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Against Intrusive r Strategy in English Vowel Hiatus: Evidence from the Buckeye Corpus and L2 Speech

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ABSTRACT

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As phonologically-documented, in vowel-vowel (VV) sequences within words or across word boundaries, when the first word ends in one of the non-high vowels such as /ə, ɑ, ɔ/ and the following vowel gets unstressed, intrusive *r* is added intervocalically. This paper attempts to examine and analyze whether such /r/-epenthesis takes place to avoid vowel hiatus in the speeches of Korean L2 English speakers (KS) collected from the production task compared to those of English native speakers (ES) extracted from the Buckeye Corpus of spontaneous conversational speech. As stimuli for both KS and ES, VV sequences across word boundaries are mainly targeted based on the possible anti-hiatus strategies, i.e. r-intrusion, glottal stop insertion and vowel deletion as well as canonical variant. Interestingly but strikingly, r-intrusion is hardly observed in both groups. For the tokens of ES, vowel hiatus predominantly arose and vowel elision was second-best. For the KS's tokens, no *r* was embedded, either. However, Korean L2 English speakers behave differently given their English proficiency. For KS with low proficiency (LP), a pause between two vowels results in glottal stop insertion but a canonical form is the most favored with no pause. However, for KS with high proficiency (HP), a pause is hardly placed in hiatus contexts and canonical variants predominantly surface. Unlike LP KS, a pause does not play a key factor to apply any other anti-hiatal strategies and further the effect of vowel height is quite significant, i.e., hiatus is more tolerated in V1-non-high than in V1-high. Contrary to the phonological claims of intrusive *r* as a hiatus breaker, vowel hiatus remains intact with no *r* intruded.

KEYWORDS
vowel hiatus, intrusive *r*, glottal stop insertion, Buckeye Corpus, variation, L2 speech

1. Introduction

In English, as well-defined in the literature so far (Broadbent 1991, Bronstein 1960, Casali 1996, Gimson 1980, Harris 1990, Lee 2018, McCarthy 1993, Uffmann 2007 and many others), when two vowels are locally adjacent but heterosyllabified within words or across word boundaries, a consonant, as a hiatus breaker, is usually epenthesized. At the point of hiatus, i.e. in vowel-vowel (VV) sequences, a glide /j/ or /w/ is added to avoid vowel clash. When the preceding vowel or V1 is high-front or has a high-front offglide, a palatal glide /j/ is inserted. On the other hand, a labio-velar glide /w/ is inserted when V1 is high-back or has a high-back offglide, i.e. homorganic. However, when the first word ends in one of the non-high vowels such as /ə, ɔ, ɑ/, a non-etymologic /r/ (the term originating from McCarthy 1993) is added as witnessed in '*law-r office*' and '*idea-r of*' (Bronstein 1960) and so forth. Unlike glide /j, w/-insertion, /r/-epenthesis is only found in the specific environment in which V1 is not diphthongal. Furthermore, the added *r*, also-called *intrusive r*, is not relevant to the featural characteristic of the preceding vowel.

Targeting the spoken data involving vowel hiatus across word boundaries, this paper attempts to examine and analyze the presence or absence of /r/-epenthesis in VV contexts from the speech tokens of Korean L2 English speakers (KS) in comparison with those of English native speakers (ES). For the latter, the speech tokens of VV contexts were extracted from the Buckeye Corpus containing the spontaneous conversational speech data from the people who live in the state of Ohio, USA. However, for collecting the spoken data of KS we conducted a speech production task in which twenty Korean students majoring in English were recruited and participated in this experiment. One step further, in order to check any difference in the way of resolving vowel hiatus, Korean L2 English learners were divided into two groups according to the level of English proficiency based on their scores of TOEIC; one group of ten belongs to the low-intermediate proficiency (LP) of English and the other ten belong to the level of high proficiency (HP).

To investigate whether or not /r/-epenthesis takes place in both speeches of ES from the Buckeye Corpus and those of KS from the speech production task and, further, compare the speech tokens of ES to those of L1 Koreans with respect to the selection of any other strategies if intrusive *r* is not chosen in hiatus contexts, two well-trained Korean researchers analyzed and assessed all the speech tokens of both groups employing the Praat 6.1. As phonologically-described, focusing on the emergence of intrusive *r* in the hiatus contexts of V1-non-high across word boundaries, we also examined any other possibilities of resolving hiatus in the same environments such as glottal stop insertion, V2-deletion and V1-deletion as well as canonical variant, i.e. an underlying form. The speeches of ES extracted from the Buckeye Corpus showed the tendency that no *r* is intruded in VV sequences. As will be discussed in more details later, the speech tokens of Korean L2 English learners also showed the similar pattern to those of ES, i.e. vowel hiatus remains unresolved instead of /r/-intrusion.

To this end, this paper is organized as follows: section 2 briefly sketches the description of English /r/-epenthesis in both phonological and phonetic perspectives. Section 3 introduces the current research based on the Buckeye Corpus of spontaneous speech and analyzes the ES's speech tokens to investigate how to repair vowel hiatus via adopting the Praat 6.1 and, further, provides the SPSS-based statistical results. Section 4 introduces the whole procedures of speech production task for Korean L2 English learners and provides the speech analyses as well as the SPSS-based statistical results. Likewise in the ES's spoken data, intrusive *r* is hardly uttered in both groups of LP and HP KS. Korean L2 English learners do not exert any articulatory effort to resolve vowel hiatus, either. As will be discussed in details later, the effect of a pause from LP KS and that of V1-high from HP KS are both significant in selecting other resolution strategies to break up vowel sequences. In section 5 general discussions are provided, which is followed by section 6 summarizing and concluding the present paper.

2. Theoretical Background

2.1 Phonological Perspectives on English Vowel Hiatus

As well-defined in the literature, intrusive *r* is an epenthetic or non-etymological *r* that occurs at hiatus position in r-less or non-rhotic dialects of English, for example, in Received Pronunciation (RP), across SE England and in E. Massachusetts. As observed and described in Gimson (1980: 208), a word-final postvocalic /r/ is retained before a vowel as the spelling indicates as in '*poor Ann*', '*fur inside*', '*near it*', and so on. This RP system of linking *r* gives rise to the creation of analogous links in similar phonetic contexts, i.e. unconsciously using intrusive *r* links after final /ə/ among those who object most strongly. However, some RP speakers try to suppress such undesirable speech habit by using a pause or a glottal stop in the critical cases of vowel hiatus. As Bronstein (1960: 122) also points out, the intrusive *r* is widespread in less-educated people but it is also found in educated colloquial speech. Accordingly, he claims that intrusive *r* is considered 'part of the substandard pattern'. Also note here that, as argued in Carr (1999: 127), intrusive *r* is very widespread across many accents of English, thus there is no reason that it should not spread to the rhotic accents of English.

