

The relationship between cross language phonetic influences and L2 proficiency in terms of VOT

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ABSTRACT

This study examined the production of aspirated stop consonants in Korean and English words to address how the influences differed particularly in terms of proficiency in L2 English. Voice onset times (VOTs) were measured from two American monolinguals and seven Korean speakers. The results showed that VOT patterns for both L1 and L2 stops differed according to their proficiency in L2 English. In L2 English, high proficient speakers produced VOTs that were similar to those of native speakers of English whereas low proficient speakers produced VOTs that were significantly longer than those of proficient speakers. In L1 Korean and L2 English, most of the proficient speakers produced VOTs similarly. Unlike previous findings, Korean VOTs were even shorter than English counterparts. The VOT shortening of aspirated stops in Korean was found for most of the proficient speakers. The findings of the present study suggest that cross language phonetic influences as well as the ongoing VOT shortening in Korean aspirated stops may be correlated with L2 proficiency. Since this is a pilot study with a small number of subjects for each proficiency group, further quantitative study is necessary to generalize.

Keywords: L1 and L2 stops, Cross language phonetic influence, Voice Onset Time (VOT), proficiency in L2 English

1. Introduction

One of the challenging issues in second language phonetics and phonology is how L2 speakers produce L2 sounds as well as L1 sounds²⁾. The effect of an L1 sound on the production of an L2 sound has been well documented (Flege, 1992; Flege et al., 1995). Foreign-accented speeches among non-native speakers of English were easy to capture (Kim, 2011). Unlike foreign-accented speech as the influence of L1 on the speech of L2, however, the L2 influences on L1 speech were hard to capture for both production and perception. It's much harder to capture the influences or differences especially when the sounds in the languages are very similar. Flege et al. (1995), in his Speech

Learning Model (SLM), has hypothesized that bilingualism in a speaker may produce an L2 effect on L1 speech. Flege and Eefing (1987) also observed significant L2 effects on L1 production.

Numerous studies have also discussed about cross language phonetic influences between L1 and L2 (Grosjean, 1989; Flege, 1987; Flege *et al.*, 1995; Fowler *et al.*, 2008). According to Grosjean's view (1989), the "mixing" of the two languages occurs inevitably because their two language systems are both engaged. This view implies that interference is bi-directional (L1 \leftrightarrow L2). Late English-French bilinguals examined by Flege (1987) detected cross-language phonetic differences between the /t/s of their two languages. Sancier and Fowler (1997) found that parallel changes took place in the speaker's two languages even though she was a "serial bilingual"—that is, she spoke only English in the US and only Portuguese in Brazil. Flege *et al.* (1995) discussed that L1 and L2 phonetic systems are interacted with each other. Fowler *et al.* (2008) found that cross language phonetic influences between the two languages have occurred even in simultaneous bilinguals (i.e. speakers who learned both languages from birth). According

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²⁾ L1 is used as a cover term referring to a native language, mother tongue, or first language and L2 as a target language or second language.

to Flege's SLM theory, changes in phone production in L1 or L2 can be either assimilatory or dissimilatory in nature (Flege, 1987; Sancier and Fowler, 1997 for the examples of phonetic assimilation; Flege and Eeffing, 1987 for those of phonetic dissimilation). Despite the fact that cross phonetic influences between L1 and L2 have been surveyed for bilingual data, little attention was paid to the production of L2 speakers whose proficiency in L2 differ. The purpose of the present study is to investigate whether cross language phonetic influences between L1 and L2 aspirated stops differ in terms of proficiency in L2 English.

In this study, voiceless aspirated stop consonants for the two languages (i.e. English and Korean) were chosen to be examined, because they both belong to the same phoneme category and they are phonetically voiceless aspirated. Lisker and Abramson (1964) classified both as one of the long lag languages³⁾. However, VOT values of aspirated stops in Korean are remarkably longer than the English counterparts⁴⁾. This can be seen in Table 1 reported by Lisker and Abramson (1964) (Klatt, 1975; Keating, 1984; Shimizu, 1996 for the similar results of the English and Korean data)⁵⁾.

