/r/ PRODUCTION IN ENGLISH AND ARABIC BILINGUAL AND MONOLINGUAL SPEAKERS

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Abstract

This paper reports an analysis of /r/ production by English-Arabic bilingual children. It addresses the question of whether the bilingual develops one phonological system or two by calling for a refinement of the notion of a system using insights from recent phonetic and sociolinguistic work on variability in speech. The bilingual subjects that were chosen for the study are three Lebanese children aged 5, 7 and 10, all born and raised in Yorkshire, England. Monolingual friends of the same age were chosen as controls, and the parents of all bilingual and monolingual children were also taped to obtain a detailed assessment of the sound patterns available in the subjects' environment. The bilinguals were taped in different language sessions with different interlocutors. /r/ was chosen due to the existence of different patterns for its production in English and Arabic that vary according to contextual and dialectal factors. Results show that (i) the bilinguals have developed separate /r/ production patterns for each of their languages that are similar to those of monolinguals, and (ii) the interaction between their two languages is mainly restricted to the bilingual mode and is a sign of their developing sociolinguistic competence.[1]

1. Introduction

This paper presents data on /r/ production by three English-Arabic bilingual children aged 5, 7, and 10, who were born and raised in Yorkshire, England. The study forms part of a project aimed at examining several aspects of sound production by the subjects in order to contribute to existing debates on bilingual phonological acquisition (Khattab, 2002b).

The study differs from other studies in several ways. First, it deals with two languages that have rarely been studied in combination in bilingual phonological acquisition. Second, it adopts a different stance on what is meant by a phonological system, by virtue of a grounding in aspects of sociolinguistics. Recent phonetic and sociolinguistic work on monolingual acquisition has argued that there is no simple stable phonological model that any child is exposed to (e.g. Foulkes, Docherty and Watt, 1999; Local, 1983; Roberts, 1997). Instead, there may be considerable variability in the input that a child receives that is not only phonological/allophonic, but may also be linked to the social characterisation of the speaker (sex, age, social class, etc.) and to speaking style. Such factors create variability in the input for any child in any community, and must therefore be mastered alongside aspects of the contrastive phonology. The bilingual child faces an added degree of variability by being exposed to input that may vary between standard, non-standard, and non-native varieties for either language.

In order to take variability into account, the study adopts a different methodology in that it does not only rely on published accounts of /r/ production patterns in either language. Since it is expected that the bilinguals' social network has an influence on their linguistic choices, monolingual English friends of the bilingual children were also taped for the project, along with monolingual Arabic controls and

[1] Many thanks for Gerry Docherty and Paul Foulkes for their valuable feedback on this paper. Also, special thanks to the families of the informants for their patience and generous help and support during the fieldwork.

the parents of all bilinguals and monolinguals (see Section 8.1). The bilinguals were recorded in different language sessions with different interlocutors in order to take account of the language mode (Grosjean, 1998).

2. Bilingual phonological acquisition

The issue of whether a bilingual child starts with one phonological system or two at the onset of language development has produced mixed results, in part due to differences in the methodologies used in studying bilinguals, but also due to a problem that is inherent in the question itself.

It is difficult to define a system even in monolingual acquisition, due to the debate over what a phonological system looks like and what age it emerges at (e.g. Burton-Roberts, Carr & Docherty, 2000). While in simple terms we might talk about the 'system' of English and the 'system' of Arabic, it is clear that each system is only identifiable in an abstract sense. If we focus on an aspect of the phonological system of English such as /r/, it is hard to define exactly what evidence we need to look for to decide whether a child has successfully acquired it. For example, in English, /r/ varies in its phonetic realisation according to word-position. Moreover, it varies across dialects, and even systematically within its dialects.

The situation is more complex when two languages are involved, as a phoneme like /r/ might be judged as the 'same' in two languages, despite important differences that may govern its production in each language. These include subtle differences in articulatory coordination, phonotactic distribution, as well as systematic social and stylistic differences. The surge in cross-linguistic studies of language acquisition and, in some cases, the use of instrumental analysis techniques, has shown that an abstract phonemic approach does not capture important language-specific allophonic (e.g. Deuchar & Quay, 2000), phonotactic (e.g. Johnson & Lancaster, 1998), and prosodic (e.g. Paradis, 2001; Whitworth, 2003) patterns of variation.

