The Rhotic Pronunciation of Anglo-English and Punjabi-English Bilingual Speakers in West Yorkshire

La pronunciación de /r/ de hablantes anglo-ingleses y punjabi-ingleses en Yorkshire del Oeste

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Abstract

In this paper, the /r/ production of adolescent Anglo-English and Punjabi-English Bilingual speakers in West Yorkshire was analysed from speech data collected in 2000. A clear difference was found between Anglo-English speakers who used the standard British rhotic, the postalveolar approximant [ɹ̠], exclusively, and the Punjabi-English Bilingual speakers who used both British rhotics and a number of different variants influenced by the Punjabi retroflex flap /ɽ/. The influence of the retroflex flap /ɽ/ was proven by formant and duration results, as well as qualitative observations of the speaker spectrograms. It is predicted that Punjabi-English speaker preference for either Punjabi influenced rhotics or British rhotics depended on if they identify as culturally integrated "British Asians" or culturally alienated "Asians". This study also considers the possibility of a progression in rhotic production of West Yorkshire Punjabi-English speakers over the last fifteen years.

Keywords: *Speech data, /r/ production, Punjabi, Anglo-English, West Yorkshire*

Resumen

Este trabajo analizó la producción del fonema /r/ de los adolescentes anglo-ingleses y punjabí-ingleses bilingües en el oeste de Yorkshire a partir de los datos recogidos en el año 2000. Se encontró una clara diferencia entre los hablantes anglo-ingleses que usan exclusivamente el /r/ británico estándar, [ɹ̠], y los hablantes bilingües punjabí-ingleses que usan el fonema /r/ británico tanto como otras variantes influenciadas por la vibrante retrofleja Punjabi /ɽ/. La influencia de esta última se demuestra en el movimiento formántico y la duración resultantes, así como por las observaciones cualitativas de los espectrogramas de los hablantes. Se predice que la preferencia de los hablantes punjabíes hacia los róticos punjabíes o los róticos británicos depende de si se identifican como "británicos asiáticos" integrados culturalmente o como asiáticos alienados

culturalmente. Este estudio también considera la posibilidad de una progresión en la producción del rótico punjabi en los angloparlantes del oeste de Yorkshire en los últimos quince años.

Palaras clave: *Datos de habla, pronunciación de /r/, punjabi, anglo-inglés, Oeste de Yorkshire*

The dialects of English in Yorkshire are largely separated in to two main zones: The area southwest of the River Wharfe which is more influenced by the Mercian dialect and the area northeast of the River that is influenced more by the Northumbrian dialect (Ellis, 1992; Rohrer, 1950; Wakelin, 1977). Leeds and Bradford are neighboring cities situated southwest of the River, and are both part of the county of West Yorkshire. Petyt (1985) found that dialect differences between these two cities are minimal, suggesting that industrial West Yorkshire as a whole is a speech community that shares many language features.

However, the cities of Leeds and Bradford differ greatly in their demography. According to the 2011 United Kingdom Census (Office for National Statistics, 2011), 23% of the population of Bradford are Indian and Pakistani (2.59% Indian and 20.41% Pakistani), and Punjabi is the second most commonly spoken language in Bradford after English (2011 United Kingdom Census). Previous linguistic studies in Bradford reported that all Punjabi bilingual participants originated from the Mirpur district in the Punjab region of Pakistan (Heselwood & McChrystal, 1999; Kirkham, 2011; Kirkham & Wormald, 2015; Wormald, 2014) where a dialect termed 'Mirpuri Pahari' is spoken (Lothers & Lothers, 2012). In Leeds, there is a far smaller Indian and Pakistani demographic (5.14%) and a larger White British population of 81.1%, compared to Bradford's White British population of 63.9%.

The acquisition of English as a second language by a large minority of Punjabi first language speakers in Bradford has led to the emergence of a particular contact variety of British Asian English that has received input from the local Bradford/West Yorkshire dialect and native Punjabi, as well as other Indo-Aryan languages prominently spoken in the area such as Urdu and Bengali. Cheshire, Kerswill, Fox & Torgersen (2011) discusses how in the emergence of contact varieties such as these, children initially acquire the language of their primary caregiver (Kerswill, 1996; Kerswill & Williams, 2000), in this case Punjabi, and then acquire the target language, English, mainly through informal and unguided second-language acquisition in their social networks.

There have been a small number of papers published on the features of British Asian English in Bradford over the last fifteen to twenty years. In 2000, Barry Heselwood & Louise McChrystal investigated the presence of Punjabi accent features in the English of ten year-old Punjabi bilingual children in Bradford, focusing closely on their realization of stop consonants, though they also found other accent features not associated with monolingual Bradford English, such as clear allophones of /l/ in syllable codas, retroflex and postalveolar articulation of /t/, /d/ and /n/, and a backed /a/ vowel

(Heselwood & McChrystal, 2000). No other research had been published on British Asian English in Bradford until 2015 when Sam Kirkham and Jessica Wormald released papers on further linguistic observations in Bradford Asian English: Wormald (2014) found that female Bradford Punjabi-English speakers produced a higher KIT and FACE (British Isles Primary Lexical Set) (Wells, 1982) vowel in comparison to Bradford Anglo-English speakers, a characteristic pattern of Asian and other Multicultural British English (Stuart-Smith, Timmins & Alam, 2011; Sharma, 2011). Kirkham & Wormald (2015) analysed the acoustic and articulatory variation of English liquids by Punjabi-English female bilinguals. It was found that they generally produced /l/ and /r/ with a more anterior constriction, while Anglo monolingual Bradford English speakers generally produced /l/ and /r/ with a more posterior constriction where the tongue dorsum is retracted (Kirkham & Wormald, 2015).