As briefly mentioned above, in English, when two vowels are juxtaposed within words or across word boundaries, i.e. in hiatus contexts, they are split off by means of consonant insertion, usually glides, to ease the articulation in fast or casual speech. According to the tongue height and backness of the preceding vowel or V1, a different glide is inserted to break up vowel sequences. When the first vowel is high-front or has a high-front off-glide, a homorganic palatal glide /j/ is added between two vowels while a homorganic labio-velar glide /w/ is inserted when the first vowel is high-back or has a high-back off-glide as witnessed in [si*j*iŋ]/[si*j*ɛd] and [flu*w*ɪd]/[slouʷɑpɹəz], respectively. However, irrespective of the V1's height and backness, a coronal approximant *r*, is embedded between two vowels when V1 is non-high such as /ə, ɔ, ɑ/. Following Bakovic (1999) and Delattre and Freeman (1968), it is assumed that such *r*, transcribed as [r] in IPA, has both a coronal gesture and a pharyngeal constriction.

Intervocalically-intruded /r/ in English as well as linking /r/ (or liaison /r/) has been phonologically spotlighted, thus dealt with in different theoretic perspectives thus far (Bakovic 1999, Broadbent 1991, Bronstein 1960, Kahn 1976, Lee 2018, McCarthy 1991, 1993, Uffmann 2007 and many others). Though it is not targeted how intrusive /r/s have been dealt with phonologically here, let us briefly take a look at the emergence of intrusive *r* at the levels of connected speech. As well-described and defined in the previous literature cited right above, non-rhotic accents of English in Received Pronunciation (RP) across SE England and in E. Massachusetts do not allow /r/s in rhymes even though the rhotic accents of English always do. Postvocalic /r/s in words such as '*car*' and '*farm*' disappear when uttered in isolation. Those /r/s, however, come alive when two words of phrases are concatenated as in '*far away*' or '*answer it*' where the /r/ is underlyingly present. This is called linking /r/ or etymologic /r/. Unlike linking *r*, intrusive *r*, also-called non-etymologic /r/, is epenthesized between two vowels though it is not underlyingly present as in '*saw America*'.

As well-described in Bronstein (1960) as well as Gimson (1980), intrusive *r* is attributed to the strong analogy to linking *r* in which the *r* reappears when it is followed by a vowel-initial word as in '*fear of*' even though this *r* is not heard in *fear* [fɪə], i.e. /r/ is completely dropped off. Therefore, intrusive *r*, though such /r/ is not underlyingly present, is widespread in the speeches of r-less speakers across morpheme boundaries (as in *draw[r]ing*) or across word boundaries as well (as in *draw [r]it*). In addition, intrusive *r* is much more frequent after the vowel /ə/ than the vowel /a/ or /ɔ/.

As denoted in McCarthy's (1991, 1993) observation and analysis on the retention and insertion of /r/ in the Eastern Massachusetts dialect of English, /r/ is invoked as a hiatus breaker when two adjacent vowels sit side by side within words and across word boundaries. Note here that such /r/s never occur preconsonantally or utterance-finally. This means that it must be always followed by a vowel in the same utterance. In addition, the vowels such as *a,ə* or *ɔ* are never followed by a vowel, which gives rise to /r/-intrusion before a following vowel-initial word. The relevant data are laid out in (1).

(1) /r/-deletion, insertion and linking (McCarthy 1991: 193)
   a. /r/-loss
      The spa*r* seems to be broken.   (cf. The *spa* seems to be broken.)
      He put the tune*r* down.   (cf. He put the *tuna* down.)
      You'*r*e somewhat older.   (cf. The boat tends to *yaw* some.)
   b. /r/-linking (or /r/-liaison)
      The *spar* [ɑr] is broken.
      He put the *tuner* [ər] on the table.
      You're [ɔr] a little older.
   c. /r/-intrusion
      The *spa* [ɑr] is broken.
      He put the *tuna* [ər] on the table.
      The boat tends to *yaw* [ɔr] a little.

As observed in (1), r-loss, r-retention and r-intrusion are highly influenced by the context of the following word, i.e. vowel-initial or consonant-initial. As observed in (1a), the underlying /r/s, as italicized, are all deleted preconsonantally, which leads to merger of '*spa*' and '*spar*' as [spa]. However, in (1b) and (1c), merger in the opposite direction takes place in prevocalic contexts. The underlying /r/s are realized before the following vowel-initial word as in (1b) while the underlyingly-absent /r/ is inserted as in (1c). Therefore, '*spar*' and '*spa*' become homophones as [spar]. One step further, the realization of the /r/ in (1b) and (1c) neutralizes underlying contrast, that is, r-final vs. vowel-final, respectively. The former is etymologically linking *r* and the latter is non-etymologically intrusive *r*.

As well-defined in the previous phonological literature (Johansson 1973, Kahn 1976, McCarthy 1991, Mohanann 1985, Pullum 1976, Vennemann 1972 among others), the distribution of *r* is syllabically-conditioned. As argued in Broadbent (1991) as well, this r-formation results from the fact that some property of the first vowel, i.e. a non-high lax vowel, spreads to the following empty onset. The epenthesized /r/ in (1c) plays a key role as an onset filler to satisfy the syllable-wellformedness condition as schematized in (2) where /r/ is added as in *sawing* [sɔ̠ɹɪŋ] and *saw Ed* [sɔ̠ɹɛd].

(2) Intrusive *r* required (McCarthy 1993: 171)
   a. [sɔ]σ [ɪŋ]σ
   b. [sɔ]σ [ɛd]σ

As specified, intrusive *r* is frequently found in cases where a vowel-final word is followed by a vowel-initial

suffix as in (2a) or another word beginning with a vowel as in (2b). Note again that the first vowel is non-high. Given the phonological point of view, this /r/-epenthesis after non-high vowels is analogous to the realization of glides as claimed in Bronstein (1960), Kahn (1976), Broadbent (1991), Uffmann (2007) and Lee (2018). Therefore, this *r* is syllabified as an onset, which fulfills the constraint ONSET militating against any vowel-initial syllables (Ito 1986, 1989).

As such, as defined in a number of phonological works mentioned above, an intruding /r/ in hiatus contexts is often witnessed in colloquial speech irrespective of any sociolinguistic suppression or speakers' degree of education, etc. in non-rhotic dialects of English. As the data clearly indicate, intrusive *r* in VV contexts is invoked as a hiatus breaker or an onset-filler to remove a vowel-initial syllable as conforming to the condition of syllable-wellformedness.