Insights from recent variationist sociolinguistic studies of monolingual acquisition have argued that different types of variability in the speech input that a child is exposed to such as dialectal, individual, and stylistic differences constitute part of the 'system' acquired by children. It is well-known that speech production is constrained by social factors, and that the input children hear may vary according to, for example, the speaker's age, gender, and speaking style. Studies by Foulkes, Docherty and Watt (1999), Local (1983), Roberts (1997), and Scobbie (2002) highlight an aspect of phonological development that is normally overlooked in the majority of studies of children's speech, that of socially-structured variability. These studies show that there is often no stable target model for the child to acquire, and that children acquire the range of sociophonetic variation that is acceptable in their speech community and the systematic distribution of the conditioned variants from a very early age as part of the development of their sociolinguistic competence.

Results from these studies have important implications for bilingual as well as monolingual studies of phonological acquisition, and suggest that it is not enough to look for the acquisition of sound features that are lexically contrastive for evidence that the child has acquired a given phonological system. Therefore, when approaching the phonological aspects of both bilingual and monolingual acquisition, it is important that a thorough assessment be made of variable targets a child must aim for in order to speak like a mature member of its immediate community.

Moving on to the issue of interaction (code-switching and code-mixing) between the bilingual's languages, research has shown that interaction is unavoidable, even when bilinguals acquire their languages simultaneously and show clear evidence of

differentiation. This has led to the more recently adopted view that bilinguals have separate but non-autonomous phonological systems, as summarised by Grosjean (1995). However, language interaction has often been interpreted as evidence for interference (deviation from the language being spoken due to the influence of the other language), without regard to the context or the language mode in which the so-called 'interference' took place (Grosjean, 1998). This study will offer evidence for different phonological modes in the bilingual by showing that each language mode has a different impact on the bilingual's production.

3. Aims of the study

This study examines the extent to which bilingual children can establish phonetically/phonologically distinct production patterns for /r/ in each language. The study sets out to answer the following questions:

1 Do English-Arabic bilinguals acquire separate sociolinguistically appropriate production patterns for /r/ for each of their languages?

2 Are their patterns of production in each language similar to those of the monolingual controls in the study?

3 Are the patterns for the monolingual subjects in this study similar to the ones normally described in the literature and therefore expected for each language?

4 Are there signs of influence from one language onto the other in the bilinguals' production? If so what are the factors that affect such influence and how are they related to the bilingual's language modes?

4. English /r/

4.1 Phonetics and phonology of English /r/

In most English accents, /r/ is produced as a voiced alveolar or post-alveolar approximant [ɹ], although the tap [ɾ] remains the localised variant found in many parts of northern England, Scotland and Wales (Hughes & Trudgill, 1996: 90; Wells, 1982: 368). Another labiodental variant, [ʋ], is increasingly becoming a feature of many urban English accents (Foulkes & Docherty, 1999, 2000; Hughes & Trudgill, 1996; Williams & Kerswill, 1999; Llamas, 1998).

There is no detailed description of the /r/ variety used in Yorkshire. Some of the available accounts of parts of Yorkshire include Hughes & Trudgill (1996: 90), who describe the /r/ in Bradford as a flap, and Stoddart, Upton & Widdowson (1999:76), who describe the Sheffield /r/ as mainly an approximant although a tap can be heard among males. Wells (1982: 368) notes that the alveolar tap [ɾ] seems quite widespread in the north of England as a rival to the usual post-alveolar approximant and associates its use with Leeds, but also acknowledges that the geographical spread of the tap is not well known. Like many English English dialects, most urban Yorkshire accents are non-rhotic even though some of the traditional rural areas in East Yorkshire are still characterised by a partial retention of post-vocalic /r/ (Hughes & Trudgill, 1996: 33; Wells, 1982: 368).