Table 1. VOT (ms) in aspirated stops

	English (n=4)		Korean (n=1)	
	Mean	Range	Mean	Range
p	58	20-120	91	65-115
t	70	30-105	94	75-105
k	80	50-135	126	85-200
p, t, k	69	20-135	104	65-200

In Table 1, the mean VOT difference between the two languages is about 30 ms. This tells that although English and Korean stops are classified as phonetically the same, there remain some subtle differences in terms of the amount of aspiration or VOT. Korean occupies a 'heavily aspirated' position along the VOT continuum, while English lies in the 'aspirated' region. It would be very interesting to see how Korean L2 speakers capture

³⁾ Long voicing lag languages classified by Lisker and Abramson (1964) consisted of Cantonese, English, Eastern Armenian, Thai, Korean, Hindi, and Marathi.

⁴⁾ VOT refers to the time interval between the release of the stop and the onset of glottal vibration, or voicing (Lisker and Abramson, 1964).

⁵⁾ Participants' ages in previous studies were ranged from 20 to 40. They all were adult native speakers of English or Korean.

and produce these subtle differences in terms of VOTs when they produce L1 and L2 aspirated stops.

Recent studies reported that VOT values of aspirated stops in Korean have been getting shorter, i.e. VOT shortening (mean 84 ms (range 22~196 ms, Kim 2008; see also Silva, 2006; Kang and Guion, 2006). Silva (2006) reported that the VOT shortening was related with age differences: Younger speakers produce shorter VOTs than older speakers (born before and after 1965). However, Kim (2008) reported that, regardless of age differences, the VOT shortening was captured. She found that the VOT differences between the two stops were neutralized because of a remarkable overlap in VOT values between lax and aspirated stops. Since VOT is no longer a cue to distinguish lax from aspirated stops, tone remains to be a primary role to contrast the two stops in both production and perception (see Kim, 2000; Kim *et al.*, 2002; Kim and Duanmu, 2004; Kim, 2008). For Korean stops, the sound change is undergoing in terms of VOT and tone. It is a controversial issue on what factors may trigger the VOT shortening for aspirated stops in Korean. Little attention has been given to the relationship between the VOT shortening and the influence of L2 English. This issue will be discussed in this study.

2. Methods

2.1 Participants

Nine speakers participated in this experiment, two American and seven Korean speakers. They were all female. Two monolingual native English-speaking participants served as native speakers of English (NE speakers) for the control group. Their mean age was 26 years. They grew up in the mid-part of the United States and spoke a Midwestern dialect (Michigan). Seven Korean-speaking participants served as L2 speakers (i.e. non-native speakers of English) for the experimental group. For the Korean participants, their proficiency in L2 English was varied. Other factors such as gender, age, and dialect were controlled. The mean age was 25 years, 6 months and the individuals ranged from 21 years, 6 months to 27 years, 4 months. They grew up in Seoul and spoke a standard Seoul dialect. All of them had learned L2 English after their puberty. Their proficiency level in L2 English was determined by the following criteria: self-reported questionnaire according to a typical five-level Likert item, IBT score of four skills, Residence of America (ROA) or an English speaking country, and interview with NE speakers employed in the study (see Appendix for questionnaire). Participants' proficiency information is summarized in Table 2.

Table 2. Participants' information about proficiency

	Self	IBT	ROA	Int. ⁶⁾	Sum ⁷⁾	Overall
YB	4.4	117	5 yrs.	5	131.4	High
KP	4.3	116	6 yrs.	4	130.3	High
MK	3.4	103	3 yrs.	3	112.4	Int.
IY	2.8	101	NA	3	106.8	Int.
NK	3.2	99	NA	3	105.2	Int.
WS	1.8	76	NA	2	79.8	Low
HS	1.8	78	NA	1	80.8	Low

According to the sum in Table 2, seven participants were classified into three proficiency levels: High Proficiency (HP) for YB and KP, Intermediate Proficiency (IP) for MK, IY, and NK, and Low Proficiency (LP) for WS and HS. For speakers WS, and HS, their speech was so halting and fragmentary that conversation was virtually impossible. They reported that they had never stayed in an English speaking country. Their proficiency belonged to real beginners in the LP group. For speakers YB and KP, they spoke very fluently with good pronunciation. Their speech on any topics was effortless and smooth. These speakers' proficiency belonged to high advanced in the HP group. The other three speakers belonged to the IP group. They were able to communicate with NE speakers but occasionally hesitant, with some unevenness caused by rephrasing and grouping for words.