Presently, no papers on British Asian English in Bradford have accounted for these more recent findings in male speakers nor have they focused on dialect differences between sexes since Heselwood & McChrystal's 1999 and 2000 papers. Additionally no papers have analyzed the linguistic features of Punjabi-English bilingual adolescents in Bradford; Kirkham & Wormald (2015) and Wormald (2014) focused on adults from 18-45 years old and from 21-36 years old respectively, while Heselwood & McChrystal's (2000) paper investigated ten year olds. Furthermore, not all of the linguistic features observed in Bradford Punjabi-English speakers are explained in relation to the influence of native Punjabi. For example, /r/ is observed by Kirkham & Wormald (2015) to have a higher second and third formant compared to Bradford Anglo-English speakers due to its more anterior constriction, yet no comment is made as to why this difference exists or what the allophone is. This paper will analyse the rhotic pronunciation of adolescent male and female Anglo-English and Punjabi-English bilingual speakers in West Yorkshire (Leeds and Bradford) from older data collected in 2000 to analyse differences between the two ethnicities and confirm Kirkham & Wormald's (2015) and Wormald (2014) observations, to relate the findings in the Punjabi-English speakers to the phonemic inventory of Punjabi and to attempt to classify the rhotic produced, to observe if these differences vary considerably between sexes and to see if there are contrasts between adolescent and adult speech in the community. This paper will also consider if there is any evidence of a progression over time in the speech of Punjabi-English bilinguals in Bradford: The benefit of observing adolescent speakers recorded in 2000 is that these same speakers today would belong to the adult group that Kirkham and Wormald investigated in 2015, meaning that this paper can give a real time study of change in the speech of Bradford Punjabi-English bilinguals from adolescence to adulthood. Though the speakers recorded in 2000 may not necessarily be the same speakers recorded by Kirkham & Wormald (2015), it is assumed that the results presented both in this study and in Kirkham & Wormald's (2015) paper are representative of the language patterns of the entire speech group, and thus we can see the possibility of a fascinating real-time change in the Bradford Punjabi community from over a decade ago to present time. It is also hoped that this paper can bring to light for Sociolinguists, Phoneticians and Second Language Researchers, the potential ways in which the analysis of one phoneme can reveal a substantial amount of information about an L2 community's adaptation to a second language, as well as how this adaptation progresses over a long period. The paper also aims to explain, through the

analysis of /r/, the social factors that can help or hinder the adaptation of the production of a phoneme in an L2 community.

Variation in the Pronunciation of /r/

Rhotics are articulatory complex sounds that vary greatly across languages. For example, Spanish has two rhotic phonemes, the alveolar trill /r/ and alveolar tap /ɾ/ that contrast phonemically in word-medial position (perro ([pero]) 'dog' vs pero ([peɾo]) 'but'), but in many forms of English, /r/ has just one realization, the postalveolar approximant [ɹ̠] (not to be confused with the alveolar approximant [ɹ]). /r/ can also vary within the same language, such as the contrast between rhotic General American English, where /r/ is pronounced prevocalically and postvocalically, and non-rhotic Received Pronunciation where /r/ is only pronounced prevocalically. This difference pertains to the point that even in a single dialect such as Received Pronunciation, the surface form of /r/ can differ based on its position in a syllable, word or phrase. Rhotic pronunciation can also vary based on sociolinguistic factors such as gender (Stuart-Smith, 2003), social class (Labov, 1966, 1972), ethnic (Hinton & Pollock, 2000), regional (Llamas & Watt, 2009) or national identity (Chambers & Trudgill, 1980).

The dialect of Leeds and Bradford is non-rhotic, meaning /r/ is only pronounced prevocalically, and the standard pronunciation of rhotics is the postalveolar approximant [ɹ̠], like most dialects in England (Wells, 1982), though the alveolar tap [ɾ] has been observed to occasionally occur in Leeds and there is evidence that /r/ is becoming increasingly realized as a labiodental approximant [ʋ] across England, including Leeds (Marsden, 2006). Punjabi by contrast is a rhotic language, meaning /r/ is pronounced prevocalically and postvocalically. The language consists of two rhotic consonants, the alveolar trill /r/ and the retroflex flap /ɽ/, that are phonemically distinct (Bakst, 2012; Bhatia, 1993; Karamat, 2010). For example, [moːr] ('peacock') and [moːɽ] ('turn') are minimal pairs in Punjabi. The flap only occurs in word-medial and word-final position whereas the trill occurs in all positions. Kirkham & Wormald (2015) found that Punjabi-English bilinguals in Bradford had a non-rhotic accent similar to British English, though they produced /r/ with a more anterior constriction than the monolingual Anglo-English speakers produce regardless of word, phrase or syllable position. This was supported by ultrasound tongue imaging data and the higher F2 and F3 values from the Punjabi-English bilinguals compared to the Anglo-English speakers, who showed a significant drop in F3 during /r/ production, a typical acoustic cue of [ɹ̠] (Ladefoged, 2006). It is likely that the more anterior constriction of Punjabi-English /r/ production is a result of the influence of native Punjabi on this contact variety. This paper will seek to classify this rhotic variant and find if these patterns were present or different in a similar group of speakers fifteen years before when they were adolescents, and also to look for any variation between male and female speakers. It will also consider, assuming similar results to Kirkham & Wormald (2015) are observed, if this anterior constriction is an allophone influenced by the Punjabi retroflex flap /ɽ/ or alveolar trill /r/ and the British postalveolar approximant /ɹ̠/. Furthermore, this paper will explore if there are any cases of Punjabi-English bilinguals using British rhotics, as was the case in Hirson & Sohail's (2007) study of British Asian English in London.

Method

IViE Corpus

The recordings for this study were taken from the 'Intonational Variation in English' (IViE) corpus (Grabe, Post & Nolan, 2001), which is a set of speech data from nine urban dialects of British English recorded from 1997-2000. The data was collected as part of a project to find intonational variation between speakers of different dialects across the British Isles. Speakers were recorded talking in five different speaking styles ranging from formal to free speech. The project has an output of several publications on intonational variation in British English. The recordings in Leeds were made by Kimberley Farrar and the Bradford recordings were made by Brechtje Post, both in 2000 (Grabe, 2003).

Participants

The speech of 24 speakers are analysed in this study. Twelve are monolingual Anglo-English speakers from Leeds and twelve are bilingual Punjabi-English speakers from Bradford. There are six males and six females in each group. According to the IViE corpus summary booklet, all the speakers were about sixteen years old at the time of recording, and all data was collected in urban secondary schools (Grabe, Post & Nolan, 2002).

Materials

Five speaking styles were recorded from the Bradford and Leeds speakers: Controlled sentences, a read text, a retold version of the text with the assistance of pictures, a map task done in single sex pairs, and a discussion on a given topic which was smoking. This study will analyse just the controlled sentence speech, and only the sentences relevant to the analysis of rhotic production. The following sentences were analysed from the corpus:

- *They are on the railings (Declarative)*
- *May I lean on the railings? (Question)*
- *Do you live in Ealing or Reading?*
- *We arrived in a limo*
- *Where is the manual?*
- *Is his name Miller or Mailer?*

Sentences 1-3 provide stressed word-initial (but not phrase-initial) rhotics (Railings, Reading) between two vowels, sentence 4 provides a stressed syllable-initial word-medial rhotic (Arrived) between two vowels, sentences 5 and 6 have phrase-medial word-final linking-r rhotics (Where, Miller) between two vowels and sentence 6 provides a word-final phrase-final postvocalic /r/ to observe if it is pronounced by the Punjabi-English bilingual speakers. With these sentences, we can compare the /r/ production of the Anglo-English and Punjabi-English bilingual speakers in different

phonological contexts.

