



The effect of L1 use on pronunciation in Quichua–Spanish bilinguals

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This study investigated the interaction of the L1 and L2 systems in bilinguals by assessing the effect of L1 use on L1 and L2 production accuracy. A novel design feature of this study is that it examined bilinguals who used their L1 on a regular basis in a bilingual setting: Otavalo, Ecuador. Thirty native Quichua speakers who were matched for age of Spanish acquisition were recruited to form three groups differing in self-reported L1 use. The three groups repeated aurally presented sentences from their L1 and L2. Monolingual listeners from each language rated the blocked, randomly presented sentences for degree of foreign accent. For the Spanish sentences, the group with the highest L1 use had stronger Quichua accents than the group with the lowest L1 use. On the other hand, L1 use had no effect on the ratings of the Quichua sentences. Results from an analysis of Korean–English bilinguals are also reported. These results replicate the finding that L1 use affects L2, but not L1 production. These findings indicate that the interaction of the L1 and L2 systems affects the success of L2 acquisition, providing evidence that factors other than neurological maturation influence L2 acquisition. © 2000 Academic Press

1. Introduction

Many recent investigations have focused on the effect of variation in the age of second language (L2) acquisition on the production and perception of an L2. The findings of these studies indicate that the earlier in life a second language is learned, the more

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native-like the pronunciation of the L2 will be (Asher & Garcia, 1969; Suter, 1976; Tahta, Wood & Loewenthal, 1981; Patkowski, 1990). Age of L2 acquisition is often indexed by the age of arrival (AOA) in a predominantly L2-speaking community. For example, Flege, Munro & MacKay (1995a) and Yeni-Komshian, Flege & Liu (1997) found that the degree of perceived foreign accent became stronger as AOA increased. Other work focusing on phonetic segments has shown that later AOAs were tied to less accurately produced L2 vowels (Munro, Flege & MacKay, 1996) and consonants (Flege, Munro & MacKay, 1995b).

Recently, Flege, Frieda & Nozawa (1997) investigated the effect of variation in the amount of self-reported use of the first language (L1) on L2 production accuracy. They found that the more the L1 (Italian) was used, the stronger the perceived foreign accent was in the L2 (English). Two groups of native Italian speakers who immigrated to Canada as children were examined. The subjects were drawn from a previous study by Flege *et al.* (1995a), which investigated English sentences spoken by 240 native Italian speakers for foreign accent. Flege *et al.* (1997) selected a subset of subjects from the previous study who were matched for chronological age and AOA in Canada. The “high L1 use” group ($n = 20$) and the “low L1 use” group ($n = 20$) differed according to self-reported Italian use, 36 vs. 3% of the time. The two native Italian groups received different English accent ratings. The high L1 use group was found to have a stronger Italian accent in English than the low L1 use group. This finding was probably not simply a practice effect stemming from more L2 use, for all of the bilingual subjects had been living in Canada for at least 18 years (mean = 34 years).

Piske & MacKay (1999) have replicated the L1 use effect on L2 production with a different sample from the same Italian immigrant population as the study by Flege *et al.* (1997). They found that groups with greater L1 use had lower foreign accent scores than groups with less L1 use for both early and late bilinguals. (The study by Flege *et al.* (1997) only examined early bilinguals.) This indicates that L1 use can have an effect on L2 production, whether the L2 was acquired as a child or as an adult.

The findings from studies by Flege *et al.* (1997) and Piske & MacKay (1999) are of potentially great importance for theories of second language acquisition and bilingualism. In AOA-based studies, age is often interpreted as a surrogate for neurological maturation, e.g., neural plasticity at the time of L2 learning. The findings from Flege *et al.* (1997) and Piske & MacKay (1999) indicate that some factor(s) other than just neurological maturation at the time of L2 learning influence L2 production capabilities. They suggest that the interaction of the L1 and the L2 can affect production and influence the ultimate degree of success in pronunciation of the L2.

Flege *et al.* (1997) proposed that the bilinguals' degree of L1 “activation” influenced L2 production accuracy. The authors discussed their findings in terms of a “single system hypothesis”, which proposes that bilinguals have a single phonological system in which the L1 and L2 phonetic systems reside. According to the single system hypothesis, bilinguals are unable to fully isolate their L1 and L2 phonetic systems. “[T]he phonic elements of the L1 subsystem necessarily influence phonic elements in the L2 system, and *vice versa*” (p. 172). The nature and strength of the influence of the L1 and the L2 on one another may be dependent on several factors, including the nature of the L1 and L2 phonetic systems (e.g., how many and what types of phonetic categories they possess) and the amount and circumstances of L1 and L2 use (Grosjean, 1992; to appear).

Although interesting, the L1 use effect described in Flege *et al.* (1997) and Piske & MacKay (1999) is far from being clearly established. The studies need to be replicated

with another population and the design extended before the L1 use effect on L2 production can be fully accepted. Two design aspects of the study by Flege *et al.* (1997) might be called into question. First, the study was a *post-hoc* analysis. The sentences analyzed were drawn from data collected for an earlier study. The L1 use effect should be studied with a data set that has the participants' amount of L1 use as a design variable to allow planned comparisons between groups differing in L1 use.