2.2 Speech materials and procedure

In order to see how voiceless aspirated stops were produced, English and Korean words in word-initial position were employed. The target words, given in Table 3, were balanced for place of articulation, vowel context (/a/ and /aɪ/) and the number of syllables. Note that Korean L2 speakers tend to produce “pie (파이), tie (타이), kye (카이)” in the two syllable words. All words were real words. Words were partly from the Kang and Guion's (2006) data.

Table 3. The target words in English and Korean

English		Korean	
[p ^h at] “pot”	[p ^h aɪ] “pie”	[p ^h at] “red bean”	[p ^h ada] “to dig”
[t ^h at] “tot”	[t ^h aɪ] “tie”	[t ^h at] “blame”	[t ^h ada] “to ride”
[k ^h at] “cot”	[k ^h aɪ] “kye”	[k ^h at] “stop”	[k ^h adi] “card”

⁶⁾ For interview, participants were evaluated by NE speakers employed in the study following the five likert scale; Very Poor (1), Poor (2), So-So (3), Good (4), and Very Good (5).

⁷⁾ All items in the left were summed up including ROA.

In order to record the target words in a constant prosodic environment, each word was presented in a carrier sentence. The carrier sentence for the English data was “_____ is the word.” The carrier sentence for the Korean data was “[_____ hasejo]” (“Say _____”). For the target words, they were located in utterance initial position. As a result, the target words were fully stressed and emphasized. A total of 288 word productions (2 NE speakers x 6 English words x 3 repetitions and 7 Korean L2 speakers x 6 Korean words / 6 English words x 3 repetitions) were recorded for analysis.

Each of the participants was recorded using a portable Panasonic recorder (RR-US591) in the sound-attenuated room. Each target word was presented on a flashcard in the orthography of each language in a random order. NE speakers read the English cards. L2 participants first read the English cards three times and then the Korean cards three times. They read sentences in the flash cards in randomized blocks. All participants were instructed, in their native languages, to read the cards at a comfortable and normal speaking rate and loudness level and to repeat any utterance when they were not satisfied with their production. Before the recording session began, speakers were given a chance to rehearse the sentences. All speakers reported familiarity with the target words. The utterances were digitally recorded at a sampling rate of 44,100 Hz and digitally transferred to a personal computer as wave files with the sampling rate using Praat 4.6.40 (Boersma and Weenink, 2005). The VOT measurements were performed using Praat 4.6.40, a speech analysis program.

The VOT of the initial stop in each target word was measured from the beginning of the stop-burst release to the onset of the periodic portion using waveform and spectrogram. The onset of the vowel in the waveform was determined by the onset of the first full glottal pulse of the vowel as well as the pitch of the spectrogram. The onset of the voicing energy in the second formant shown in a time-locked spectrogram was used to help determine voicing onset in conjunction with the waveform.

3. Results and Discussion

3.1. L1 influence on L2 speech: L1 and L2 English VOTs

In order to compare the VOT values of L1 English stops with L2 English counterparts, the pooled results of the two American and seven Korean speakers for each place of articulation are given in Table 4.

Table 4. Voice Onset Times (ms) of L1 and L2 English stops

	L1 English (n=2)			L2 English (n=7)		
	Mean	Range	SD.	Mean	Range	SD.
/p/	82	69~101	9	67	31~124	25
/t/	107	85~123	13	74	39~136	27
/k/	95	66~134	14	94	49~145	29
p, t, k	95	66~134	19	78	31~145	29

Although /p, t, k/ in English and Korean are phonetically voiceless aspirated, Korean VOTs were remarkably longer than English counterparts in Lisker and Abramson (1964) (see Table 1). According to Flege et al. (1995), an L2 sound that is “identified” with a sound in the L1 will be replaced by the L1 sound. If there is an L1 influence on L2 speech, L2 English stops produced by Korean speakers are expected to be the same as L1 Korean stops or longer VOTs than L1 English stops. However, the reverse pattern can be seen in Table 4 where L2 English VOTs are shorter than L1 English counterparts.

Note that English VOTs produced by NE speakers in the present study are even longer than Lisker and Abramson’ (1964) English data in Table 1. Longer VOTs might be due to the fact that the target words were fully stressed and located in utterance initial position. The VOT strengthening effect in domain-initial position has been well documented in several languages (Jun, 1993, in Korean; Pierrehumbert and Talkin, 1992, in English; Keating et al., 2003), suggesting that it may be a general articulatory process.