Analysis

For each sentence uttered by the speakers, the rhotic consonant was identified on the spectrogram on Praat (Boersma & Weenink, 2016) and segmented manually. Since rhotics display great variability in their realisations across and within languages, the way in which they were segmented depended on the nature of the /r/ pronunciation. If the rhotic was an approximant, characterized by observable formants on the spectrogram and a loss of intensity compared to its surrounding vowels, the onset was marked at the start of articulatory movement away from the vowel, which is where the formants started transitioning to the rhotic. The offset of the approximant was marked at the end of the articulatory transition to the next vowel, which is where the formants finished transitioning to the steady state of the following vowel. For phrase-final word-final /r/, the offset was marked at the end of periodic voicing.

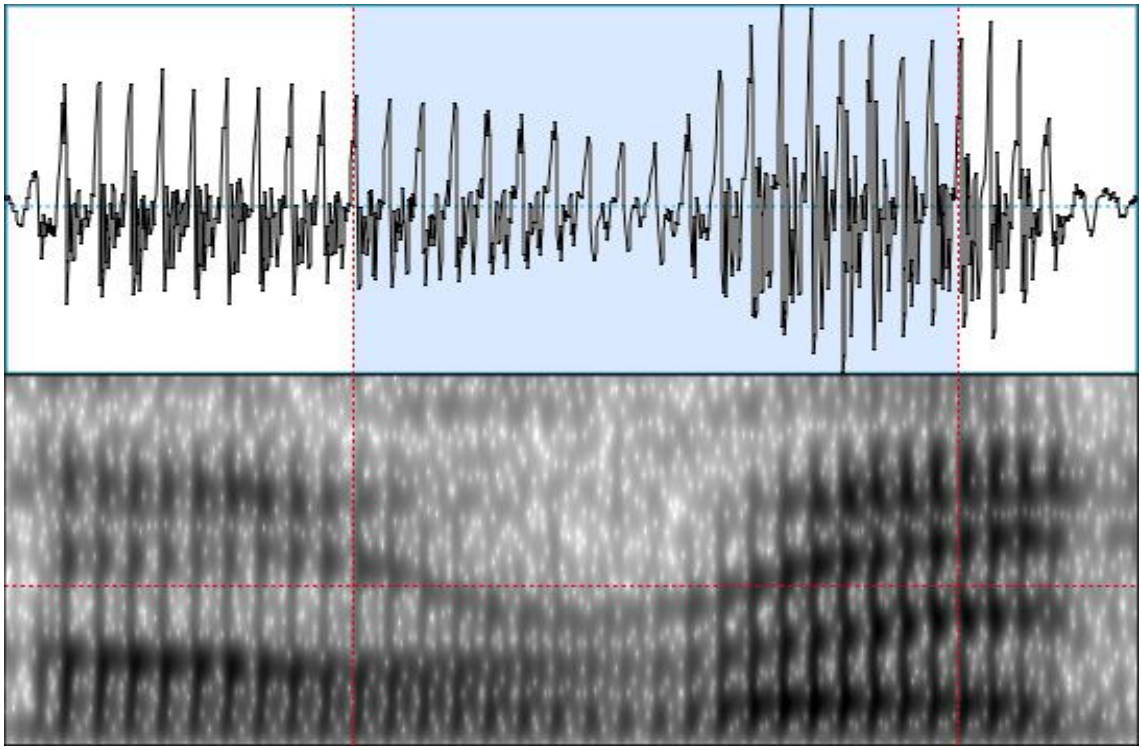

Figure 1. The segmentation of a postalveolar approximant.

Figure 1 shows how a postalveolar approximant [ɹ̠] between two vowels was segmented. Note that the rhotics in all figures are marked at the start and completion of formant, and therefore, articulator movement, motivated by Gao & Xu (2013). If the rhotic was a retroflex flap [ɽ], characterized by a short plosive burst similar to a voiced stop consonant, the onset was marked at the end of periodic voicing for the vowel where there was a sharp drop in intensity as the articulators began to constrict to articulate a flap, and the offset was marked at the start of periodic voicing of the next vowel after the flap gesture. *Figure* 2 shows how a retroflex flap was segmented. Spectrogram

figures are sourced from the author's data unless otherwise specified. All Spectrogram screenshots are from Praat with the frequency range between 0 to 5000Hz.

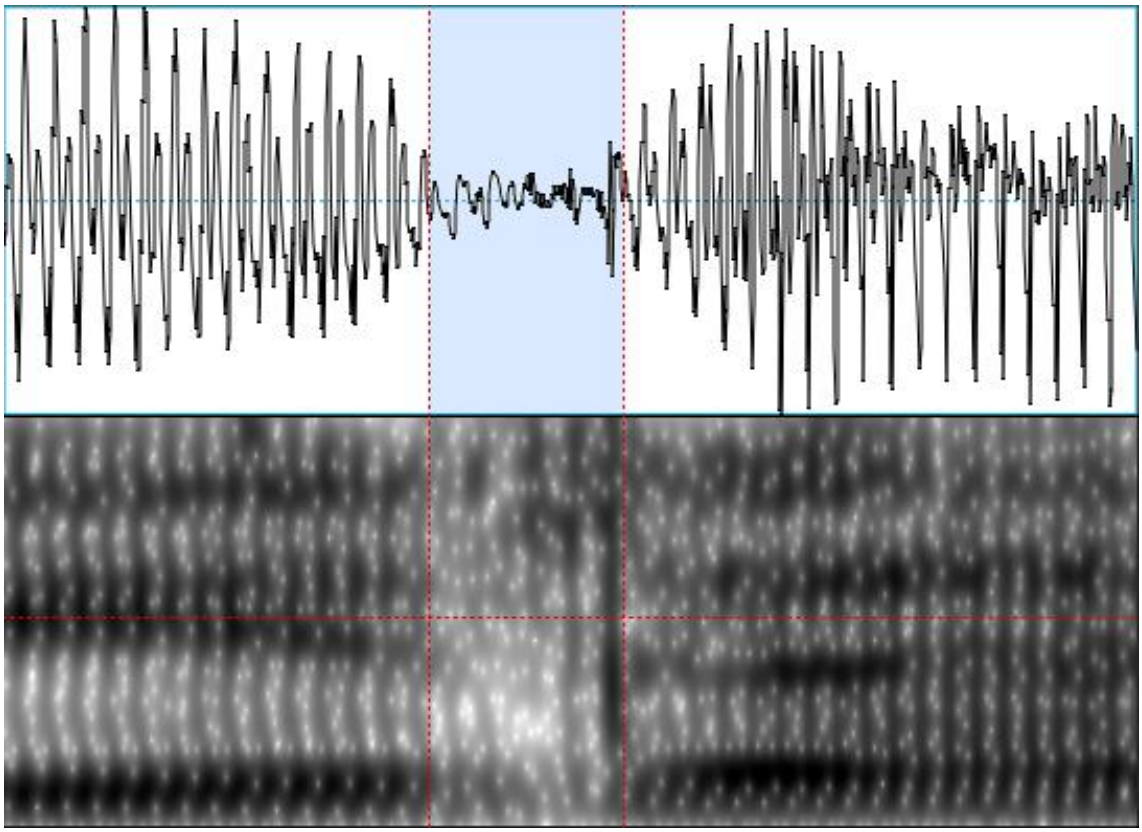

Figure 2. The segmentation of a retroflex flap.