2.2 Phonetic Grounds on English Vowel Hiatus

Though just few in number with respect to the phonetic approach to /r/-epenthesis in North American English and not even similar to the current speech production task either, here let us briefly discuss the valuable findings of Davidson and Erker (2014) in which glide-insertion is not invoked as a repair strategy of hiatus resolution in English. As briefly mentioned earlier, glide-insertion is adopted to resolve hiatus in VV sequences, thus a high front glide [j] or a high back glide [w] is embedded through the assimilation process to the V1's height and backness.

Given Davidson and Erker's (2014) phonetic approach to hiatus resolution in English, they divide VV sequences into three environments: VV sequences within words (VV), VV sequences across word boundaries (VBV) where V2 gets stressed and VV sequences with the second word beginning with a glide (VGV). Note here that, in all three categories, the first vowel ends in a high front/back vowel or has a high front/back offglide, which means that a front glide /j/ for the former or a round glide /w/ for the latter is epenthesized in general. However, they do not deal with the data of /r/-epenthesis in which the first vowel ends in a non-high vowel in their speech production task.

The participants of fourteen are all college students ranging in age from eighteen to twenty-four attending NYU in New York, USA. Though the participants belong to the younger generation and are limited in number as well, they do not employ glide /j, w/-insertion as an anti-hiatal strategy in their speech production. Rather, vowel hiatus is resolved by glottal stop insertion across word boundaries, i.e. in VBV where the second vowel gets stressed as witnessed in '*see [ʔ]ótters*' (Davidson and Erker 2014). However, in both VGV and VV contexts, hiatus is simply tolerated, thus glottal stop insertion as well as glide insertion is not witnessed at all. One step further, they added further experiment and reported that a glottal stop is not uttered in VBV, this time, the second vowel is unstressed, thus hiatus still remains unresolved. Here one thing worthy to consider is that glottal stop insertion in VBV is highly associated with the presence or absence of V2-stress. To put it differently, no glottal insertion is found in VBV where V2 is not stressed.

As will be discussed in details later, the current phonetic study was designed to examine how Korean L2 English learners attempt to resolve vowel hiatus when the first word ends with a non-high vowel and its following word begins with a schwa, i.e. a function word. In fact, the major concern of the present study is whether or not intrusive *r* is adopted as an anti-hiatus strategy as phonologically described. In comparison with the present study, the experiment of Davison and Erker (2014) mainly focuses on the employment of glide /j, w/-insertion among young English native speakers in the context of vowel clash. Davidson and Erker (2014) found that glottal stop insertion is frequent before V2-stress but is completely blocked before an unstressed V2 in VBV.

The research points will be addressed throughout the present paper. First, whether or not vowel hiatus is resolved by so-called intrusive *r* and other strategies such as V1-deletion, V2-deletion, glottal stop insertion and canonical variant in both speeches of ES and KS. Remind here that, as reported in Davidson and Erker (2014), hiatus is readily resolved by means of [ʔ]-insertion with V2 stressed instead of gliding but there appears no hiatus resolution elsewhere, even in VBV where V_2 gets unstressed, which results from their additionally expanded experiment. Second, do Korean English learners show the similar pattern in resolving hiatus? Third, is there any possibility that L1's phonological difference of syllable-timed Korean may affect the speech production of stressed-timed English? If possible, Korean learners of English may not resort to V2-deletion to repair vowel hiatus. Rather, they hold both vowels sometimes or insert a pause between two vowels some other times, which results in glottal stop insertion.

Taken together, when vowel hiatus arises across word boundaries, inserting a consonant, mainly a glide, is a good choice to remove vowel clash. In order to achieve a phonologically well-formed syllable structure, a glide *j* or *w* fills an empty onset in general. Putting aside the issue whether a postvocalic *r* is a glide or not, /r/ is mainly adopted as a hiatus breaker, especially after non-high vowels in English. However, as reported phonetically though it is rare and limited only in Davidson and Erker (2014) for North American English, glide-insertion is not a welcome strategy to relieve vowel hiatus among English young speakers. Rather, for the word-boundary VBV environments, a glottal stop [ʔ] is chosen before a stressed vowel to split off vowel sequences since it is the least-marked consonant for place (de Lacy 2006). Elsewhere, hiatus stays intact even in VBV where V_2 gets unstressed.

3. English Speakers' Production of Vowel Hiatus

3.1 Data Collection and Analysis

As briefly mentioned above, the Buckeye Corpus was created out of linguistic interests in phonological variation and spoken word recognition by eliciting spontaneous American English (Fosler-Lussier et al. 2007, Pitt et al. 2005). Forty native speakers of English were recruited from Columbus, Ohio, USA and their conversations were recorded. They were all middle-class Caucasians and their recordings were stratified according to their sex (half women and half men) and age (half under 30 years old and half over 40 years old). This corpus is evaluated such that the sample is large enough to reflect interspeaker variations and represents the speech community (Fasold 1990). The corpus is composed of approximately 300,000 transcribed words and 870,000 phones. Talkers had interviews about multiple topics such as politics, schools, family, and so on. Conversations were recorded digitally in WAV file formats and were transcribed orthographically and phonetically.

To examine whether and in what context 'intrusive *r*' emerges in conversational speech of American English speakers, a total of forty tokens of two-word phrases were randomly elicited from the Buckeye Corpus. The first words in the sequence are mono-, di- or trisyllabic and they end with a vowel. The second words start with a vowel /ə, ɪ, a, æ, o/. In this study, we explored two potential factors influencing the applicability of intrusive *r* in English: lexical frequency of the first word and the height of the first vowel in VV sequences. First, to investigate the effect of the frequency of the first words in the sequences, twenty target sequences contained the high-frequency words as the first word whereas the other twenty embedded the low-frequency words (e.g., *agree on* vs. *apply in*). Second, to see the effect of the height of V1, four groups of stimuli were elicited according to

the height of the final vowels of the first words: /i, u/w, ə, ɔ/ (e.g., *agree on, you are, area of, law and*). Note here that some of high-vowel tokens were employed as filler words to hinder subjects from noticing the experimental design.

Table 1 illustrates the tokens and their numbers collected from the Buckeye Corpus. V1 refers to the vowel placed at the end of the first target words, i.e. the first vowel in vowel-hiatus context and the numbers refer to the number of tokens of target sequences for the analyses in the study. In total, 118 stimuli collected from the Buckeye Corpus were analyzed, including 107 stimuli containing high-frequency words and 11 stimuli embedding low-frequency words as the first word in vowel-hiatus contexts. Tokens were divided into two frequency categories according to the occurrences of each token, i.e., tokens above frequency 10 are high and those below frequency 10 are low.