Second, in the study by Flege *et al.* (1997), the low L1 use group reported using Italian so infrequently (3% of the time) that it is uncertain whether they actually had an *active* L1 system. That is, it is uncertain if the low L1 use participants could actually speak Italian at the time they were tested. In the Piske & MacKay (1999) study, participants in the low L1 use groups reported using Italian slightly more (7 and 10%). However, no evaluation of the participants' Italian capabilities was performed in the studies by Flege *et al.* (1997) or Piske & MacKay (1999).

Participants' responses to a language background questionnaire in the study by Flege *et al.* (1997) indicated that they may not have spoken Italian very well. The participants tested were Italian immigrants to Ottawa, Canada, with AOAs ranging from 3 to 10 years. The Italian population in the city of Ottawa is small (less than 10 000 of a total population of approximately 300 000 for the city of Ottawa). In addition, some unpublished research involving a sample of Italian-English bilinguals drawn from the same population as the study by Flege *et al.* (1997) suggests that the low L1 use group only used Italian in very limited domains. The low L1 use group rarely used Italian anywhere but visiting family. The high L1 use group used Italian in several domains, such as visiting family, at work, at home, with friends, while shopping, and at church. The low L1 use group probably used Italian with older family members outside the home, and spoke Italian with very few individuals.

Given the low use of Italian (3%) and the limited domain in which Italian was spoken, it is possible that some of the subjects in the low L1 use group had never fully developed, or had lost, production proficiency in Italian. The loss of production proficiency is not an unreasonable proposal as the Italians had lived in Canada for 34 years on average and spoken Italian only rarely during that time. Grosjean (1982) suggested that language forgetting is "probably as frequent as language learning in adults" (p. 238) and that production is more affected by loss than perception or comprehension are. He proposed that people undergoing the language forgetting process can be termed "dormant bilinguals" in that they no longer use one of their languages on a regular basis. Perhaps the L1 use effect found in the Flege *et al.* (1997) study was actually a difference between dormant bilinguals and functioning bilingual speakers. Further investigation into the L1 use effect should be carried out with a population of speakers who use their L1 on a regular basis in a wide variety of contexts. In addition, an assessment of the participants' L1 proficiency should also be conducted.

The aim of the present study was to replicate and extend the study by Flege *et al.* (1997). The study is replicated by examining the effect of L1 use on L2 production in groups of bilinguals who differed in L1 use. Replication of the earlier study would confirm the finding that L1 use affects L2 production, potentially supporting the single system hypothesis. A failure to replicate the Flege *et al.* (1997) study might suggest that the reported L1 use effect was actually a difference between functionally monolingual and bilingual speakers. The study was extended in two ways. First, the participants' L1 capabilities were assessed and the effect of L1 use on L1 as well as L2 production proficiency was investigated.

Second, the participants in the current study differed from the study by Flege *et al.* (1997) in that they continued to use both their L1 and L2 on a regular basis. In addition, unlike the previous study, in which the participants lived in an immigrant community, the participants in the current study lived in a community characterized by widespread, societal bilingualism: Otavalo, Ecuador. Otavalo is a small city in the Andean highlands of northern Ecuador and an area of cultural and linguistic contact between two large ethnic groups locally known as “indigenous Otavaleños” and “mestizos”.

Otavalo is the commercial and administrative center for a rural area populated primarily by members of a Native American indigenous group commonly known as Otavaleños. Approximately 60 000 indigenous Otavaleños (Meisch, 1997) live in Otavalo and surrounding communities. The other ethnic group, Spanish-speaking Ecuadorians commonly known as mestizos, comprise a majority of the residents of the city of Otavalo (total population 26 000), and a substantial minority of the rural population.

Indigenous Otavaleños speak a dialect of Quichua, a Quechuan language related to the Quichua of Peru and Bolivia. While Quichua is technically accorded limited recognition as an official language under Ecuador’s constitution, Spanish is the *de facto* official language in Ecuador and is used for virtually all official purposes.

Individual bilinguals living in the Otavalo area vary widely in the amount they use their two languages on a daily basis. About 30 years ago, many Otavaleños were monolingual speakers of Quichua. Quichua–Spanish bilinguals were typically mestizos in jobs with a high degree of interethnic contact. However, recent social changes and educational reforms have brought about near-universal Quichua–Spanish bilingualism among indigenous Otavaleños. Currently, Quichua monolingualism is rare in the Otavalo area. Even near-monolingualism is limited to older people in isolated communities and children who have not yet reached school age.

This change in language use has not, however, led to the replacement of Quichua by Spanish. The use of Spanish has increased, but the use of Quichua has remained strong. While knowledge of Spanish is important to indigenous Otavaleños for educational, political, and economic purposes, Quichua is seen as an important part of indigenous ethnic and cultural identity and is still the preferred language in most indigenous homes and communities. Most indigenous Otavaleños now speak both Quichua and Spanish fluently and use both in varying contexts in their daily lives. Furthermore, individual bilinguals use the two languages to differing extents, depending on factors such as their jobs, social networks, personal preferences, and whether they live in Otavalo or an indigenous community.