It was also possible that a fricative may be produced if an approximant was articulated with the oral articulators tighter than usual, producing frication. In this case, a fricative was segmented with its onset at the end of periodic voicing of the previous vowel, and its offset at the start of periodic voicing of the next vowel, as *Figure 3* shows.

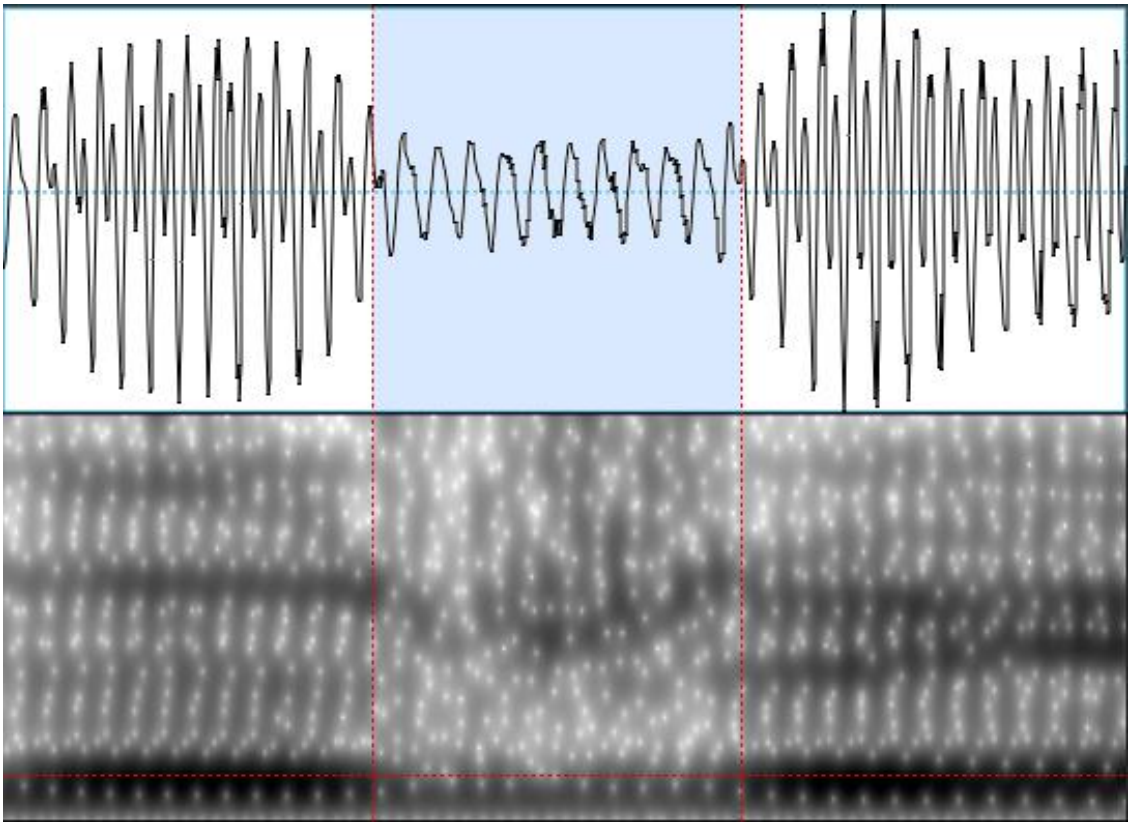

Figure 3. The segmentation of a fricative.

If an alveolar trill [r] was observed, its onset was segmented at the end of periodic voicing of the previous vowel, and its offset was segmented at the start of periodic voicing of the following vowel, as *Figure 4*, taken from Lamy (2015), shows.

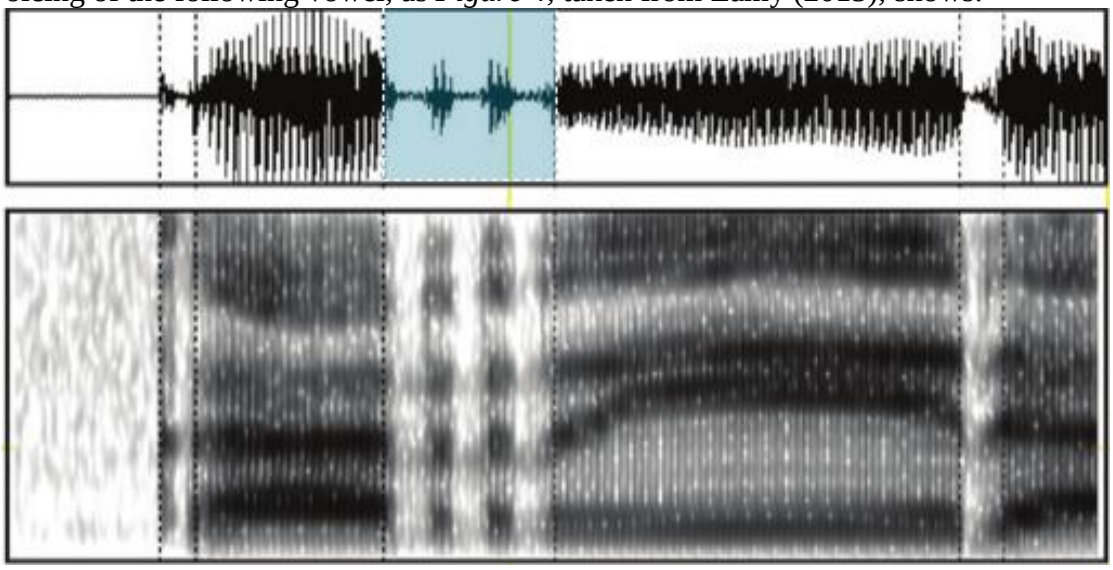

Figure 4. The segmentation of an alveolar trill. Taken from («A sociophonetic analysis of thrill production in Panamanian Spanish», 2012).