Table 1. Tokens (First Words in the Sequences) and their Frequency in the Buckeye Corpus

Freq	V$_1$	Word 1	# of tokens analyzed	Freq	V$_1$	Word 1	# of tokens analyzed
Hi	/a/	blah	3	Lo	/ə/	sorta	1
	/ɔ/	saw	28			Africa	1
		law	18			visa	1
		draw	4			yoga	1
	/ɪə/	area	21			Tulsa	1
		idea	15			ultra	1
	/ə/	hafta	4			charisma	2
		kinda	3			diploma	1
		data	6			Arizona	1
		extra	5			Capita	1
Total			107				11

The token sound files extracted from the Buckeye Corpus were evaluated aurally from two researchers to identify the /r/ portion, i.e. whether /r/ is inserted between two vowels or what type the realization variant is. As stated earlier, the production type of each token was categorized into one of five: (i) canonical form, (ii) intrusive-r insertion, (iii) glottal stop insertion, (iv) V2-deletion, and (v) V1-deletion.

3.2 Results

Figure 1 shows the number of tokens for each production type variants produced by native American English speakers. Table 2 shows the number of tokens and their rates for each of five categories where each variant is realized and accordingly labeled via auditory judgment by two phonetically trained authors. As shown in Figure 1 below, two most frequent variants in the vowel hiatus environments were canonical variants and V2-deletion ones, amounting to 40.7% (n = 48) and 33.9% (n = 40), respectively. Interestingly, intrusive-r variants were extremely rare, realized solely as two tokens in high frequency phrases. Glottal stop insertion variants constituted 18.6% (n = 22) in the corpus.
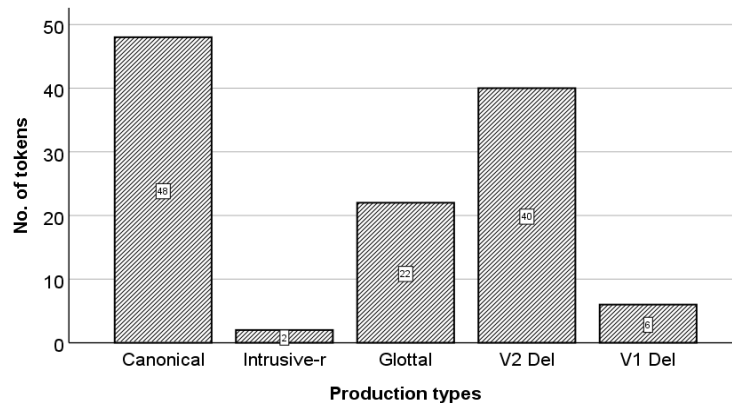
Figure 1. Number of Tokens for Each Production Type

The chi-square tests revealed that the overall patterns of the occurrences of these five types of variants are influenced by the frequency of the first words in the tokens (X^2(df4) = 12.81, $p < .05$). The results are deviant from our expectation to some extent in that so-called 'intrusive-r' was not realized by the native American English speakers in the Buckeye Corpus. They indicate that vowel hiatus tends to be tolerated despite of its phonological markedness or is handled with other repair strategies such as glottal stop insertion or vowel elision.

Table 2. The Tokens and Rates (%) of Production Variants by Frequency of the First Words

	Canonical	r-insert	Glottal stop	V2-Del	V1-Del
Lo freq.	2 (18.2)	0	0	9 (81.8)	0
Hi freq.	46 (43)	2 (1.9)	22 (20.6)	31 (29)	6 (5.6)
Total	48 (40.7)	2 (1.7)	22 (18.6)	40 (33.9)	6 (5.1)

In order to probe the potential influence of the height of the word-final V1 on the production variants, analyses were performed. The results showed that the vowel height (low vs. mid) does not affect the variants type (X^2(df4) = 4.48, $p > .05$). To be specific, the VV sequences across word boundaries were realized as canonical forms by 100% (n = 11) when the V1s are low and the most frequent variants were also canonical when the V1s are mid (39.1%). In addition, V2-deletion forms were quite common with 33.9% of realizations. Intrusive-r arose only with two tokens (1.7%) in the mid-vowel condition. These results were obtained via examining the distribution of the production of VV sequences using the Buckeye Corpus. They suggested that English native speakers did not create intrusive-r type unlike the traditional phonological description of the rule in the context of vowel hiatus and the prevalent realization was the canonical forms, i.e. the underlying forms.

Acoustic analyses were undertaken to examine the variation in the vowel hiatus production. In particular, the duration of the surface vowels across a word boundary was measured. A one-way ANOVA exhibited that the duration of the vowel in the vowel hiatus context was affected by the production types (F(4, 117) = 21.4, $p < .001$). As illustrated in Figure 2, the duration of vowel parts across a word boundary is longest in the intrusive-r variant and the canonical realizations, i.e. 222ms and 217ms, respectively. Glottal stop variants also had comparatively long durations (198ms), exhibiting no significant differences from the two conditions as evident from post-hoc LSD analyses (all $p > .05$). On the other hand, as naturally estimated, the vowel parts are significantly shorter for V2-deletion or V1-deletion variants as one vowel is deleted. One thing to note is that

intrusive *r* or glottal stop insertion between the vowels does not influence the temporal properties of the vowels in the canonical forms.
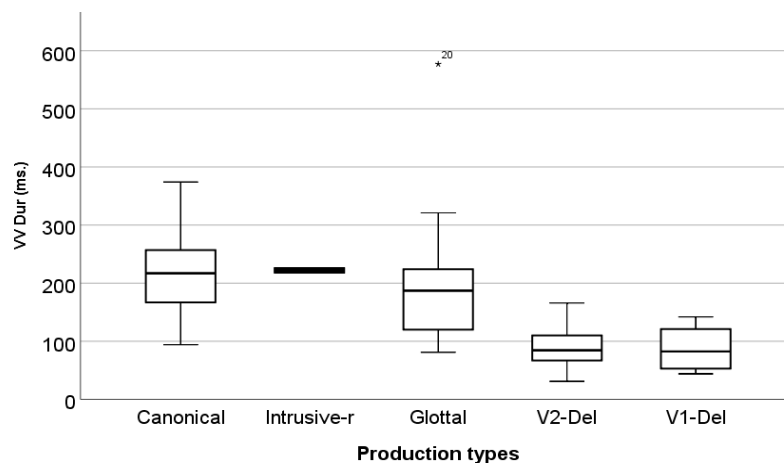

Figure 2. Duration of Vowel(s) across Word Boundary by Production Type

Lexical frequency of the first words or the height of their word-final vowels did not exert an influence of the durations of the vowel parts. The duration of the inserted glottal stops was also measured to confirm that glottal stops were inserted substantially. The average duration was 67.8ms, ranging from 13 to 189ms (*SD* = 48). Mean durations of glottal stops by the first words in the stimuli are illustrated in Table 3. The glottal stops were longest after '*draw*' and shortest after '*kinda*'. Furthermore, the rates of glottal insertion varied depending on the first words. For instance, out of 10 stimuli, three sequences containing '*idea, area, saw*' showed the comparatively higher susceptibility to glottal stop insertion, respectively, 27% (= 4/15), 24% (= 5/21), 21% (= 6/28).