The organization of the following sections will be as follows: first, data from an accent rating experiment for Quichua–Spanish bilinguals will be presented. The results indicate that L1 use affects L2, but not L1 production accuracy. Second, these results are replicated by a study that investigates Korean–English bilinguals. Finally, the theoretical implications of the findings are discussed.

2. Method

2.1. Participants

The Quichua–Spanish bilinguals who participated in this study were from indigenous bilingual communities in and around Otavalo, Ecuador. All of them learned Quichua

as a first language at home and later learned Spanish as an L2 when they began school or work. All of the participants recorded for this experiment came from communities that Stark, Carpenter, Anrango & Conterón (1974) identified as speaking the Otavalo subdialect of the Imbabura dialect of Ecuadorian Quichua. Participants in the experiment reported here came from the communities of Cotama, Montserrat, Peguche, Punyaro, San Juan, San Martín, or the city of Otavalo.

Thirty Quichua–Spanish bilinguals were recruited and assigned to one of three subgroups on the basis of their self-reported Quichua (i.e., L1) use. Five Quichua near monolinguals and five Spanish monolinguals were also recruited. The near-monolingual Quichua speakers began learning Spanish at an average age of 18 years and spoke Spanish only in limited contexts (e.g., for transactional purposes in the marketplace). Their Spanish was judged to be very limited by the authors and by Quichua–Spanish bilinguals living in their communities. The Spanish monolinguals were all residents of the same community, Otavalo, and all were speakers of the Northern Ecuadorian Sierra dialect of Spanish. They reported having no knowledge of Quichua.

The participants' amount of L1 use was determined from responses to a language background questionnaire (LBQ). The LBQ was administered to the Quichua speakers orally in Quichua. A Quichua-speaking field assistant read the questions and recorded the participants' responses. In addition to basic biographical data, the questionnaire asked participants the age at which they learned Spanish and questions on language use. The seven questions on language use were as follows: (1) Which language have you used most overall since childhood? (2) Which language do you use most at home? (3) Which language do you use most with your siblings? (4) Which language do you use most with friends at parties? (5) Which language do you use most with friends when you meet on the street? (6) Which language do you use most at work? (7) Which language do you use most overall currently?

The participants gave one of three possible responses to each of the seven questions: "Usually Quichua," "Both an Equal Amount," or "Usually Spanish."¹ Participants were given one point for each "Usually Quichua" response, a half point for each "Both an Equal Amount" response, and zero points for each "Usually Spanish" response for a possible maximum total of seven points.

The questions on the LBQ dealt with typical situations in which bilinguals might be expected to vary with regard to language preference. Thus, these ratings should not be taken as an overall assessment of language use. A high rating for Quichua usage on these questions does not mean that an individual never uses Spanish. Spanish is normally used even by high Quichua use speakers in institutional settings, interactions with mestizo Spanish speakers, business transactions, and service encounters. Situations in which Spanish is used by all bilinguals were not included in the LBQ because they would provide no differentiation of the groups, but only serve to lower the L1 use scores evenly across the three groups.

As shown in Table I, the three groups of Quichua–Spanish bilinguals differed significantly in their use of Quichua. Tukey's tests returned significant findings for all comparisons of the three groups ($p < 0.01$). The three bilingual groups thus differed in terms of L1 use, but other subject variables were controlled for. Most importantly, the subjects were

¹ The LBQ did not ask participants to estimate percentage use for their two languages, as in the study by Flege *et al.* (1997). Given the widely varying education levels of the participants from no formal schooling to college education, familiarity with percentages would be expected to vary radically, making the measure unreliable.

TABLE I. Characteristics of the three groups of Quichua-Spanish bilinguals*

	Groups			<i>F</i> (2,27)	Prob.
	Low L1 use	Mid L1 use	High L1 use		
Quichua use	2.9 (0.9)	4.5 (0.5)	6.4 (0.6)	61.4	$p < 0.01$
Age of Spanish acquisition	6.7 (0.9)	6.1 (0.7)	6.5 (1.1)	1.0	$p > 0.10$
Length of Spanish use	14.9 (5.1)	14.7 (4.6)	19.9 (5.9)	3.1	$p > 0.10$
Chronological age	21.6 (5.6)	20.8 (4.9)	26.4 (5.8)	3.1	$p > 0.10$
Years of education	8.2 (4.1)	8.8 (3.5)	6.2 (3.6)	1.3	$p > 0.10$

*There were 10 subjects for each group (five male and five female). Mean values with SD in parentheses; the first variable uses a 7-point scale, the last four variables are expressed in years.

matched for age of Spanish (L2) acquisition. The participants in the three bilingual groups reported learning Spanish between ages of 5 and 8 (when they began school) and, as shown in Table I, did not differ significantly in terms of age of L2 acquisition. Furthermore, the three groups did not differ significantly in their length of Spanish use, chronological age, or years of education. Each group was balanced for gender, with five male and five female subjects. Finally, each of the groups included people working at a wide range of occupations both inside and outside the home.