The rhotic consonants were analysed in three ways: The first was qualitative

observation of the spectrogram and auditory impression to determine what the allophone was. To be considered as one of the proposed allophones, it had to be determined through both impressionistic auditory evaluations and its appearance on the spectrogram. If the rhotic was a postalveolar approximant [ɹ̠], it was expected that F3 would fall significantly (Ladefoged, 2006) as shown in *Figure 1*. If the rhotic were pronounced as a retroflex flap [ɽ], the spectrogram would be expected to show a plosive burst (Ladefoged, 2006) as displayed in *Figure 2*. If the variant produced were an approximant influenced by Punjabi, formants would be expected to be present, and F2 and F3 to be higher than the postalveolar approximant [ɹ̠] as Kirkham & Wormald's (2015) results show. Whether this approximant was alveolar [ɹ] or retroflex [ɻ] depended on the difference between F4 and F5. It is reported that retroflex rhotics display a larger difference between F4 and F5 (Zhou, Espy-Wilson, Tiede, Boyce, Holland & Choe, 2008) than other rhotics. Therefore, if the F4-F5 difference was observed to be greater than usual, the approximant was considered retroflex. If not, it was deemed alveolar. It should be noted that when this study refers to a retroflex approximant [ɻ], it is not referring to the exact same variant that is used in some North American and West Country English accents (Delattre & Freeman, 1968; Trudgill, 1984), but a sound that is articulated in a more anterior position, influenced by the Punjabi retroflex flap [ɽ]. *Figure 5* shows a typical Punjabi-English retroflex approximant.

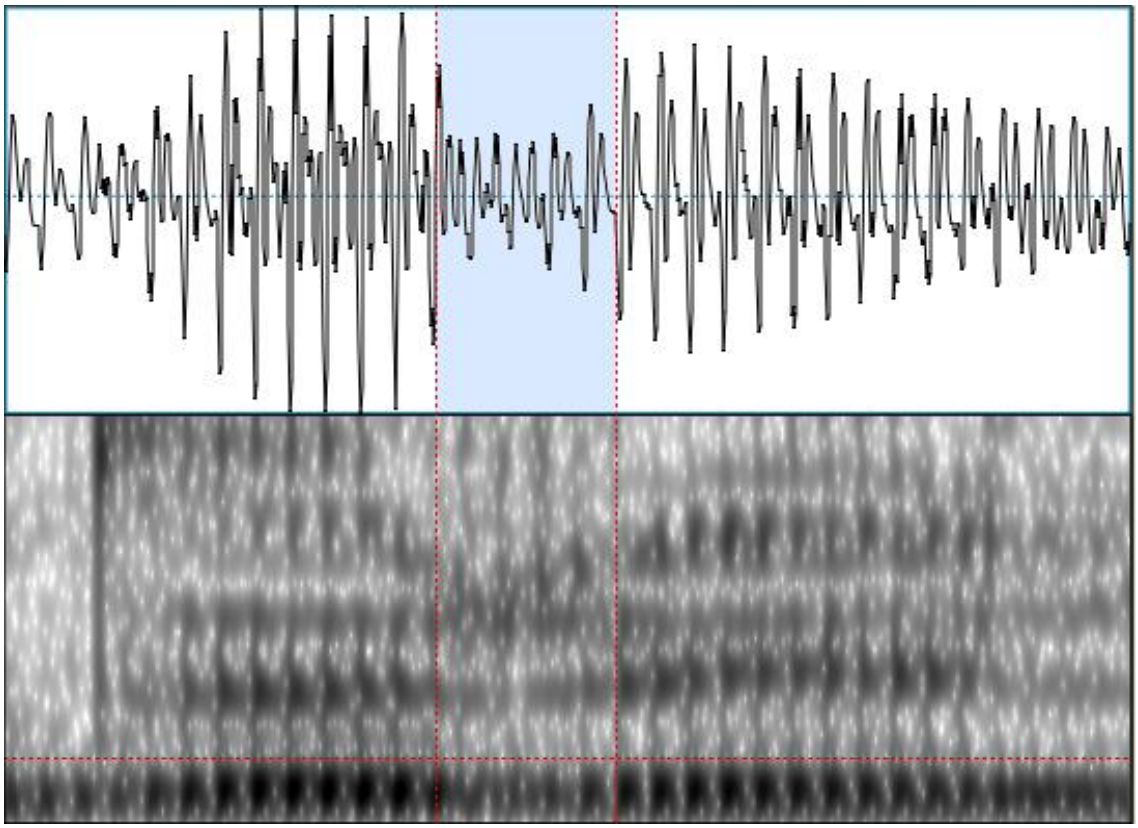

Figure 5. A Punjabi-English Retroflex Approximant.

An alveolar approximant [ɹ] was likely to look similar, only with a smaller F4-F5

difference. It was also possible that one may have observed an articulation between a flap and an approximant where the tongue constriction was extremely close to the hard palate that a fricative was produced. For this variant, it was anticipated that the formants would be much fainter or absent, and that there would be aperiodic energy in the higher frequencies of the spectrogram (Ladefoged, 2006), as shown in *Figure 3*.

When an alveolar trill was produced, the spectrogram displayed a short series of periodic voicing as the tip of the tongue is set in motion by the current of air (Ladefoged, 2006) as shown in *Figure 4*.

The second way in which the rhotics were analysed was by quantitative formant measurements in order to confirm the qualitative observations and auditory impressions. Formant measurements of the rhotic were taken manually on Praat using the formant tracker. For approximants, the formants were measured at the point where the intensity of the consonant was lowest. Since the intensity of an approximant is at its lowest when the oral articulators are closest (Reetz & Jongman, 2011), the lowest point of intensity of the approximant can be considered its midpoint. The other rhotic formants were measured, if there were any, at the midpoint of the duration of the consonant. Moreover, the results of the formants are presented separately for males and females as it is known that the average higher pitch of female speakers causes them to exhibit higher formant frequencies than male speakers (Hillenbrand, Getty, Clark & Wheeler, 1995). The mean average of the formants for each speaker group (Male Anglo-English speakers, Female, Anglo-English speakers, Male Punjabi-English speakers and Female Punjabi-English speakers) were calculated and outliers which lay outside two standard deviations of the mean average were not included in the results.