Table 3. Duration of the Glottal Stops Inserted between Vowels by the First Words in the Buckeye Corpus

V1	Word 1	No.	Mean Dur	Min	Max
/ɔ/	saw	6	46	21	70
	law	1	31	31	31
	draw	1	189	189	189
/ɪə/	area	5	76	20	114
	idea	4	97	42	179
/ə/	hafta	1	73	73	73
	kinda	2	19	13	25
	data	1	54	54	54
Total		21	68	13	189

In sum, the canonical realizations of vowel sequences in vowel-hiatus contexts are the dominant production in spoken American English as evident from the Buckeye Corpus. This corpus data are inconsistent with the rule description of intrusive-r phenomenon documented in the phonological literature. In addition, it was found that vowel deletion (39%) was quite a common strategy to resolve vowel hiatus and glottal stop variants also emerged to some extent (19%) but the expected intrusive-r variants were markedly few and rare (1.7%).

4. Korean Speakers' Production of Vowel Sequences

4.1 Participants

Twenty Korean learners of English participated in this speech production task. Twenty speakers are all undergraduate students attending Daegu University in Korea and were majoring in English at the time of their participation. According to the scores of the official English test of TOEIC, participants were divided into two groups: ten low-intermediate and the other ten advanced learners. For the latter group of HP KS ranging in age from twenty-one to thirty, the majority of the participants does not have any experience to stay in English-speaking countries but one of them stayed for 7 years while the other did for a half year. It is also reported that their English learning period in Korea from elementary school to the present is 14.2 years on average and that the English ability judged by themselves was the average score of 6.6 on the scale from 1 the least to 10 the most. Furthermore, the lower proficiency group of 10 KS are on average 21 years old, ranging from 20 to 28 years old. Seven were female and three male. Their average period of learning English in the formal education setting was 10 years ($SD = 2.2$). Only three out of ten KS had experience of staying in English-speaking countries. Their average self-evaluation score of English proficiency was 5.7. This information indicates that they are English learners of intermediate level. Among twenty Koreans, 9 male and 11 female students participated in this experiment. There is no report that anybody suffers from speech or hearing disorders. They received an appropriate amount of monetary compensation for their participation.

4.2 Materials

On the analogy of ES's tokens extracted from the Buckeye Corpus in which the first lexical word ends in a non-high vowel and the second one is a vowel-initial function word, the target stimuli were selected and included the word-boundary VV environments. The total KS's tokens used in this experiment were 180 and, among them, 63 tokens consisted of filler words. Except for the filler tokens, the total 117 tokens were analyzed and evaluated (2340=117x20). Among them, some lexical words (60 in total) end in a non-low vowel to check whether or not the participants are influenced by vowel height, thus overapply r-intrusion to fix vowel hiatus in VV contexts. After the production task of twenty Koreans, two researchers discriminated and assessed each token to see i) the presence or absence of hiatus resolution in VV contexts and further, if hiatus is resolved, on what strategy Korean L2 English learners mainly rely among five possible categories as arranged in (3) below. Note that no articulatory effort to repair vowel hiatus is made in (1e) with both vowels uttered and (1b) with a pause embedded intervocalically, which helps a glottal stop epenthesized concomitantly. Note again that the second vowels are all unstressed.

(3) The possible ways of hiatus resolution in VV contexts

    a. r-insertion   /r/ is inserted intervocalically.

    b. ʔ-insertion   A glottal stop is inserted (when there is a pause).

    c. V2-deletion   V2 is deleted.

    d. V1-deletion   V1 is deleted.

    e. VV   Both Vs are uttered with no hiatus resolution.

Among the five categories with respect to the strategies to fix vowel hiatus, we examine the presence or absence of hiatus resolution and further, if hiatus is resolved, which strategy is favored the most or the least between LP KS and HP KS in comparison with ES's speech from the Buckeye Corpus as observed and described above. As discussed in details later, due to the lack of the /r/-intrusion strategy in the speeches of both ES and Korean L2 English learners, the remainders in (3) are mainly targeted as the production types in hiatus contexts.

4.3 Procedures

Recordings took place in a quiet room using the headset equipped with a microphone attached to the desktop computer. Prior to recording, each participant was given a reading sheet in which the total 180 tokens are divided into three blocks of 60 tokens which are randomly arranged. After reading each block at once, the participants got a brief break and finished the whole recording right after reading the last 60 tokens of the reading sheet. Each participant was also asked to read the whole list of tokens in a fast speed as much as they can and complete the survey of personal information related to the current experiment before or after his or her recording. Each token consists of a two-word sequence and is read, for instance, "*Please say __gonna also__*" and, further, in the reading sheet, the first word ending in a consonant or in a non-low vowel is also included, which enables the participants not to catch the experimental design. Recordings were made using the Praat 6.1 version (Boersma and Weenink 2020) at a sampling rate of 44 KHz. After the whole recordings were complete, two researchers analyzed and assessed two sets of tokens whereby one took the tokens of LP KS and the other took those of HP KS.

4.4 Results

Due to the severe rarity of /r/-epenthesis in hiatus contexts from both speeches of ES and KS, we excluded /r/-epenthesis from the further consideration and mainly focused on the remaining surface types of canonical form, glottal stop insertion with a pause, V2-deletion and V1-deletion. To see whether the participants exert any effort to resolve vowel hiatus and further, if hiatus fixed, which strategy they prefer the most, the KS tokens from the recordings were discriminated and evaluated. Compared to the ES tokens in which r-intrusion is not a welcome strategy of hiatus resolution in VV sequences, the KS speeches also showed the similar pattern, i.e. hiatus remains unresolved and, further, especially in LP KS, [ʔ]-insertion takes place when there exists a pause between two vowels, which goes against the results of Davidson and Erker (2014) where it appears only when V2 gets stressed. It is highlighted that the intrusive-r strategy is rarely witnessed in the speeches of both ES and KS. Among KS's speeches, the participants' English proficiency makes a significant difference in the adoption of a repair strategy in hiatus contexts. What comes next is the different behavior of LP KS from HP KS in VV sequences along with their statistical results.

4.4.1 Low-proficiency KS

Table 4 shows the numbers and the rates of the production type by frequency for LP KS. As illustrated, the vowel-hiatus context where r-insertion is expected to occur was handled with approximately four types of production: canonical VV sequence, glottal stop insertion, V2-deletion and V1-deletion. Note again that the strategy of r-insertion is not favored in KS as well as ES, thus it is not considered here. Regardless of lexical

frequency of the first word in the string stimuli, the most frequent form was the production with glottal stop insertion (57.7%). The canonical variant form, i.e. vowel hiatus, was also quite frequent (41.95%) whereas deletion of V1 or V2 was rare, occurring below 1%. The one-way repeated-measures ANOVA revealed that the rates of each production type were significantly different ($F(3, 27) = 9.63, p < .001$). Most striking and unexpected is the finding that the r-insertion variant form was never realized by LP Korean L2 English speakers. Overall, the VV sequences across word boundaries were realized as glottal stop variants or canonical VV forms.