4.2 Acoustic description of English /r/

The English approximant is normally characterised by a weak vowel-like acoustic structure made up of a series of weak formants due to a narrower constriction than that normally made for vowels. This is manifested by an average of 10dB lower amplitude in the liquid compared with a following stressed vowel (Stevens, 1998: 534). The retroflex and rounded variant of [ɹ] is distinguished by a particularly low F3

that is close to F2 (Borden & Harris, 1984: 113; Cruttenden, 2001: 207; Ladefoged & Maddieson, 1996: 234; Stevens, 1998: 535[2]), while energy above F3 is normally very weak due to the existence of two anterior constrictions in the vocal tract, one made by the tongue tip or blade, and the other by the narrowed lips.

Due to its weak formants, [ɹ] tends to be identified on spectrograms by its steeply rising transitions to a following vowel. As for the labiodental variants, there are few examples of acoustic analysis of it in general, and only one study with acoustic description of the variant occurring in British English (Foulkes & Docherty, 2000). Contrary to [ɹ], [ʋ] displays less phonologically-conditioned variation in F3 and is generally characterised by a dip in all formants, though its F3 is still higher than that of [ɹ], with an average of around 200 Hz difference. Foulkes & Docherty suggest that the possible lack of F3 is a sign of little or absence of tongue retroflexion or bunching that is typically associated with [ɹ].

4.3 Acquisition of /r/ by monolingual speakers

Few studies have focused specifically on the development of /r/, and the information gathered here for its acquisition is taken from more general studies of phonological development (Bernhardt & Stemberger, 1998: 305/331; Cruttenden, 2001: 209; Edwards, 1973: 9; Ingram, 1979: 135-140; Matthews, 2001: 216-218; Menyuk, 1971: 80; Moskowitz, 1970; Sander, 1972: 62; Smith; 1973: 2/18/75; Vihman, 1996: 219/ 239). In English, the production of liquids emerges relatively late, preceded by early production of nasals, plosives, and some of the fricatives. The production of [ɹ] is known to involve physically complex articulations and usually emerges late in children's speech, commonly around the age of 4;5. [ɹ] production is highly variable and is not normally mastered before the age of 6, with mature production in prevocalic contexts generally preceding that of post-vocalic ones. [ɹ] is frequently replaced by [w] and [ʋ] in initial position, e.g. 'rabbit' [wæbɪʔ]; 'red' [ʋɛd], and less commonly by [l] and [j] e.g. 'rain' [leːn]; 'room' [juːm]. /r/ is often deleted in initial consonant clusters and in medial and final position (for rhotic accents), e.g. 'grandma' [ˈgɛːmɑ]; 'dress' [dɛs]; 'very' [vɛiː]; 'car' [kɑː]. In initial clusters with alveolar stops, stops are often affricated or fricated, e.g. [dʒɛs]. Another process common in early productions is stopping e.g. 'rat' [dæt]; 'record' [gɛˈkɔːd].

5. Arabic /r/

5.1 Phonetics and phonology of Arabic /r/

Arabic /r/ is normally a tap or a trill, depending on free and allophonic variation (Anani, 1985: 132; Nasr, 1966: 5; Shaheen, 1979: 142). Allophonic variation is mainly concerned with the distinction between single and geminate /r/'s in intervocalic position, whereby single /r/'s are produced as taps ([ˈbaɾa] 'he sharpened') and geminates as trills ([ˈbarːa] 'outside'). There is, however, free and individual variation in the production of taps and trills, so that single /r/'s are sometimes trilled while geminates can be realised as single long taps. Also, like any other language where a possible realisation for /r/ is a trill, not all speakers produce a

[2] Stevens argues that the resonance that appears close to F2 is not actually F3, but a new resonance that he calls F_R created by the front cavity anterior to the point of constriction (caused by the side chamber under the tongue tip retroflexion). Still, the effect of F3 or F_R is that of a dipped energy into the approximant and a sharp rise out of it.

trill and even those who do use trills have taps and other realisations as well (Lindau, 1985: 161). Moreover, there is the possibility of a trill being produced by a single pulse or closure followed by a prolonged opening phase rather than several pulses (Lavoie, 2001: 83; Lindau, 1985: 161). Lavoie (2001: 143-144) further notes that the number of pulses per trill may vary according to context; her findings on Spanish trills show greater number of pulses for trills that are produced in stressed rather than unstressed positions.

