to greater rates of improvement. The study tests whether this will hold true in the case of English [ɹ] and if [ɹ] will indeed show more rapid or a greater degree of improvement than [l] over a fixed time.

The child and adult participants were tested twice. On the first occasion all had a length of residency in the United States of 0.5 years, and on the second time all had a length of residency of 1.6 years. The participants were played recordings of the syllable /Ca/ and their ability to discriminate between consonant pairs was tested. At the initial testing, correct discrimination by adults was significantly higher than the children for all consonant pairs. Also, the adults showed little change in accuracy between the first and second testing for any of the consonant pairs.

However, the children's data showed great improvement, especially for the pairs of /l/-/r/ and /r/-/w/. With a score of 1 indicating perfect category discrimination and a score less than 0.5 indicating a lack of category discrimination, the score of the Japanese children at T1 was 0.44 for l/-/r/ and 0.55 for r/-/w/. By the second test the scores of the Japanese children were 0.7 for /l/-/r/, and 0.86 for /r/-/w/. The authors concluded that this indicated a significant improvement of the perceptual assimilation of [ɹ] by the Japanese children.

These results were compared to another experiment, focusing on the production of the same consonant contrasts. The results showed the adults improved little between the first and second tests. As for the children, their production of English consonants did improve over the year, for the sounds /

r/ and /w/ but not for /l/.

While the children's improvement of the production of /w/, "appeared to contradict the SLM's hypothesis that phonetic dissimilarity between L1 and L2 sounds, not similarity, facilitates L2 learning" (Aoyama et al., 2004, p. 247). the improvement of both the perception and production of [ɹ] do lend support to the SLM's model of perceptual assimilation. The writers conclude that while the production of [l] may appear to be more accurate at an initial stage of L2 learning, more learning of [ɹ] seems to occur both in production and perception for NJ learners of English (Aoyama et al., 2004, p. 246). The differences in the learning process of the sounds [ɹ] and [l] were directly related to their distance and similarity to their nearest equivalent in the Japanese phonetic inventory.

Conclusion

The three studies assessed above provide insight into the assimilation of English sounds by native speakers of Japanese. All three make use of the SLM and PAM theoretical framework to form their studies and interpret their results, empirically supporting both these theories. Perceptual assimilation of foreign sounds appears to be somewhat systematic and heavily reliant on the learner's L1. In the future, more longitudinal studies and cross language investigation of various languages can add to the understanding of phonological perception in the broader field of second language acquisition. A systemized approach to perception in second language phonology is potentially useful to both learners and teachers. It can help to identify causes of difficulty/errors in both listening comprehension and spoken output and assist in the development of pronunciation pedagogy.

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