2.2. Procedure

The participants' repetitions of sentences in Quichua and Spanish were recorded. The order of presentation for the languages was counterbalanced for the bilingual speakers. The monolingual speakers repeated sentences in just one language.

The Quichua and Spanish sentences examined are given in Table II. They were roughly balanced in terms of number of syllables (the Spanish sentences had an average of 8.5 syllables and the Quichua sentences had an average of nine syllables), and all sentences contained familiar words.

The sentences were presented to the participants in a mini-dialogue format in which the participants heard a question followed by an answer. For example, the participants heard one voice asking "Chagraca alillatachu?" then a second voice replying "Chairami quiqui llcushijun." Then, the first voice asks again, "Chagraca alillatachu?" The participants responded with the same answer given by the second voice.² Pairs of native speakers recorded the Quichua and Spanish mini-dialogues. Each sentence was elicited twice in the same manner before moving on to the next sentence. There were two practice sentences at the beginning of the set followed by the experimental sentences in a fixed order. The procedure was entirely aural; the subjects were given nothing written. The sentence repetitions were recorded using a head-mounted microphone (Shure SM10A) and DAT tape recorder (Sony model TCD-D8).

Only correctly repeated sentences were selected for analysis. Repetitions containing any type of a grammatical error, incorrectly repeated word, or disfluent production were not selected. The second repetition of the sentence was used if correctly repeated. If not, the first repetition was used. The first repetition was used in only 2% of the cases. The

² The English translation for the question and answer pair is "Are the fields doing all right?" "The immature ears of corn are just coming out."

TABLE II. Quichua and Spanish sentences repeated by participants

<i>Quichua sentences*</i>	
Ñuca paicunata catigrini.	“I’m going to follow them.”
Taita Jusimi catishca.	“Elder Jose followed (me).”
Sucu fachalinata jatugrini.	“I’m going to sell a gray shawl.”
Chairami quiqui llucshijun.	“The immature ears of corn are just coming out.”
Paica casi tiyajurca.	“He/she was sitting quietly.”
<i>Spanish sentences</i>	
Hace más calor en la costa.	“It is hotter on the coast.”
Busco la Calle Maldonado.	“I am looking for Maldonado Street.”
Me dieron un vaso de jugo.	“They gave me a glass of juice.”
Es una cosa muy bella.	“It is a very beautiful thing.”
Compré un buso rojo.	“I bought a red sweater.”

*Quichua sentences are presented in the Unified Quichua Orthography.

sentences were digitized at 22.05 kHz with 16-bit resolution, and normalized to 50% peak intensity. They were later presented to listeners who rated them for degree of perceived foreign accent.³

The Spanish sentences produced by the 35 participants (30 bilinguals and 5 Spanish monolinguals) were presented to five native Spanish listeners. The Quichua sentences produced by 35 individuals (30 bilinguals and 5 Quichua near-monolinguals) were presented to five near-monolingual Quichua listeners. No speaker was also a listener. The five Spanish raters were from Otavalo and spoke the Northern Ecuadorian Sierra dialect of Spanish and the five Quichua raters were from the Otavalo area and were speakers of the Otavalo subdialect of Imbabura Quichua (described above). The Quichua raters had all learned Spanish after the age of 15 years and had limited Spanish proficiency. In each rating experiment, there were five separate blocks, one for each of the five sentences. Within each block, the sentences spoken by 35 participants were randomly presented four times each without replacement. A different random order was used for each of the five sentences.

The listeners in both experiments were instructed (in their native language) to rate the sentences for degree of foreign accent. In the case of the Spanish sentences, they were asked to rate for Quichua accent, and in the case of the Quichua sentences, they were asked to rate for Spanish accent. The participants were presented with a computer screen showing nine buttons and asked to rate on a nine-point scale, one being most accented and nine being without accent. The listeners were told to use all nine buttons. The first rating for each sentence was discarded, and only the last three ratings for each sentence were used in the analysis.

3. Results and discussion

3.1. Spanish sentences

Investigation of the intra-rater reliability for the three presentations of the Spanish sentences returned acceptable correlation coefficients ranging from $\rho = 0.84$ to 0.94 for

³ The term “foreign accent” will be used here, because it is consistent with the extant literature. However, it is not the ideal term for this study. The accents studied here are not foreign, but coexist in the same community.

TABLE III. Ratings for Spanish sentences*

Group	N	Mean (SD)
Monolingual Spanish	5	7.3 (0.4)
Low L1 use	10	6.8 (1.0)
Mid L1 use	10	5.9 (1.0)
High L1 use	10	4.7 (2.0)

*Ratings based on a 9-point scale, with one being most accented and nine being un-accented.

the five listeners (mean = 0.92). The raters also showed a high degree of reliability with an interclass correlation for the five raters of $\rho = 0.96$ (using an algorithm for fixed judges on mean scores; see Shrout & Fleiss, 1979).