Taps are also produced differently depending on context (Lavoie, 2001: 84), language, and even speakers of the same language (Lindau, 1985: 161). Lavoie (2001: 84) goes as far as placing the Spanish tap under the approximant category when it occurs in medial position. Descriptions of the Arabic tap echo the diversity of realizations found in other languages. Shaheen (1979: 142-145), for instance, notes that although Arabic /r/ is always labelled as a tap (or a trill), it can be phonetically realised as a tap, a frictionless continuant or a fricative. The symbols used by Shaheen for the three variants of each category are [ɾ], [ɹ] and [r̊].

As opposed to the absence of post-vocalic /r/ in non-rhotic English accents, Arabic /r/ is produced in all pre- and post-vocalic contexts. Moreover, Arabic /r/ can occur as the nucleus of initial e.g. [ɾˈbɪħna] 'we won' and final syllables e.g. [ʔabɾ] 'grave', and also subject to gemination e.g. [ˈbarːa] 'outside'.

5.2 Acoustic analysis of Arabic /r/

Since the production of taps and trills is characterised by one or several rapid interruptions of the air stream, their spectra typically have similar acoustic features to plosives along with a vowel-like formant structure and/or friction-type noise that is visible between the transients (Ladefoged & Maddieson, 1996: 218; Shaheen, 1979: 142).

In initial position, descriptions of the Arabic tap mention the presence of distinct formant structures interrupted by a vertical transient, while the trill is characterised by multiple vertical transients and can be acoustically regarded as a series of taps (Al-Ani, 1970: 33; Lindau, 1985: 166; Shaheen, 1979: 145-160). Acoustic energy is concentrated in well-defined formants only at the lower end of the spectrum. In 80% of /r/ occurrences F3 is absent and acoustic energy above F2 is unevenly distributed, though vaguely anticipating the formants of the following vowel. In the absence of a transient, /r/ is said to appear as a frictionless continuant [ɹ]. It is interesting to note that while for English [ɹ] F2 and F3 are very close, F2 and F3 (when present) in Arabic are often widely separated (Shaheen, 1979: 145-160).

In intervocalic position, the spectrum of /r/ is described as being similar to that of a stop. It appears on the spectrogram as a gap with no energy above the voice bar, apart from occasional appearance of a shadow of the formants of the adjacent vowel (Shaheen, 1979: 145-160). As for final position, when devoiced, /r/ can often show a spectrum of a fricative nature [r̊]. Acoustic energy varies between widespread diffusion in the frequency range 2700-5000Hz, and lower level frequencies so that F1 and F2 could be detected despite their low intensity.

5.3 Acquisition of /r/ by monolingual speakers

Similarly to English, /r/ production in Arabic is usually more difficult to acquire than /l/ and may be replaced by /l/ in the initial stages (Amayreh & Dyson, 1998: 646; Omar, 1973: 48-56). Dyson & Amayreh, (2000: 84) actually group /r/ under the most difficult sounds to acquire along with the emphatics due to the articulatory complexity

that is involved in its production. Though Arabic /r/ emerges around the age of 3, it only reaches an acceptable performance towards around the age of 5;6, approximately the same age as that of the acquisition of the English /r/.

Monolingual developmental features for Arabic /r/ normally include deletion e.g. [naːʔ] 'fire' for adult [naːɾ], assimilation, e.g. [ʔikkab] 'I ride' for adult [ˈʔirkab] and substitution, which being more frequent and mainly involves lateralisation, e.g. [ˈlasam] 'he drew' for adult [ˈɾasam]. Lateralisation shows a clear developmental trend, declining rapidly from early production till the age of 4;4, and normally disappearing after 5;5 (Dyson & Amayreh, 2000: 89-91; Omar, 1973: 56). Another occasional type of /r/ substitution is gliding of /r/ to [j], but there are normally no occurrences of [w] for either /r/ or /l/. This pattern is quite different from English where /r/ gliding to [j] but mainly [w] is frequent whereas lateralisation is uncommon, although it does occur occasionally (Smith, 1973: 75). This may be due to the fact that [ɾ] and [l] share tongue tip contact, while [ɹ] and [l] do not, while [ɹ] and [w] involve labiality. A final rare type of /r/ substitution reported in Dyson & Amayreh (2000: 94) is stopping, though there is no mention of the stop variants produced.