The fact that L2 English VOTs were shorter than L1 English VOTs did not hold for all speakers. Figure 1 shows the individual data averaged across three places of articulation. Each plot present individual mean and range of English VOTs (± 1 SEM).

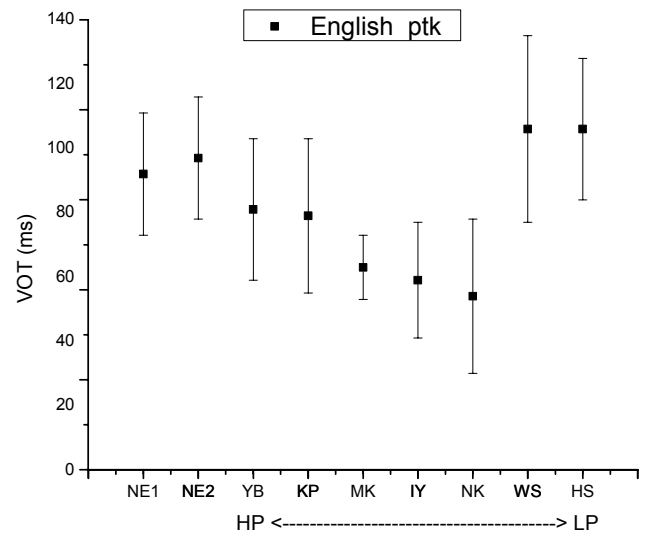


Figure 1. Voice Onset times (± 1 SEM) of NE (NE1 and NE2 on the left two plots) and Korean speakers of English. Individual data were averaged across /p/, /t/, and /k/ (HP = High Proficiency and LP = Low Proficiency).

Figure 1 shows that speakers’ VOT patterns differ according to proficiency in L2 English. In L2 English, HP speakers (YB and KP) produced VOTs that were similar to those of NE speakers whereas LP speakers (WS and HS) produced VOTs that were significantly longer than those of non-LP speakers. IP speakers (MK, IY, and NK) produced remarkably shorter VOTs than other speakers and even shorter than NE speakers. It would be very interesting to see how these speakers produce L1 Korean stops in the following section.

Based on Lisker and Abramson’ (1964) data where Korean VOTs were longer than English counterparts, the influence of L1 on the speech of L2 seemed to be robust only for the LP speakers where L2 sounds were replaced by the L1 sounds (i.e. phonetic assimilation).

Table 5 presents the individual data for each place of articulation. The fact that speakers’ VOT patterns differ according to proficiency in L2 English held well for almost all speakers across three places of articulation. In Table 5, however, three speakers KP, NK, and WS showed remarkable VOT differences between labials and velars. For these speakers, the mean VOT for /p/ was 59, 33, 83 ms, respectively whereas the corresponding values for /k/ were 96, 87, and 139 ms. The mean difference between /p/ and /k/ for these speakers was about 40 ms. This implies that L2 English VOTs were not very stable across three places of articulation. Remarkable VOT variations can be observed also from the Korean data in the next section.

Table 5. Voice Onset Time in Milliseconds (ms): L2 stops
(n=7, Standard deviation in parenthesis)

Spkrs.	/p/	/t/	/k/	/p, t, k/
YB	83(1)	73(37)	87(11)	81(22)
KP	59(13)	82(16)	96(27)	79(24)
MK	58(7)	64(11)	68(10)	63(10)
IY	53(28)	54(2)	71(7)	59(18)
NK	33(2)	43(0.4)	87(4)	54(24)
WS	83(4)	97(10)	139(27)	106(29)
HS	102(18)	105(21)	111(29)	106(22)
Total	67(25)	74(27)	94(29)	78(29)

3.2. L2 influence on L1 speech: L1 Korean VOTs

Unlike L1 English VOTs presented in Figure 1, L1 Korean VOTs were produced remarkably different, as seen in Figure 2. Figure 2 shows the individual data averaged across three places of articulation. Each plot present individual mean and range of Korean VOTs (± 1 SEM).