As clarified below, the data in Table 4 were analyzed further to see if lexical frequency of the first words affects the distribution of the production variants. The Pearson Chi-Square test showed that the four production patterns are not influenced by lexical frequency ($X^2(df3) = 4.04, p > .05$). This indicates that glottal stop variants or canonical variants constitute the most frequent types of realization regardless of whether the first words are high- or low-frequency ones.

Table 4. The Tokens and Rates (%) of Production Variants by Frequency of the First Words

	Canonical	Glottal stop	V2-Del	V1-Del
Low freq.	239 (40)	358 (59.9)	0 (0)	1 (0.2)
High freq.	263 (43.8)	333 (55.5)	1 (0.2)	3 (0.5)
Total	502 (41.9)	691 (57.7)	1 (0.1)	4 (0.3)

We further examined whether the presence or absence of a pause exerts an influence on the production patterns for VV sequences for the LP L2 English KS. Table 5 shows the tokens and rates of production variants by the presence of pauses. First, when VV sequences were uttered without pauses, 92.4% of the sequences were realized canonically, surfacing in the VV forms. The glottal stop was inserted between the vowels only in 6.8% of the tokens, resolving the vowel hiatus. In No-Pause condition, the rates of each production type revealed significant differences ($F(3, 24) = 42, p < .001$). Second, interestingly, when the two-word sequences were produced with a pause across a word boundary, a glottal stop was inserted approximately with 94% of the tokens. On the contrary, the percentages of canonical type were very small, amounting only to 6%. The rates for the type of variation were also significant in Pause condition ($F(3, 24) = 804.5, p < .001$). This finding indicates that the presence or absence of a pause between vowels across a word boundary plays a crucial role in determining the production type variants. This was also confirmed by a two-way (2x4) repeated-measures ANOVA with pause and production type as within-subject factors, showing a significant interaction between the two ($F(3, 21) = 84.1, p < .001$). The significant influence of the pause in the distribution of the production type was also confirmed by the Chi-Square test ($X^2(df3) = 903.3, p < .001$).

Table 5. The Tokens and Rates (%) of Production Variants by the Presence of Pause between the Two Words (Parentheses represent the percentages.)

	Canonical	Glottal stop	V2-Del	V1-Del
No pause	460 (92.4)	34 (6.8)	1 (0.2)	3 (0.6)
Pause	42 (6)	657 (93.9)	0 (0)	1 (0.1)
Total	502 (41.9)	691 (57.7)	1 (0.1)	4 (0.3)

Overall, the results show that LP KS tend to realize the tokens containing VV sequences across word boundaries as canonical variants without a pause between the vowels, keeping vowel-hiatus intact. Additionally, the glottal stop insertion variants were most frequent when a pause was found between the vowels. Finally, we

investigated the individual variation with respect to the production type variants. Of interest is that whether the dominant production pattern is canonical VV variants without a pause or glottal stop variants with a pause seems to differ across individual KS.

The individual speakers can be divided into three groups according to their preference for their production type. The first group of KS (K1, K2, K5, K6, K10) showed the enormously frequent realization of glottal stop insertion variants with a pause over the canonical variants without a pause (90% vs. 10%). Conversely, for the second group (K3, K7, K9), the canonical variants occurred more frequently than the glottal stop ones (90% vs. 10%). To be specific, most of the words were realized canonically, tolerating vowel hiatus. The third group (K4, K8) did not show the greater differences in the rates between the glottal stop variants and the canonical forms than the other two groups. This individual preferences are illustrated in Table 6. This finding suggests that the production type patterns are mediated by individual KS's preferences. The Chi-Square tests confirm that individual speakers influence the realization patterns of production type variants (X^2(df27) = 606.2, p < .001).

Table 6. The Mean Rates (%) of Production Variants and Subjects

Subjects	Canonical	Glottal stop	V2-Del	V1-Del
1	9.2	90	0	0.8
2	7.5	92.5	0	0
3	89.2	10.8	0	0
4	63.3	34.2	0	2.5
5	5.9	94.1	0	0
6	18.3	81.7	0	0
7	73.1	26.1	0.8	0
8	50.8	49.2	0	0
9	93.3	6.7	0	0
10	8.3	91.7	0	0

4.4.2 High-proficiency KS

To compare with the production patterns for LP KS, we looked into the production types and their proportions for the same stimuli. Table 7 shows the tokens and mean percentages of the production variants by the frequency of the first words. As seen plainly, regardless of the frequency, the two-word sequences were realized canonically above 90%, preserving the vowel hiatus. The Chi-Square tests revealed that the lexical frequency does not influence the production patterns (X^2(df3) = 1.2, p > .05). Frequency collapsed across the speakers and tokens, the rates for production types were significantly different (F(3, 27) = 1321, p < .001). Specifically, canonical realization was the most frequent, and then V-deletion occurred by 5.6%. The variant of glottal stop insertion was quite rare (3%) and V-insertion variant was the least common.

Unexpected is the finding that canonical variants for HP KS were more than double the percentages of those for LP KS (91.5% vs. 41.9%), indicating that vowel-hiatus is tolerated without any strategies such as vowel deletion, glottal stop insertion, and so forth. Glottal stop insertion emerged less frequently for the former group than the latter group (3% vs. 57.7%). In addition, what is surprising is that r-insertion variant was never spoken unlike our expectation. However, it is not clear whether the HP KS's strong tendency to preserve the underlying vowel-hiatus across a word boundary guarantees that they did not acquire the strategy of intrusive-r or glottal stop insertion.