6. Bilingual acquisition of /r/

Acquisition of /r/ by bilinguals has mainly been looked at as part of case studies of the overall bilingual phonological development of a given child. While early views argue for an initial single system for the acquisition of /r/'s by bilinguals (e.g. Leopold, 1970), later studies offer evidence for the bilinguals' ability to distinguish between the patterns of /r/ production in each of their languages from an early age (e.g. Burling, 1971; Ingram, 1982; Ball, Müller & Munro, 2001). Each of these studies will be discussed briefly in this section.

In Leopold's (1970: 64) longitudinal study of his English-German bilingual daughter's production, the author notes that Hildegard initially treated the German and English /r/'s in the same way in terms of omissions and substitutions. For instance, initial /r/ was constantly replaced by [w], which Leopold explains as serving the labial nature of the English /r/ and the raised tongue back position of the German velar. Final /r/'s were omitted or substituted by vowels of varying quality, but lacked labialisation. Burling's (1971) study, on the other hand, describes a case of early differentiation between the patterns of liquid production by his English-Garo speaking child between the ages of 1;4 and 2;8. For instance, between the ages of 1;5 and 2;8, Stephen used [l] for both Garo [l] and [ɾ] e.g. [lama] for /ɾama/ 'road', while he replaced English /r/ with [w] or omitted it altogether. None of the Garo liquids were replaced with the labial-velar approximant. A similar observation is noted by Ingram (1982) in his study of his Italian-English bilingual daughter, which provides another piece of evidence for two different phonological patterns for /r/ as produced by the child. Ingram's daughter substituted [l] for /r/ in Italian (e.g. [lakonta] for [ɾakonta] 'story') and [w] for /r/ in English (e.g. 'ready' [wedi]).

Ball et al (2001) examined the developmental patterns in the acquisition of rhotic consonants by 85 Welsh-English bilingual children between the ages of 2;6 and 5;0, divided into five age ranges and into Welsh-dominant or English-dominant subjects. Welsh has both a voiced and a voiceless alveolar trill [r] and [r̥ʰ] which occur in all word-positions, whereas the accent of the English spoken by most Welsh-English bilinguals is mainly non-rhotic and uses a post-alveolar approximant [ɹ]. There was a varied number and quality of substitutions that the subjects exhibited in

their /r/ productions in both languages, particularly for the Welsh trill but for the English approximant as well. Ball et al's study showed that differences in rate of acquisition and amount of variability were linked to the dominant language of the subjects, and the use of substitutions derived from acoustic as well as articulatory similarity with the target sound.

While the studies mentioned have concentrated on the early stage of bilingual acquisition, data from the later stages of bilingual development are needed in order to examine whether or not there is full separation of /r/ production in each language. Another important issue that has not been discussed by any of the studies above is the influence of the language mode on the type of variants that the bilinguals might choose to use.

7. Sociolinguistic issues in the acquisition of /r/

Few studies have considered the phonological repertoire of bilingual children with the particular local accent(s) spoken in their environment in mind in order to examine the motivating factors that instigate the production of one realisation over a number of competing alternatives. One such study is by Verma, Firth & Corrigan (1992), who examined the developing phonological system of Panjabi/Urdu speaking children learning English as an L2 in two different areas in Britain, West Yorkshire and Scotland. The Panjabi/Urdu speaking subjects from West Yorkshire seemed to alternate between the tap [ɾ] and the trill [r], which the authors interpreted as a combination of influence from their L1 and their local variety (Verma et al, 1992: 189). It is interesting to note, however, that the children did not produce the retroflex variant [ɽ], which would have been a clear influence from their L1. The subjects did have a rhotic accent, and therefore tended to produce postvocalic /r/'s as in 'star' [staɹ], and 'water' [wɔʔər]. Though Verma et al interpret this as transfer from the subjects' mother tongue in which all orthographic 'r's are produced. The subjects have learned their English primarily from school, and English orthography may have made it more difficult for them to acquire non-rhoticity.