The third way in which /r/ was analysed was by the quantitative measurement of duration, to explore if there was a relation between the type of rhotic observed and its duration. It was hypothesized that approximants would take longer to produce than flaps since they are characterized by a very rapid closure (Ladefoged, 2006), and if the duration of the Punjabi influenced approximant was shorter than the postalveolar approximant, this may be due to the influence of the Punjabi flap. The mean average of the rhotic duration was calculated for the four speaker groups and any outliers that lay two standard deviations outside of the mean were not included in the results. Some rhotics were not measured at all if pronounced too quickly so that the consonant was not fully articulated or if there was too much background noise on the recording. Note that the duration and formant results we will observe may not necessarily match those of the spectrograms in the figures provided in this paper. The crucial point of these measurements is the comparison between the different rhotic variants in the results rather than the preceding figures. We can consider the second and third way of analyzing /r/ as one of the same thing: Quantitative Acoustic Phonetic Analysis, while the first way is Qualitative Impressionistic Analysis.

Results

In the following results, the analysis of the word-final phrase-final rhotic “Mailer” is not included since most utterances of this phoneme were not pronounced, confirming

that Punjabi-English bilingual speakers in Bradford speak with a non-rhotic accent. However, one male and one female Punjabi speaker pronounced the /r/ as a postalveolar approximant [ɹ̠], similar to most North American English speakers (Plag, Braun, Lappe, & Schramm, 2009).

In addition, the results of this study are not separated in to syllable, word or phrase positions as it was found that position did not affect the rhotic produced, its formants or duration. This is likely because although the rhotics were in contrasting phonological positions, they were always in the same phonetic environment, between two vowels (VCV) in the middle of a phrase.

Qualitative Analysis Results

The first point to make about these qualitative analysis results is that no alveolar trills or approximants were observed. The only Punjabi influenced allophones found were retroflex approximants [ɻ], retroflex fricatives [ʐ], and retroflex flaps [ɽ]. It is assumed that the fricatives were retroflex since it is highly probable that they were more tightly constricted retroflex approximants, and in the cases where the fricative formants were measurable, they were almost identical to the retroflex approximants. Again, the retroflex fricative [ʐ] referred to in this study is not exactly the same as the one found in languages such as Russian and Slovak (Hamann, 2004; Hanulíková & Hamann, 2010) as the Punjabi-English speakers in this investigation pronounce it with a more anterior constriction.

Table 1.
Table of the Percentage of Variants Used by Each Speaker Group.

	Postalveolar Approximant	Labiodental Approximant	Retroflex Approximant	Retroflex Fricative	Retroflex Flap	Number of Measurements
Male Anglo-English Speakers	100%	0%	0%	0%	0%	25
Female Anglo-English Speakers	100%	0%	0%	0%	0%	27
Male Punjabi-English Speakers	33.33%	0%	50%	16.67%	0%	18
Female Punjabi-English Speakers	40%	8%	28%	20%	4%	25

Figure 6. Graph of the Percentage of Variants Used by Each Speaker Group.

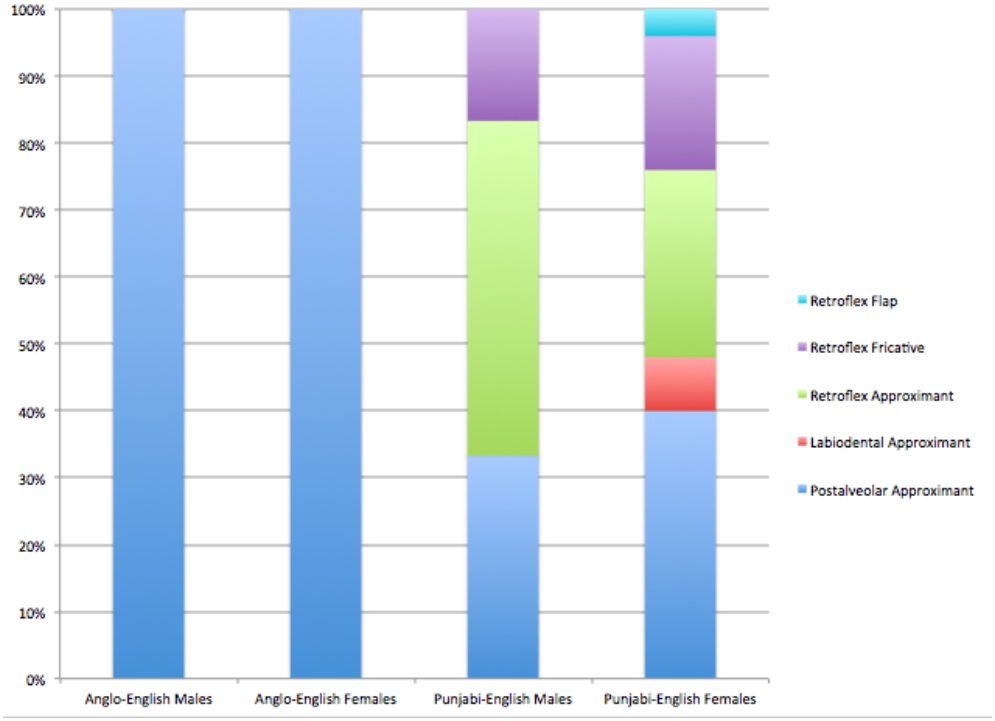

Table 1 and *Figure 6* show that all Anglo-English speakers used a postalveolar approximant [ɹ̠] 100% of the time. The results for the Punjabi-English bilingual speakers show more variation. Both the male and female Punjabi-English speakers use the British postalveolar approximant variant in 30-40% of the measured rhotics, and a small amount of labiodental approximants [ʋ] were found in the female Punjabi-English group. Labiodental approximants were identified by a much higher F3 than the postalveolar approximants (Foulkes & Docherty 2000) but without the larger F4-F5 difference found in the retroflex approximants (Zhou et al., 2008. They were deemed not to be Punjabi influenced alveolar approximants because they sounded labiodental, and the duration of these approximants was significantly longer than the other Punjabi influenced variants, closer to the duration of British rhotics. The most commonly produced Punjabi influenced variant was the retroflex approximant [ɻ]: Females used it in 50% of their rhotics and males used it 28% of the time. The retroflex fricative [ʐ] was the second most common Punjabi influenced allophone with females using it 20% of the time and males using it in 16.67% of their rhotic consonants. Only one retroflex flap [ɽ] was recorded from a Punjabi female speaker. Punjabi female speakers used a higher percentage of British variants (48%) than Punjabi male speakers (33%), though both groups generally favoured using Punjabi influenced rhotics over British ones.

Though the overall results may suggest that Punjabi-English bilinguals alternate regularly between British rhotics and Punjabi influenced variants, *Table 2* shows that there is significant variation in /r/ production between individual speakers.