The mean ratings for the Spanish sentences are given in Table III. The mean scores for the three groups decreased with Quichua usage, with the group of native Spanish speakers receiving the highest rating. An ANOVA examining the ratings obtained for the three bilingual groups yielded a significant effect of group, $F(2,29) = 5.5$, $p < 0.01$. Tukey's tests indicated that there was a significant difference ($p < 0.01$) between the low L1 use group and high L1 use group. In addition, the correlation between Quichua use and the accent ratings for the bilingual speakers was significant, $r = -0.54$, $df = 28$, $p < 0.01$. This finding indicated that the use of Quichua (L1) affected the perceived degree of foreign accent in the production of Spanish (L2) sentences for Quichua-Spanish bilinguals when age of Spanish acquisition was controlled.

It is also of interest to address the question of whether any of the Quichua-Spanish bilinguals had achieved a native-like level of performance in the pronunciation of Spanish sentences. Bongearts, van Summeren, Planken & Schils (1997) and Flege *et al.* (1995a) considered foreign accent ratings to be native-like if they were within 2.0 standard deviations of the native mean. Adopting this criterion for native-like performance, 12 of the 30 Quichua-Spanish bilingual participants received native-like foreign accent ratings for their productions of Spanish sentences. Seven participants were in the low L1 use group, three were in the mid-L1 use group, and two were in the high L1 use group. Thus, the low L1 use group held the majority of the participants receiving foreign accent ratings comparable to the native Spanish speakers' ratings.

3.2. Quichua sentences

Investigation of the intra-rater reliability for the three presentations of the Quichua sentences returned unacceptable correlation coefficients, ranging from $\rho = 0.44$ to 0.73 for the five listeners (mean = 0.64). The poor reliability could be due to either unreliable judges or the nature of the data, which apparently had little variability. In other words, there may have been virtually no difference in foreign accents across the speakers.

The ratings themselves also suggest minimal difference in accent across the speakers. The mean ratings for the Quichua sentences are given in Table IV. Note that the mean scores for the three groups of bilinguals and one group of Quichua-dominant speakers do not differ much. An ANOVA examining the ratings obtained for the three bilingual groups was non-significant, $F(2,29) = 1.53$, $p > 0.10$. In addition, the correlation between Quichua usage and the accent ratings for the bilingual speakers was non-significant, $r = -0.28$, $df = 28$, $p > 0.10$. A comparison of the 30 bilingual participants'

TABLE IV. Ratings for Quichua sentences*

Group	N	Mean (SD)
Near-monolingual Quichua	5	5.2 (1.3)
Low L1 use	10	5.7 (0.9)
Mid-L1 use	10	5.3 (0.9)
High L1 use	10	5.1 (0.9)

*Ratings based on a 9-point scale, with one being most accented and nine being un-accented.

TABLE V. Ratings for Quichua sentences in follow-up study*

Group	N	Mean (SD)
Early learners of Quichua	5	6.4 (0.6)
Late learners of Quichua	5	4.4 (1.0)

*Ratings based on a 9-point scale, with one being most accented and nine being un-accented.

ratings with the near-monolinguals' ratings reveals that all 30 bilinguals' ratings are within 2.0 standard deviations of the near-monolinguals' mean rating.

The null finding just reported has two possible explanations: either the raters detected no foreign accent in the Quichua sentences, or the raters could not perform the task. Perhaps the raters were not adept in hearing foreign accents in Quichua. Although many mestizos have historically learned Quichua as an L2 (especially those working on haciendas with Quichua speakers), it is not a world language with many L2 learners. Therefore, it is possible that foreign accents are encountered so rarely as to leave little conceptual experience with accentedness. It is also possible that the scalar rating technique used here was not readily understood by the near-monolingual Quichua judges, who had an average of just 2.1 years of education (with two judges having no formal education at all).

In order to determine whether the judges could hear foreign accents in Quichua and use the rating technique, a small follow-up experiment was carried out. This time, age of Quichua acquisition was manipulated. AOA is known to have a profound effect on foreign accent ratings (Patkowski, 1990; Flege *et al.*, 1995a). Thus, we expected the AOA manipulation to produce differences in foreign accent. If the judges were indeed able to perceive foreign accent in Quichua and also able to use the rating scale, differences between two groups that differed in AOA should be found.

Ten speakers were examined, five of whom had learned Quichua as infants and five of whom had learned Quichua after the age of 15. The same five sentences used in the original accent-rating experiment (elicited in the same manner) were again used. Three of the five raters from the experiment just reported were asked to return to serve as raters in the follow-up experiment.

As shown in Table V, the later learners of Quichua were given lower ratings than the earlier learners of Quichua, indicating a stronger Spanish accent in their Quichua. A *t*-test performed on the data returned a significant finding, $t = 3.98$, $df = 9$, $p < 0.01$. In addition, the intra-rater correlations for the three presentations of the sentences were stronger, reaching acceptable levels, $\rho = 0.74$ – 0.87 (mean = 0.82).

The results from the follow-up experiment indicated that the Quichua-dominant raters could hear foreign accents in Quichua as well as use the rating scale. Thus, the results from the larger study of accent ratings for Quichua sentences could best be interpreted as follows: the three groups of Quichua–Spanish bilinguals did not have noticeably different degrees of Spanish foreign accents in Quichua as a function of the amount of Quichua (i.e., L1) use.