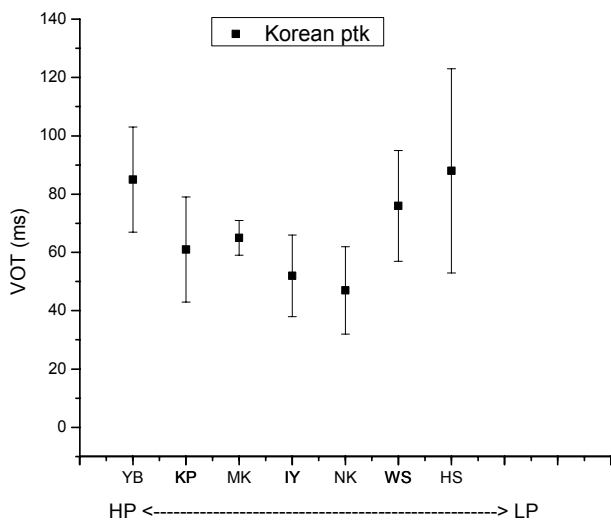


Figure 2. Voice Onset times (± 1 SEM) of Korean stops. Individual data were averaged across /p/, /t/, and /k/. (HP = High Proficiency and LP = Low Proficiency).

In the Introduction, we discussed that the VOT shortening of aspirated stops have occurred in Korean. Figure 2 shows that the VOT shortening is clearly seen for most of proficient speakers except for speaker YB. In L1 Korean, more proficient speakers (KP, MK, IY, and NK) tend to produce VOTs that were significantly shorter than less proficient speakers (WS and HS). The hypothesis of the present study is that the triggering factor for the shortening phenomenon might be related with the influence of L2 English on L1 Korean.

HP speaker YB was an exception. She did not show the VOT shortening like other proficient speakers. In her production, L1 Korean VOTs were very similar to L2 English VOTs, indicating that she carried an assimilatory influence of L2 on the speech of L1. According to Flege et al.'s (1995) phonetic assimilation or dissimilation, L1 sounds may be produced similar to or different from L2 sounds. Speaker YB underwent phonetic assimilation whereas other proficient speakers might undergo phonetic dissimilation.

Except for speaker YB, most of the proficient speakers tend to produce Korean stops with even shorter VOTs than the English counterparts, indicating that the VOT shortening of Korean aspirated stops have occurred. Since all participants employed in the present study were in their twenties, the present results could not be accounted for in terms of the AGE factor as proposed by Silva (2006). Instead, speaker variation in this study was accounted well for in terms of the factor PROFICIENCY: more proficient speakers (i.e. KP, MK, IY, and NK) tend to produce shorter VOTs than less proficient speakers (WS and HS). The shortening phenomenon can be seen across three places of articulation in Table 6.

Table 6. Voice Onset Time in Milliseconds (ms):

Spkrs.	Korean stops (n=7)			
	/p/	/t/	/k/	/p,t,k/
YB	65(3)	80(2)	107	85(18)
KP	46(5)	57(1)	81(4)	62(18)
MK	63(2)	72(7)	59(2)	65(6)
IY	54(2)	37(14)	65(2)	52(14)
NK	29(5)	52(4)	60(5)	47(15)
WS	60(11)	76(4)	93(25)	76(19)
HS	73(3)	61(1)	128(7)	88(35)
Total	55(15)	62(15)	86(27)	68(24)

Compared with previous findings (Lisker and Abramson, 1964; Shimizu, 1996), Korean VOTs in the present study were remarkably shorter for almost all speakers as well as across three places of articulation (mean 126 ms in Lisker and Abramson, 1964 vs. mean 68 ms in the present study). Similar to the L2 English data, however, remarkable VOT differences among three places of articulation were noticeable for some speakers. There is about 40 ms difference between /p/ and /k/ for speakers YB, KP, NK, and HS. For almost all speakers, velars are produced longest, alveolars longer, and labials shortest.

3.3. Cross language phonetic influences and proficiency in L2 English: L1 Korean and L2 English VOTs

For direct comparison, English and Korean VOTs are presented together in Figure 3. In Figure 3, each plot shows mean VOTs (± 1 SEM) in L2 English and L1 Korean for individual Korean speakers, respectively.