Table 2.
Table of the Percentage of Variants Used by Each Punjabi-English Speaker.

	Postalveolar Approximant	Labiodental Approximant	Retroflex Approximant	Retroflex Fricative	Retroflex Flap	Number of Measurements
Male 1	0%	0%	75%	25%	0%	4
Male 2	0%	0%	50%	50%	0%	4
Male 3	66.7%	0%	0%	33.3%	0%	3
Male 4	0%	0%	100%	0%	0%	1
Male 5	100%	0%	0%	0%	0%	4
Male 6	0%	0%	100%	0%	0%	2
Female 1	25%	0%	50%	25%	0%	4
Female 2	25%	0%	25%	50%	0%	4
Female 3	20%	0%	40%	40%	0%	5
Female 4	0%	25%	50%	0%	25%	4
Female 5	100%	0%	0%	0%	0%	4
Female 6	75%	25%	0%	0%	0%	4

Table 2 reveals that not all Punjabi-English speakers used both British and Punjabi influenced rhotics. In the male speaker group, all but one speaker (Male 3) used either British or Punjabi influenced rhotics exclusively. In the female group, individual speakers displayed more alternations between British and Punjabi influenced /r/, though all speakers showed a preference for one rhotic group over the other. Females 1-4 showed a preference for Punjabi-influenced rhotics, using them 75-80% of the time, while Female 5 and 6 used British rhotics exclusively. Furthermore, it is worth noting that Female 5 and Male 3 were the two speakers who produced /r/ postvocalically in sentence 6.

Quantitative Analysis Results

Formant Results. *Table 3* shows the mean average formant values for the rhotics with postalveolar, retroflex and labiodental articulation across the four speaker groups. Note that the following formant values of F5 for the Punjabi-English female postalveolar approximants are not shown since there were no measurable fifth formants for this particular group.

Table 3.
Table of the Mean Average Formant Values for Postalveolar, Retroflex and Labiodental Rhotics by Each Speaker Group.

Average Formant Value (Hz)				
Postalveolar Articulation				
	F2	F3	F4	F5
Anglo-English Males	1177	1780	2778	3336
Anglo-English Females	1371	2242	3341	3585
Punjabi-English Males	1264	1825	2667	3323
Punjabi-English Females	1629	2324	3105	N/A
Retroflex Articulation				
	F2	F3	F4	F5
Punjabi-English Males	1583	2374	3002	3903
Punjabi-English Females	1850	2624	3312	4438
Labiodental Articulation				
	F2	F3	F4	F5
Punjabi-English Females	1511	2720	3572	4234

The results show, as anticipated, that the formants of the female speakers were always considerably higher than formants for the male speakers. The average values of F2 and F3 for the retroflex rhotics were significantly higher than the postalveolar rhotics across males and females. Moreover, the difference between F4 and F5 was considerably greater for the retroflex variants (900-1100Hz) than the postalveolar and

labiodental variants (200-700Hz) as Zhou et al. (2008 observed, and the labiodental rhotics had a higher F3 than the postalveolar rhotics as predicted by Foulkes & Docherty (2000).

Duration Results. *Table 4* below shows the mean average duration for the postalveolar, retroflex and labiodental rhotics across the four speaker groups, and *Table 5* shows the mean average duration for the different manners of retroflex rhotics by the Punjabi-English speakers.

Table 4.
Table of the Mean Average Duration Values for Postalveolar, Retroflex and Labiodental Rhotics by Each Speaker Group.

Duration (ms)						
Postalveolar Approximant				Retroflex Articulation		Labiodental Articulation
Anglo-English Males	Anglo-English Females	Punjabi-English Males	Punjabi-English Females	Punjabi-English Males	Punjabi-English Females	Punjabi-English Females
132.88	117.58	108.17	102.9	70	70	118

Table 5.
Table of the Mean Average Duration Values for the Different Manners of Retroflex Rhotics by the Punjabi-English Speakers.

Duration (ms)		
	Punjabi-English Males	Punjabi-English Females
Retroflex Approximant	71	75
Retroflex Fricative	66	68
Retroflex Flap	N/A	50

Table 4 shows that the duration of the British postalveolar and labiodental variants for all speaker groups was significantly greater than the duration of the Punjabi influenced retroflex rhotics. *Table 5* shows that within the class of retroflex variants, the approximant [ɻ] had the longest duration, followed by the fricative [ʐ] and then the flap [ɽ] for both male and female speakers. The retroflex approximant had a markedly shorter duration than the postalveolar [ɹ̠] and labiodental [ʋ] approximants.

Discussion

The results show that there was a clear difference in the production of /r/ between the Anglo-English and Punjabi-English bilingual speakers. The Anglo-English speakers used the British postalveolar approximant [ɹ̠] on every occasion while the Punjabi-English speakers produced a wider variety of rhotics. In addition the results show that being a Punjabi-English bilingual speaker does not necessarily entail that the speaker always uses a rhotic influenced by the Punjabi language, and in some cases, the speaker may not use one at all. Some Punjabi-English speakers used British variants such as the postalveolar and labiodental approximant exclusively and some used only rhotics influenced by Punjabi, while others used both British and Punjabi-influenced variants.

This variation within the Punjabi-English speaker group is likely to be due to social factors. The reason that Male 3 and 5, and Female 5 and 6 use almost entirely British variants may be due to a difference in identity compared to the other speakers. Hirson & Sohail (2007) examined the variability of rhotics in Punjabi-English bilinguals in London, and found that speakers differed drastically in their /r/ pronunciation depending on if they self-identified as either a 'British Asian', relatively integrated in to British society, or as 'Asian', more alienated from British culture. Their identity was teased out through questionnaires that addressed their language background, language use and their views on current social and cultural issues relevant to them. A picture-naming task consisting of high frequency words of concrete words was used to elicit their data. The 'British Asian' speakers used postalveolar approximants almost all of the time while 'Asian' speakers produced a range of Punjabi-influenced rhotics as well as British ones. It is possible that Male 3 and 5, and Female 5 and 6 consider themselves to be integrated 'British Asians' while the others may self-identify as 'Asians'. Hirson and Sohail also found that 'Asian' speakers had rhotic accents, pronouncing /r/ as a bunched postalveolar or retroflex approximant in postvocalic positions, which is unsurprising considering Punjabi is a rhotic accent and 'Asian' speakers felt more of an affinity with their Asian background. These results however show that Male 3 and Female 5, two of the more 'British Asian' speakers, are the only ones to pronounce /r/ postvocalically. It could be speculated that while the other speakers use more Punjabi-influenced rhotics than Male 3 and Female 5, these two speakers, though integrated in to British culture, maintain their Asian identity with a rhotic accent to maintain an allegiance with their heritage (Foulkes & Docherty, 1999).