3.3. Discussion of Spanish and Quichua results

The results from the foreign accent study on Spanish sentences replicated the study by Flege *et al.* (1997). The more the L1 (Quichua) was used, the stronger the foreign accent ratings were for the L2 (Spanish) sentences. In addition, the current study assessed the participants' production capability in the L1, something not done in the earlier study. No difference in L1 production capability, as assessed by foreign accent rating, was found between the three groups of bilingual participants. These findings indicate that results from the study by Flege *et al.* (1997) were due to an interaction between the L1 and L2 phonetic systems and not due to differences arising from testing dormant and active bilinguals.

Another finding to emerge from this study was the differential effect of L1 use on L2 *vs.* L1 production. Greater L1 use produced more accented L2 sentences, whereas L1 use had no effect on the perceived accent of L1 sentences. Since L1 and L2 use are presumably inversely correlated, we can infer that L2 use does not affect perceived accent in L1. This suggests that the balance between L1 and L2 use exerts a measurable effect on the extent to which the L1 sound system influences the pronunciation of an L2, whereas it does not affect the extent to which the L2 sound system influences pronunciation of the L1. This finding has apparently not been reported before. It is of potential theoretical significance in that it suggests an asymmetry in how the two sound systems of a bilingual may influence one another.

However, before the asymmetrical effect of L1 use on the L2 *vs.* L1 systems is accepted, it must be replicated. In the next section, results from an analysis of Korean–English bilinguals are presented. The effect of L1 use on the foreign accent ratings of L1 and L2 sentences is investigated, replicating the Quichua–Spanish experiment.

4. Examining L1 use effects in Korean/English bilinguals

A recent finding by Yeni-Komshian, Flege & Liu (in press) is related to the issue of how, or if, the L1 and L2 systems influence one another. These authors examined the pronunciation of English and Korean sentences that were repeated, following native-produced models, by 240 native speakers of Korean. The native Korean subjects differed according to their age of arrival (AOA) in the United States (range: 2–23 years). All had lived in the United States for a minimum of 8 years at the time of testing. Native English-speaking listeners used a 9-point scale to rate English sentences spoken by the bilinguals; native Korean-speaking listeners used a similar scale to rate Korean sentences spoken by the bilinguals. Degree of foreign accent in the L1 and L2 was found to be inversely correlated ($p < 0.01$). That is, the subjects who had a relatively good pronunciation of English (mostly early bilinguals) tended to have a poor pronunciation of Korean, whereas those who had a poor pronunciation of English (mostly late

TABLE VI. Subgroups of 20 Korean/English bilinguals differing according to self-reported use of Korean but were matched for age of arrival in the United States (see text)*

	Groups		<i>F</i> (1,38)	Prob.
	High L1 use	Low L1 use		
Korean use	4.1 (0.5)	2.1 (0.5)	186.9	$p < 0.01$
Age of arrival in US	11 (5)	11 (5)	0.0	$p > 0.10$
Length of residence in US	15 (4)	15 (4)	0.2	$p > 0.10$
Chronological age	26 (4)	26 (6)	0.2	$p > 0.10$
Years of education in US	13 (4)	13 (3)	0.0	$p > 0.10$

*Mean values with SD in parentheses; the first variable was determined by a series of self-reported rating-scales probing language use in a variety of contexts; the scales ranged from “seldom” (1) to “often” (5); the last four variables are expressed in years

bilinguals) tended to have a good pronunciation of Korean. However, the study by Yeni-Komshian *et al.* (in press) did not directly address the issue of whether variation in L1 use had a comparable effect on the pronunciation of the L1 and L2.

The question addressed in this section is whether the differing effect of L1 use on the pronunciation of Quichua and Spanish sentences by Quichua–Spanish bilinguals would also characterize the pronunciation of Korean and English sentences by the Korean–English bilinguals examined by Yeni-Komshian *et al.* (in press).

The technique used here to assess the effect of L1 use on the pronunciation of L1 and L2 sentences was the matched group analysis technique developed by Flege, Yeni-Komshian & Liu (1999) to examine the acquisition of L2 phonology and morphosyntax. The development of this technique was motivated by the observation that a variety of subject variables are likely to be correlated with one another in a large sample of immigrants such as the one examined in Yeni-Komshian *et al.* (in press). For example, the 240 Korean/English bilinguals’ self-reports concerning amount of Korean use were correlated positively with their chronological age ($r = 0.33$) and AOA in the United States ($r = 0.66$), and inversely correlated with length of residence in the United States ($r = -0.41$), and years of education in the United States ($r = -0.59$). Thus, merely showing an effect of L1 use on the pronunciation of either English or Korean sentences would not, in itself, demonstrate that L1 use measurably affected the Korean/English bilinguals’ pronunciation. Such an effect might be due to confounded variables.