Similarly, Agnihotri (1979) examined processes of assimilation to Leeds English that Sikh children of immigrant families exhibit in relation to their length of stay in Leeds and found an overall negative correlation between 'accent-revealing' features (features that would identify them as non-native speakers) and length of stay in Britain. There were, however, other important determining factors such as speech style, gender, social background and area of residence of the families involved. For instance, the occurrence of post-vocalic /r/ tended to decrease in the subjects' production not only with the length of stay, but also in casual style as opposed to reading style, with females more than males, for Sikh children of Indian origin rather than Kenyan origin, and for Sikh children who interacted more frequently with native Leeds English speakers than those who lived in immigrant areas (see Agnihotri, 1979: 243-253 for a discussion).

More interestingly, Agnihotri found that the English of each of the individuals showed simultaneous use of features from the different varieties that they were exposed to from native and non-native speakers of the language. This mixed code exhibited itself in the way the children produced the same sounds sometimes 'the Indian way' and other times 'the English way' in the same utterance. For instance, the author gives the example 'mother', which was produced by the children as [mʊðə], [mʊðəɾ], or even [mʊðəɹ], sometimes within the same utterance. The use of features from all varieties by the young bilingual has also been discussed by Heselwood &

McChrystal (2000), although Agnihotri attributed their use to code-mixed utterances whereas Heselwood & McChrystal found such features even in their attempt to elicit data from their subjects in a monolingual mode. The current study will further explore this issue by investigating whether the bilinguals produce different /r/ variants depending on the language(s) used in the different sessions.

8. Methodology

8.1 The subjects

A total of 23 subjects were recorded for this study, including three English-Arabic bilingual children and three monolingual children from each language, along with both parents of all children (Table 1). With respect to the children, there are three age groups (5, 7, and 10) and all subjects in a given group are of the same sex.

Table 1: Details of subjects and their parents.

Age group 5				Origin		
Language groups	**Name**	**Age**	**Sex**	**Child**	**Mother**	**Father**
Mono. English	Lissa	5;5	F	York	Kennick	Leicester
Bilingual	Maguy	5;6	F	York	Beirut	Beirut
Mono. Arabic	Sarah	5;4	F	Beirut	Beirut	Beirut

Age group 7				Origin		
Language groups	**Name**	**Age**	**Sex**	**Child**	**Mother**	**Father**
Mono. English	William	7;5	M	Leeds	Stockton	Norwich
Bilingual	Mazen	7;1	M	Leeds	Beirut	Beirut
Mono. Arabic	Jad	7;4	M	Beirut	Beirut	Beirut

Age group 10				Origin		
Language groups	**Name**	**Age**	**Sex**	**Child**	**Mother**	**Father**
Mono. English	Andrew	10;3	M	Leeds	York	London
Bilingual	Mohamed	10;2	M	Leeds	Beirut	Beirut
Mono. Arabic	Khodr	10;3	M	Beirut	Beirut	Beirut

The monolingual English subjects are close friends of the bilinguals. Although the children were born and raised in Yorkshire, their parents come from different areas in Britain. The bilingual subjects are children of Lebanese families who have lived in Yorkshire for over ten years. All the parents are native speakers of Arabic and mainly use Arabic with their children at home, but code-switching is a common feature in the speech of parents and children alike. All three children started attending English nurseries from around age 1;0 and all three are English-dominant.[3] The only contact that the children have with Arabic is from their parents and a couple of Lebanese families living in other cities. Both families are keen on bringing up the children as bilinguals and have positive attitudes towards both languages. The monolingual Arabic subjects were chosen from the same district as the bilinguals' parents in the Lebanon. Two of the monolingual children (Jad and Sarah) and two of the bilinguals (Mazen and Mohammed) are siblings, so there are only four parents in each of the bilingual and monolingual Arabic groups.

Apart from the main subjects from this study, recent data collected for the Leeds Intonational Variation in English (IViE) corpus (Grabe & Nolan, 2001) were analysed

[3] The decision on language dominance was made following a series of informal interviews with the subjects, their parents, and their school teachers.

in order to obtain more information about /r/ production in the community. The corpus consists of recordings of ten 16-year-old speakers who were all born and raised in Leeds, and who were engaged in map task, story telling, and reading activities. There was no sign of rhoticity in the speech of any of the subjects, and the predominant variant produced was the alveolar approximant (Khattab, 2002b).