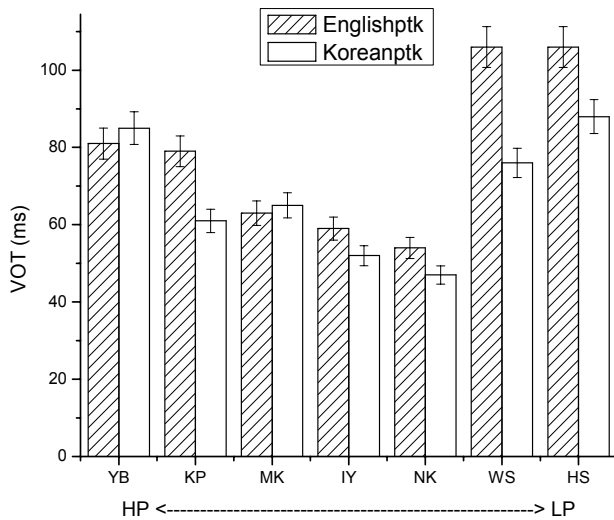


Figure 3. Voice Onset times (± 1 SEM) of Korean speakers of L2 English and L1 Korean. Individual data were averaged across /p/, /t/, and /k/.

In Figure 3, the VOT patterns for both L1 and L2 stops can be interpreted by proficiency in L2 English as well as cross language phonetic influences in the following aspects. First, L1 and L2 VOTs were very similar to each other for most of proficient speakers except for speaker KP. In other words, the two sounds were phonetically assimilated with each other. The VOT differences between L1 and L2 stops are getting shorter for non-LP speakers whereas those are getting bigger for LP speakers (WS and HS). Second, relatively long VOTs for both L1 and L2 stops were produced for LP speakers (WS and HS). This indicates that there was a strong L1 influence on L2 speech for these speakers. Third, VOT length for both L1 and L2 stops was closely related with proficiency in L2 English; longer for LP speakers whereas shorter for non-LP speakers. Once L1 stops were produced short, L2 stops were short as well and vice versa. Fourth, the VOT shortening of Korean aspirated stops can be observed from most of proficient speakers except for speaker YB. For example, IP speakers MK, IY, and NK produced both stops relatively shorter, indicating that there must be a strong L2 influence on L1 speech. For these speakers, there were little VOT differences between L1 and L2 stops.

The overall results of the present study showed that, in the production of L1 and L2 stops, VOTs among L2 speakers differ according to proficiency in L2 English. The VOT shortening was robust for IP speakers due to the cross language phonetic influences.

4. Conclusion

The present study examined the VOTs of L1 Korean and L2 English voiceless aspirated stops produced by Korean speakers. The result showed that there were cross language phonetic influences and the influences differed in terms of proficiency in L2 English. In addition, the VOT shortening occurred for most of proficient speakers. Overall, in L2 English, high proficient speakers produced VOTs that were similar to those of native speakers of English whereas low proficient speakers produced VOTs that were significantly longer than those of proficient speakers. In L1 Korean and L2 English, most of the proficient speakers produced VOTs similarly. Unlike previous findings, Korean VOTs were even shorter than English counterparts for most of the speakers. The VOT shortening of aspirated stops in Korean was found for most of the proficient speakers.

According to Grosjean's (1989) view that interference is bid-direction ($L1 \leftrightarrow L2$), the two language systems are influenced with each other. Once L1 stops were produced shorter, L2 stops were produced shorter and vice versa, indicating that the two phonetic systems were influenced with each other. The shortening phenomenon was found for most of proficient speakers, but not for LP speakers, indicating that it was closely related with proficiency in L2.

The findings of the present study suggest that cross language phonetic influences as well as the ongoing VOT shortening in Korean aspirated stops may be correlated with L2 proficiency. Learning a new language may trigger the sound change of L1 or vice versa due to cross language phonetic influences.

Since the present study is a pilot study with a small number of participants for each proficiency group, further study is necessary to generalize.

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APPENDIX (Questionnaire)

Part A. Biographical information

1. Gender: Male Female
2. What is your age?
3. What is your nationality?
4. What is your native language?

(If you grew up with more than one language, please specify)

5. What is your major here in college?
6. What is your status here in college?
7. How long have you stayed in the US?

Part B. Rate your proficiency in L2 English

1. Rate yourself according to the following categories:
 Your overall comprehension ability in English: 1 2 3 4 5
 Your overall speaking ability in English: 1 2 3 4 5
 Your overall reading ability in English: 1 2 3 4 5
 Your overall writing ability in English: 1 2 3 4 5
 Your overall pronunciation in English: 1 2 3 4 5
 (1=Very Poor, 2=Poor, 3=So-so, 4=Good, 5=Very Good)

2. Do you have an accent when you speak English? If so, please rate the strength of your accent according to the following scale.

No Accent, Very weak, Weak, Intermediate, Strong, very strong

Thank you very much for your honest responses and for your help with this study.