Two matched subgroups of 20 subjects each were drawn from the sample of 240 Korean–English bilinguals examined by Yeni-Komshian *et al.* (in press) in order to examine the effect of L1 use in a relatively unconfounded manner. The subjects were sorted in ascending order of L1 use and AOA. Then, without access to the foreign accent ratings, pairs of subjects were identified who had the same AOA but differed according to self-reported L1 use. As shown in Table VI, subjects selected for inclusion in the two matched subgroups had the same average AOA (viz., 11 years) but differed significantly in L1 use as measured on a 5-point, self-reported scale ranging from “seldom” (1) to “often” (5). The subgroup consisting of subjects who gave low estimates of L1 use will be referred to here as the “low-use” bilinguals, whereas the subgroup consisting of individuals who gave higher L1 use estimates will be referred to as the “high-use” bilinguals. As expected from similar analyses carried out by Flege *et al.* (1999), matching

TABLE VII. Subgroups of 20 Korean/English bilinguals differing according to their age of arrival in the United States but matched for self-reported use of Korean (see text)*

	Groups		$F(1,38)$	Prob.
	Early bilinguals	Late bilinguals		
Age of arrival in US	5 (2)	19 (3)	355.1	$p < 0.01$
Korean use	3.0 (0.5)	3.0 (0.5)	0.0	$p > 0.10$
Length of residence in US	18 (3)	15 (6)	3.9	$p > 0.10$
Chronological age	22 (3)	33 (6)	65.2	$p < 0.01$
Years of education in US	17 (2)	7 (2)	193.7	$p < 0.01$

*Mean values with SD in parentheses; Korean use was determined by a series of self-reported rating-scales probing language use in a variety of contexts; the scales ranged from “seldom” (1) to “often” (5); all other variables are expressed in years.

subjects according to AOA greatly reduced variation in other variables as well. The matched subgroups did not differ significantly in terms of years of residence in the United States, chronological age at the time of testing, or years of education in the United States ($p > 0.10$).

The L1 and L2 foreign accent ratings obtained by Yeni-Komshian *et al.* (in press) for the two matched subgroups of Korean/English bilinguals were submitted to separate ANOVAs. The first analysis revealed that the low-use bilinguals obtained significantly higher ratings for their English sentences than did the high-use bilinguals (5.6 *vs.* 4.4, $F(1,38) = 4.3$, $p < 0.05$). That is, the bilinguals who used Korean relatively seldom had a significantly better pronunciation of English than did those who reported using Korean relatively often. The second analysis revealed that the ratings obtained for Korean sentences by the low-use and the high-use bilinguals (5.3 *vs.* 5.8) did not differ significantly, $F(1,38) = 1.2$, $p > 0.10$. That is, the subgroups differing in self-reported use of Korean were not found to have differed in terms of strength of English foreign accent in Korean.

The findings just reported seem to have replicated the results presented earlier for Quichua–Spanish bilinguals in showing an L1 use effect on the pronunciation of L2 but not L1 sentences. However, it is at least possible that the method used to evaluate the pronunciation of Korean was not sufficiently sensitive to reveal pronunciation differences in subgroups of 20 subjects each. We therefore carried out a “control” analysis examining subgroups of 20 subjects each who were matched for L1 use but differed according to AOA. The null finding reported for the Korean sentences in the first analysis would not be convincing unless a difference in ratings of Korean sentences were observed for the subgroups examined in the control analysis.

As shown in Table VII, the two matched subgroups examined in the control analysis had the same self-reported use of Korean (mean = 3.0) but non-overlapping AOAs. The subjects whose AOAs ranged from 3 to 9 years (mean = 5 years) will be referred to here as the “early” bilinguals. The subjects whose AOAs ranged from 15 to 23 years (mean = 19 years) will be referred to as the “late” bilinguals. As expected (Flege *et al.*, 1999), matching on L1 use reduced variation in other variables as well. The matched subgroups did not differ significantly in length of residence in the United States nor in self-reported L1 use. However, the late bilinguals were significantly older than the early

bilinguals, and had received significantly fewer years of education in the United States ($p < 0.01$).

The foreign accent ratings obtained for the matched subgroups were submitted to separate ANOVAs, one for the English sentences and one for the Korean sentences. The first analysis revealed that the early bilinguals obtained significantly higher ratings than the late bilinguals (7.0 vs. 3.6), $F(1,38) = 99.1$, $p < 0.01$. That is, the subjects who began learning English as young children had a significantly better pronunciation of English sentences than did those who began learning English in late adolescence. Conversely, the second analysis revealed that the early bilinguals obtained significantly lower ratings for the pronunciation of Korean sentences than the late bilinguals did (3.4 vs. 6.6), $F(1,38) = 98.3$, $p < 0.01$. That is, the subjects who began learning English as children had significantly stronger American English foreign accents when they repeated Korean sentences than did those who began learning English in late adolescence. Given the significant findings of the control analysis, we can reasonably conclude that, as was the case for the Quichua-Spanish bilinguals, amount of L1 use affected pronunciation of the L2 but not the L1.

5. General discussion

The results from this study indicated that the amount of L1 use affects L2 production. The participants in the first analysis presented were Quichua-Spanish bilinguals living in Otavalo, Ecuador, who began learning Spanish between the ages of 5 and 8 and differed in L1 (Quichua) use. The high Quichua use group had significantly stronger accents than the low Quichua use group for L2 sentences. In addition, a significant negative correlation was found between L1 use and accent ratings for L2 sentences. This was probably not just a practice effect, for the participants had been speaking Spanish for an average of 17 years.