8.2 Procedure

Tape-recording sessions took place in the subjects' homes and were designed around picture-naming games, story-telling, and free-play sessions for the children, and word lists, story-telling, and interviews for the adults. A Tascam DA-P1 DAT recorder was used during all sessions, with Transtec external microphones clipped to the subjects' clothes. For the picture-naming games, the bilingual children were recorded twice, following a one-language-per-session format. While I conducted the sessions with the children in English, the mothers were asked to conduct the Arabic sessions on the basis that the children would be more likely to use Arabic with their parents than with anybody else in their environment. However, while the children used only English in the English sessions, they frequently reverted to code-switching during the Arabic sessions or responded in English even when the mothers were asking them questions in Arabic. The code-switched utterances were analysed and interpreted separately from the single-language utterances and proved significant in the overall interpretation of the results.

8.3 Material collected for /r/

Data for this study were extracted from the activities mentioned in section 8.2 (Table 2). All the words that had 'r's in the spelling as well as in the pronunciation were examined in both languages in order to compare the occurrence of post-vocalic /r/'s by different subjects and in different languages.

Table 2: Sample tokens used for the examination of /r/ in English and Arabic

English	**pre-vocalic**		**postvocalic**	
Examples	giraffe orange red carrot		butterfly worm deer horse	
Arabic	**pre-vocalic**		**postvocalic**	
Examples	**IPA**	**Gloss**	**IPA**	**Gloss**
	zaɾaːfe	giraffe	ʔaħmaɾ	red
	bɪrːaːd	fridge	xjaːɾ	cucumber
	faɾaːʃe	butterfly	bɪrnajtˤɑ	hat
	ʒazɾa	carrot	kɪrse	chair

8.4 Analysis

While auditory analysis was conducted on the data collected from running speech, both auditory and acoustic investigations were conducted on the words produced in isolation. The /r/ tokens that were produced were initially coded for one of nine categories (Table 3), including three choices for the obstruent-like type, four choices for the approximant type, one for deletions and a final one for other realizations. The decision behind this categorisation was made during the auditory analysis in order to avoid as much as possible forcing variants into rigid categories, without losing sight

of the aim of the investigation, which in principle is to find out whether the bilinguals will produce language- and accent-specific /r/ variants.

Table 3: number of categories devised for labelling the /r/ tokens in English and Arabic

Stop-like types			**Approximant types**					
1	2	3	4	5	6	7	8	9
r	ɾ	ɾ̝	ɹ	weak ɹ	weak ʊ	ʊ	Ø	other

With respect to the stop-like types, category 3 was included when it was noticed that some of the productions of the Arabic tap were heard more like approximants than taps. Although this type of weak stop realization has been noticed before and labeled [ɹ] by Shaheen (1976), a different label was necessary due to the fact that the realization still differed from the English approximant [ɹ] in that there was no audible reflex of retroflexion or lip rounding. For this reason, [ɾ̝] was chosen instead and later acoustic analysis offered further evidence for its nature and its distinction from [ɹ]. The distinction between [ɾ̝] and [ɹ] proved important in the analysis of the bilinguals' production in the two languages (see Sections 9.4 and 10.3).

As for the approximant types, a 4-point scale was devised once again to allow for the variation that was found in some speakers' pronunciation rather than forcing tokens into the alveolar or the labial variety (see Foulkes & Docherty, 2000). Finally, the 'Ø' and 'other' categories were included because of their importance in revealing contextual, developmental, and sociolinguistic differences in /r/ production in either language. For instance, in the English data, all the tokens of post-vocalic /r/ were checked for the presence or absence of an audible /r/. Then, a similar check was made for the Arabic /r/'s in similar environments in order to detect whether the subjects have applied non-rhoticity onto their Arabic /r/'s. As for the variants that were other than a tap, trill, or an approximant, these revealed a wider repertoire for the bilinguals and will be discussed further in the results sections.

A total of 4229 tokens were auditorily analysed for this study, and then around 1500 of these tokens were analysed acoustically. However, results from the acoustic analysis will not be presented quantitatively, but will rather be used as qualitative support to the auditory analysis (spectrographic examples will be shown later).