Table 7. The Tokens and Rates (%) of Production Variants by Frequency of the First Words for High-Proficiency KS

	Canonical	Glottal stop	V2-Del	V-Insertion
Low freq.	523 (91.1)	18 (3.1)	32 (5.6)	1 (0.5)
High freq.	547 (91.9)	17 (2.9)	31 (5.2)	0 (0)
Total	1070 (91.5)	35 (3)	63 (5.4)	1 (1)

We examined whether the presence or absence of a pause between a word boundary influences the patterns of production variants. Table 8 represents the tokens and rates of the production types by pause. Analysis revealed that the presence of a pause exerts an effect on the patterns of production types (X^2(df6) = 66.9, p < .001). Interestingly, this result for HP KS seems to be consistent with that for LP KS as reported above. As seen in Table 8, when a pause was not put across a word boundary, canonical variants occurred most often (90.5%) and then V2-deletion realization was less often (6.3%). On the other hand, when a pause was placed, canonical forms were most frequent (97.6%) and glottal variants occurred more often than V2-deletion variants. In spite of this difference, canonical variants constituted the majority of the production type. In comparison with the characteristics of the speech production of LP KS discussed above, there are two things considered here: first, the HP English learners tend to utter a two-word phrase just like one-word with no pause, which does not necessitate the insertion of a glottal stop. Second, they are also sensitive to the presence or absence of V2-stress. Accordingly, they exert to suppress glottal stop insertion before an unstressed V2 with or without a pause. This results in the maximum use of canonical variants in hiatus contexts as observed in Davidson and Erker (2014).

Table 8. The Tokens and Rates (%) of Production Variants by the Presence of Pause between the Two Words (Parentheses represent the percentages.)

	Canonical	Glottal stop	V2-Del	V-Insertion
No pause	866 (90.5)	30 (3.1)	60 (6.3)	1 (0.8)
Pause	205 (97.6)	5 (2.4)	0 (0)	0 (0)
Total	1070 (91.5)	35 (3)	63 (5.4)	1 (1)

A two-way repeated-measures ANOVA revealed that no main effect of pause was found (F(1, 9) = 2.23, p > .05) whereas main effect of production type was significant (F(3, 27) = 113.5, p < .001). Furthermore, the interaction between these two factors did not arise (F(3, 27) = .91, p > .05). This result seems to be attributable to the finding that canonical variants reached almost ceiling point, occurring most often than the other variants as confirmed by post-hoc analyses.

The data in Table 9 show the tokens and rates of production variants by the height of the final vowel of the first word. It is known that intrusive-r occurs in vowel-hiatus contexts where the first vowel is non-high whereas the glides /j, w/ are inserted when the first vowel is a high vowel. Accordingly, we examined whether the production patterns differ according to the height of the first vowel in vowel-hiatus situations. Chi-square tests revealed that the pattern of variants is affected by the vowel height (X^2(df3)=15.5, p = .001). As seen in Table 9, glottal stop variants and V2-deletion variants were produced more frequently in high vowel contexts than in non-high vowel context. Furthermore, canonical forms were less common in high vowel context than in non-high vowel context. Contrary to our expectation, intrusive-r variants were not realized at all in non-high vowel context or no tokens underwent glide-insertion process. Although the results obtained are not compatible with

typical patterns found for native speakers of English, it is interesting that HP KS's production patterns are sensitive to a phonological factor, i.e. the vowel-height.

Table 9. The Tokens and Rates (%) of Production Variants by the Height of the Final Vowel of the First Word (Parentheses represent the percentages.)

	Canonical	Glottal stop	V2-Del	V-Insertion
Non-high	533 (94.5)	15 (2.7)	16 (2.8)	0 (0)
High V	537 (88.8)	20 (3.3)	47 (7.8)	1 (0.2)

To see whether there are potential inter-speaker variations as to the production patterns like the case of LP KS, we looked into the patterns for individual speakers. Table 10 shows mean percentages of production variants by subjects. Chi-Square tests revealed that the production patterns were influenced by individual subjects (X^2(df27) = 81.1, p < .001). For all subjects, canonical forms constituted the largest number of variant realizations among the production types. According to the relative frequency of glottal variants over V2-deletion variants, the patterns can be divided into two groups. The first group (K1, K4, K5) produced glottal variants more frequently than V2-deletion variants. The second group (K2, K3, K6, k7, K8, K9, K10) showed more frequent realizations of V2-deletion variants than glottal variants. Two or three realizations occurred for all the subjects.

Table 10. The Mean Rates (%) of Production Variants and Subjects

Subjects	Canonical	Glottal stop	V2-Del	V1-Del
1	91.5	6	2.6	0
2	95.7	0	4.3	0
3	90.6	2.6	6	0.9
4	96.6	3.4	0	0
5	89.7	10.3	0	0
6	85.5	2.6	12	0
7	90.6	2.6	6.8	0
8	85.5	2.6	12	0
9	96.6	0	3.4	0
10	93.2	0	6.8	0

In sum, the production patterns for HP KS were markedly different from those for LP KS. First, compared to the number of vowel deletion variants, glottal variants were realized quite less frequently for the former than for the latter. Second, the great majority of the stimuli were realized as canonical forms without any repair strategy for vowel-hiatus contexts for the former.

5. General Discussion

We looked into the production patterns concerning the vowel hiatus resulting from the juxtaposition of two adjacent vowels across word boundaries by L1 English speakers and L2 speakers. To extract the data from these two groups and compare them, the Buckeye Corpus was mobilized for L1 data and L2 data were gleaned from

the production of Korean learners of English. Interestingly and clearly, the canonical variant, i.e. the pronunciation of the underlying vowel sequences, is the dominant production in conversational spontaneous American English as verified from the Buckeye Corpus. This is not in line with our expectation that the strategy of intrusive-r is used to resolve vowel hiatus as often described in the phonological studies. Novel in our finding is that vowel deletion from the Buckeye Corpus is the primary strategy and intrusive-r variants are quite rare unlike our expectation.

Approximately half of the world's languages are known to avoid vowel hiatus with respect to phonological markedness or the ease of articulation (Bell and Hooper 1978, Redford and van Donkelaar 2008). Many strategies have been documented for resolving hiatus or to create phonologically less marked syllable type, i.e. CV, including vowel deletion, glottal stop insertion, insertion of glides such as /w, j/, intrusive *r*, etc. (Allerton 2000). The common hiatus-breakers in English are the approximants /w, j, r/ depending on the first vowels in the vowel adjacency (Cox and Palethorpe 2007). However, given the findings obtained from the corpus-based present study, American English speakers did not adopt the strategy such as intrusive *r* when the first vowels were low or mid. Rather, they tolerated the vowel hiatus or favored vowel deletion. Presence or absence of liaison seems to differ according to a range of factors such as the speaking rate, the string frequency or regional dialects. However, what is interesting in the current corpus study is that intrusive *r*, which is a type of [r]-sandhi, rarely occurred even in the casual, colloquial speech samples in the Buckeye Corpus. This indicates that the speaking rate does not have a significant effect on the applicability of intrusive *r*. Also the findings in this corpus study appear to support the idea that /r/ is not coded or represented in the lexical representations in American English (McMahon, Foulkes and Tollfree 1994).