These results replicate Flege *et al.* (1997), even though the population in this study differed in important ways from the earlier study. The participants in this study all used their L1 (Quichua) on a regular basis. In addition, they did not differ in production proficiency in their L1, as assessed by a foreign accent rating experiment. Thus, we can be reasonably sure that the participants had an active L1 (Quichua) system, which was not certain for the study by Flege *et al.* (1997).

These results are confirmed by the second study reported here in which Korean-English bilinguals showed a similar L1 use effect. The amount of L1 (Korean) use affected the pronunciation of L2 but not L1 sentences.

The results from the current study, taken together with the results from the Flege *et al.* (1997) and Piske & MacKay (1999) studies, indicate that the amount of L1 use affects L2 production. Specifically, speakers who use their L1 more frequently are found to have stronger foreign accents in their L2 than speakers who use their L1 less frequently. This suggests that the L1 and L2 systems can interact at a phonetic level and that this interaction plays a determining role in the acquisition of L2 pronunciation. The implication is that chronological age (or brain maturation) at the time of first L2 exposure is not the only factor to influence success in L2 learning. The amount of L1 use, and thus perhaps L1 activation, also influences production capabilities in an L2.

The question arises of how the current findings relate to the single system hypothesis. This proposal states that the phonetic systems used by bilinguals when producing their two languages reside in a common phonological space (Flege, 1995) and that, although

the two systems can be activated to varying degrees (Grosjean, to appear; Paradis, 1993), one phonetic subsystem cannot be fully deactivated while the other one is in use (Soares & Grosjean, 1984). The proposal further states that because the L1 and L2 reside in common phonological space, and neither of the languages can be fully deactivated, the phonic elements of the L1 and L2 will influence one another in production, and perhaps, perception. The strength of the influence could be affected by overall recent use of the L1 and L2, whether the conversation partners speak the L1 and/or the L2, the extent to which interlocutors code switch, and the topic of conversation (Grosjean, 1982, 1992, to appear). The results from the current study indicate that, indeed, amount of L1 use influences the production of the L2. We propose that the amount of L1 use determines the *strength* of the influence on the L2.

The finding that 12 of the 30 Quichua–Spanish bilinguals received foreign accent ratings within the (near-) monolingual range for *both* Quichua and Spanish also has implications for understanding the interaction between the L1 and L2. As mentioned above, the majority of the bilinguals who received native-like Spanish ratings were in the low L1 use group. Given this information, we can further refine our proposal that the amount of L1 use determines the strength of the influence on the L2. Perhaps it is the case that in long-term bilinguals who learned their L2 in childhood, a certain threshold of L1 use must be reached before a measurable influence on the L2 is noted. After this threshold is reached, the greater the L1 use, the greater the influence on L2 production.

A new finding to come out of the current Quichua–Spanish bilingual study was the differential effect that amount of L1 use had on L1 and L2 production. Amount of L1 use was found to affect perceived foreign accent ratings for L2 but not L1 sentences. This finding was replicated in the second analysis, which investigated Korean–English bilinguals. The amount of Korean (L1) use was found to affect the perceived foreign accent rating for the English (L2), but not the Korean sentences. If we assume that L1 use is at least roughly inversely correlated with L2 use, these findings suggest that the balance of L1 and L2 use exerts a measurable effect on the extent to which the L1 sound system influences the pronunciation of an L2, whereas it does not affect the extent to which the L2 sound system influences pronunciation of the L1.

This asymmetry might be based on how the L1 and L2 systems of bilinguals are functionally organized in the cortex. Recently, Kim, Relkin, Lee & Hirsch (1997) investigated the representation of multiple languages in bilinguals using functional magnetic resonance imaging. The authors found that in frontal-lobe language-sensitive regions of the brain (also known as Broca's area) second languages acquired in young adulthood are spatially separated from native languages. However, for bilinguals who learned both their languages simultaneously as infants, the two languages tended to be represented in common frontal cortical areas. Perhaps the sequential bilinguals investigated here are more like the adult L2 learners than the simultaneous bilinguals investigated by Kim *et al.* (1997) and, thus, have spatially separated L1 and L2 frontal-lobe regions. We speculate that some aspects of the L1 in sequential bilinguals, such as those represented in Broca's area (which has been linked to production) are immune to effects from the L2 once they are established in infancy and early childhood.

Another plausible explanation for the asymmetrical effect of L1 use on L1 and L2 might be the greater importance of L1 production for social identity. The appearance of a Spanish accent in Quichua might well threaten individuals' identity as Quichua speakers and community members in ways which are quite different from the consequences of a Quichua accent in Spanish.

Further study into L2 effects on L1 production needs to be carried out before any firm conclusions can be drawn. However, given the results from the current study, the single system hypothesis can be modified to state that for bilinguals who learned their L2 after infancy, influence between L1 and L2 based on usage is unidirectional, with the L1 affecting the production of L2 only.

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