Kirkham & Wormald (2015) found that on average, Punjabi-English bilingual speakers in Bradford produced /r/ with a higher F2 and F3 than Anglo-English speakers due to a more anterior constriction, which is confirmed in this study, though no comment was made on what variant was being articulated. By considering the phonemic inventory of Punjabi and the larger difference between F4 and F5, it is likely that this allophone is retroflex with an anterior constriction. The results in this study also suggest that being a Punjabi-English bilingual does not always entail a higher F2 and F3 than an Anglo-English speaker. When the Punjabi-English rhotics are categorized by allophone, it is clear that on the occasions when a postalveolar approximant [ɹ̠] is produced, the formants are similar to the Anglo-English speakers, and when a retroflex rhotic is produced, F2 and F3 are much higher, proving that the difference in formants is dependent on rhotic pronunciation, not racial or language background.

Within the Punjabi influenced retroflex class of rhotics, three separate allophones were found, the retroflex approximant [ɻ], the retroflex fricative [ʐ] and the retroflex flap [ɽ]. The presence of the flap is likely the result of the retroflex flap in Punjabi being inserted into this British Asian dialect. The retroflex approximant is hypothesized to be a hybrid contact allophone that is influenced by the retroflex flap of Punjabi and the postalveolar approximant of British English. The retroflex fricative is similarly articulated to the retroflex approximant, only the constriction between the tongue and hard palate is tighter so that there is frication. The presence of the fricative is likely the product of speakers producing an allophone in between the retroflex flap and retroflex approximant. The duration results show a distinct difference between the length of

British and Punjabi influenced rhotics. More proof that the retroflex approximant is influenced by the Punjabi retroflex flap is the fact its duration is much shorter than the British variants, and closer to the flap duration. Though the retroflex approximant can be considered a combination of the postalveolar approximant and retroflex flap, the allophone does appear to be closer phonetically to the flap, in terms of duration and place of articulation, especially considering the anterior constriction of the approximant proved by the higher F2 and F3. The duration results also provide more proof that the retroflex fricative is a combination of the retroflex flap and retroflex approximant since its duration lies in between the two allophones.

One of the aims of this paper was to search for differences between male and female Punjabi-English speakers, and though there is some variation in rhotic production, the overall patterns are the same. The female speakers on average used more British rhotics than the male speakers, and even the female speakers who predominantly used Punjabi-influenced variants uttered at least one British rhotic. This is possible evidence for Trudgill's arguments that female speakers are more sensitive to standard and non-standard variables than males (Trudgill, 1972), and are more conscious of using the standard British variant, even if they do self-identify as 'Asian' and use more Punjabi influenced rhotics. However, both groups overall showed a preference for Punjabi influenced rhotics over British rhotics, they both displayed a higher F2 and F3 and a larger F4-F5 difference in their retroflex rhotics, and they both produced Punjabi influenced rhotics with a shorter duration than British rhotics.

Another objective of this paper was to observe if there has been any real-time change from these results that were recorded from Punjabi-English bilingual adolescents in Bradford in 2000 to the results in Kirkham & Wormald's (2015) study of the same community as adults. Their study measured the /r/ production of five female Punjabi-English bilinguals in Bradford aged 21-36, and they found that four of the five speakers produced /r/ with a more anterior constriction while one speaker's tongue position was more retracted. This suggests that four of the five speakers were using Punjabi influenced rhotics, likely to be retroflex as proven by this study. When the results of both experiments are considered, it is possible that the use of British rhotics by Punjabi-English speakers has decreased in the space of approximately fifteen years and the preference for Punjabi influenced variants has grown, though with only five female speakers and no male speakers tested in Kirkham & Wormald's (2015) study, this possibility should be approached with caution. Only if this point is proven true with more evidence in future research should questions be asked as to why this progression is occurring.

Conclusion

This study has found that there is a clear difference in the rhotic production of Anglo-English and Punjabi-English bilinguals in West Yorkshire, with Anglo-English speakers producing solely postalveolar approximants [ɹ̠] in the data collected and analysed, and Punjabi-English bilinguals producing a range of allophones, from British variants such as the postalveolar [ɹ̠] and labiodental approximant [ʋ], to rhotics influenced by Punjabi such as the retroflex flap [ɽ], retroflex fricative [ʐ̞] and retroflex

approximant [ɻ]. The retroflex approximant is considered a contact allophone influenced by the British postalveolar approximant and the Punjabi retroflex flap, and the retroflex fricative is likely to be an articulation between the retroflex flap and the retroflex approximant. Both male and female Punjabi-English speakers overall prefer Punjabi influenced rhotic production over British rhotics, though there are significant differences between individual speakers, with some using predominantly British variants and others using mostly Punjabi influenced variants. The reasons for this are likely due to differing social identities of the speakers (Hirson & Sohail, 2007). This paper also speculates on the possibility of a change in progress in Punjabi-English rhotic production in Bradford over the last fifteen years, stating that it is possible that the use of British rhotic production has decreased and the preference for Punjabi influenced rhotics has increased, though more research is needed to confirm this. In the future, a more thorough examination of present day /r/ production in the Punjabi-English Bradford community must be conducted. More participants must be analysed from both sexes, with a greater focus on what rhotic allophones are present, and the amount that each variant is produced. Individual speaker variation must also be considered, and participant identity affiliation should be teased out using questionnaires (Hirson & Sohail, 2007) to see if self-identifying as 'British Asian' or 'Asian' is a key factor in the /r/ production of a speaker. Auditory impressions, qualitative observations of the spectrogram, formant and duration measurements should all be taken in to account to determine the allophone uttered. If it is found that the preference for Punjabi influenced rhotic use has grown as Kirkham & Wormald's (2015) results suggest, then sociolinguistic reasons for this change must be considered. If this progression is genuine, future research should ask if it is a change in the speech of Punjabi-English adolescents in to adulthood or a change representative of the entire Punjabi-English speech community. To address this question, present day Punjabi-English adolescents should be examined as well as adults. If they are favouring Punjabi influenced rhotics as much as the adults, then perhaps there has been a general shift in /r/ pronunciation in British Asian English in West Yorkshire over the last fifteen years. In terms of the broader implications for Sociolinguistics, Phonetics, and Second Language Studies, this study shows that through the analysis of one phoneme, much can be revealed about the integration of an L2 community in to a city. Variation in the phoneme production can uncover underlying attitudes to the country of their second language, and by observing older data, we can obtain a better understanding of how L2 communities progress in the pronunciation of their second language through a 15 year long real-time study such as this, a rarity in language analysis studies.

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