Hay and Sudbury (2005) suggested in their corpus study that the likelihood of intrusive *r* is affected by the frequency of the collocation and its higher frequency is more likely to induce intrusive *r* in New Zealand English (NZE). It is also proposed that intrusive *r* is also conditioned by social condition in Australian English as well as NZE (Gordon et al. 2004, Hay and Maclagan 2010). In marked contrast to NZE, there was no significant difference in the likelihood of intrusive *r* according to the frequency of the first words in the two-word strings in American English in the Buckeye Corpus along with the striking lack of intrusive *r*.

This striking lack of liaison patterns for native American English speakers in the present study provides interesting implications as to the phonological nature of this rule as well as L2 pedagogy. First, intrusive *r* might be restated in such that its application is mainly optional and not common even in casual conversational speech. Second, it might be estimated that, if the degree of application of intrusive *r* is substantially low, the emphasis on the teaching of this rule also should be adjusted in the formal education settings as well as in the L2 teaching materials.

Cox et al.'s (2014) corpus study in Australian English showed that hiatus was repaired mostly with linking *r* (70.9%) and with glottal stop insertion (22.8%). The combined realization of linking *r* and glottal stop was only 3.4%. Although their study focused on linking *r* conceivably because of non-rhotic nature of Australian English, the rates of likelihood of glottalization is similar to those of intrusive *r* in the Buckeye Corpus (22.8% vs. 18.6%). Their study also examined whether the duration of the two word flanking the vowel hiatus across a word boundary is a predictor of production type. They found that linking *r* was produced with shorter duration whereas longer duration gave rise to higher rates of glottalization. In contrast with the data in Australian English corpus, the Buckeye Corpus in this study showed that the duration of the vowel portion in hiatus does not display significant differences between intrusive-r type, severely rare though, and glottal stop type (222ms vs. 198ms). Of course, we did not measure the total duration of the two words but only of the vowel parts. In any case, this finding indicates that the duration of the vowels flanking the two words is not an influential predictor of

production type whether intrusive *r* or glottal stop insertion in the Buckeye Corpus.

Next, striking in our finding for LP Korean L2 speakers is the dominant production of glottal stop insertion and the absence of intrusive *r*. In particular, 92.4% of the tokens were pronounced as glottalized variants when a pause was placed between the two words. The promotion of the use of glottalization to resolve the hiatus varied according to individual speakers and their use of pause. One possible explanation is that the positioning of the pause creates the environment of inserting the pre-vocalic glottal stop where another foot is formed after the pause. Giegerich (1999) posits that liaison is optionally applied or absent across the foot boundary before which the pre-vocalic glottal stop might occur. The auditory inspection of the word-initial second vowel in hiatus confirms that this vowel is auditorily similar to full vowels such as [ɔ, ɪ, ɛ, ʌ, æ] in the second words of *on*, *of*, *in*, *up*, *and*. Put together, a pause in conjunction with the full, strong vowels gives rise to a new foot, which precludes liaison such as linking *r* or intrusive *r*. This account is offered by Uffmann (2007) positing that vowel hiatus is resolved with a glide to minimize contrast between the two unstressed vowels whereas the insertion of a glottal stop occurs to maximize contrast between a vowel and its adjacent stressed vowel in the hiatus. This indicates that LP KS is sensitive to the prosodic boundary or the foot-based intrusive *r* or glottal stop insertion might be phonetically implemented as evidenced by Korean L2 English speakers. However, this tentative account seems to be implausible for the finding of the Buckeye Corpus probably because the auditory judgment of the second vowels in the hiatus shows that they are mostly weak, reduced vowels and likely to form a foot where liaison might be present with intrusive *r*.

Alternative account is that liaison mechanism including intrusive-r process itself has not been acquired for the LP KS and thus is difficult to mobilize as the effective to cope with hiatus for them. Of course, to confirm this account, further research might be conducted to see if its apparently corresponding linking *r* is produced for these LP KS. Another plausible explanation concerns the amount of exposure to the exemplars produced by English native speakers. Judging from the data found in the Buckeye Corpus, it might be the case that the KS have not been exposed to the exemplars containing the vowel hiatus without intrusive *r* variants like American English speakers. This means that KS pronunciation patterns are similar to those of ES speeches, i.e. no intrusive *r*.

What is of interest is the finding that vowel hiatus remained intact above 90% of tokens produced by the HP KS. Furthermore, other variants such as glottal stop insertion or vowel deletion forms were quite rare below 6%. Compared to the findings for LP KS, HP KS showed higher tolerance of vowel hiatus and lower rates of glottalization. This difference might be attributable to the variation of production patterns such that the former promote the use of glottal stop with pause more greatly than the latter due to lack of fluency. Namely, the latter might have produced the hiatus more smoothly without break than the former, inhibiting the glottal stop insertion.

In sum, the present study reveals three distinct patterns of phonological variants for the vowel hiatus across a word boundary depending on the different L2 proficiency groups: the prevalence of canonical variants and vowel deletion for American English speakers evident from the Buckeye Corpus, the dominance of glottalization and canonical realizations for LP KS and predominance of canonical variants for HP KS. This study makes contribution to accruing the knowledge of the phonological variation in combination with the different strategies to handle vowel hiatus for L1 and L2 speakers.

6. Conclusion

As phonologically-described, vowel clash in English is resolved by means of consonant insertion, usually

glides. Irrespective of the argumentations on the status of intrusive *r* that 'r' is treated as a [-consonantal] glide (Kahn 1976), 'r' is a glide in contemporary phonology in general (Broadbent 1991) or 'r' is articulatorily quite similar to a schwa (Gick 2002), it has been shown that 'r' is not a good option chosen to remove vowel clash in VV environments. The present phonetic study does not support such a phonological claim that intrusive *r* is invoked as an anti-hiatal strategy in VV contexts.

As fully discussed earlier, English vowel hiatus is resolved by adopting different strategies according to L1 and L2 English speaker groups. We have found that canonical variants and vowel deletion forms were most frequent in the Buckeye Corpus, glottal stop variants and canonical forms emerged as dominant for LP KS, and hiatus remained intact in most of the pronunciations made by HP KS. The most interesting is the finding that the expected pattern, i.e. *inserted r*, arose rarely among all three groups. This leads us to speculate that the intrusive-r phenomenon is not as common as described in the previous phonological literature, suggesting that it is optional and supporting the idea that [r] is not coded in lexical representation in rhotic English speakers as well as L2 speakers unlike Gick's (1990) proposal.

Future studies would benefit from the investigation of many factors affecting the realization of hiatus challenges such as speech rates, prosodic condition, lexical frequency, dialectal groups, speaker variable of age, gender, and so on. Associated researches on other liaison processes such as linking *r* and insertion of glides /w, j/ would help us to understand the comprehensive set of strategies harnessed in hiatus contexts across L1 and L2. Further manipulated experiments with these factors and contexts would contribute to the understanding of the lexical representations for different groups of speakers as well.

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Examples in: English
Applicable Languages: English
Applicable Level: Tertiary