8.5 Presentation of results

For the purpose of brevity, abbreviations will be used for the subjects in the presentation of results (Table 4).

Table 4: Initials used for the subjects in the presentation of results.

	Age 5	**Age 7**	**Age 10**	**Adults**	
Monolingual English	E5	E7	E10	EF	EM
Bilingual	B5	B7	B10	BF	BM
Monolingual Arabic	A5	A7	A10	AF	AM
Total = 23	**3**	**3**	**3**	**7**	**7**

9. English results

9.1 Adults: monolinguals' parents

Figure 1 shows results for the /r/ variants used by the monolinguals' parents during the reading and story telling activities. Some categories of variants have been

collapsed together in order to concentrate on the obstruent-*versus*-approximant pattern first. As can be seen, the overwhelming variant used by the monolinguals' parents is the approximant [ɹ], and all six of them have a non-rhotic accent. These results suggests that the approximant (and not the tap) is the variant used by this small Yorkshire community of speakers, although one has to be careful about generalizing the results since most of the parents are not originally from Yorkshire (Table 1).

As for the small percentage of [ʋ]'s that were found in the monolingual parents' production, individual results (Figure 1) show that the labial variant was mainly produced by EM10, who originally comes from London where he grew up till he was 18. His use of [ʋ] is perhaps not surprising, since the labial variant is a well-documented realization for /r/ in the South-East (Foulkes & Docherty, 2000; Hughes & Trudgill, 1996: 60). As for EF5, EM5, and EF10, the [ʋ]-like tokens that they produced were very small in number (Appendix 1), were mainly grouped under category 6 (weak [ʋ]), and mainly occurred as a result of an adjacent labial ('bread' [bʋɛd]; 'frog' [fʋɔg]) as noted elsewhere (Foulkes & Docherty, 2000).

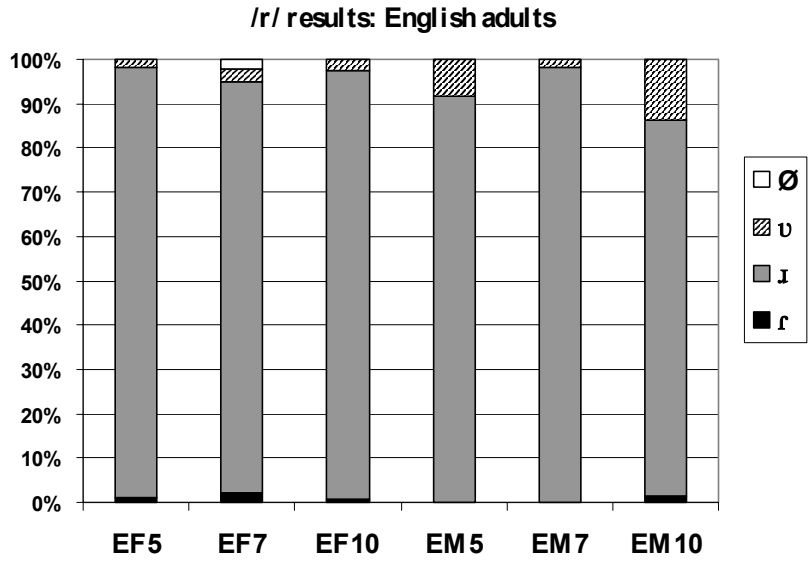

Figure 1: Results for the different /r/ variants produced by the monolinguals' parents in onset positions. **'Ø'** includes deletions and other realisations. N = 720.

9.2 Adults: Bilinguals' parents

The bilinguals' parents display the typical behaviour of L2 speakers whose L1 patterns interfere with their L2 by producing the majority of their /r/'s in English as taps or trills and by having a rhotic accent (Figure 2). The production of post-vocalic /r/'s may also reflect the type of English that the parents learned before moving to England. The bilinguals' parents did produce a small number of [ɹ]s, along with a number of non-rhotic productions (hence the zero-realisations in post-vocalic environments). This suggests that they are aware of the English /r/ production patterns, but do not or cannot produce them consistently due to the influence of Arabic /r/ patterns. What is important to note, though, is that the kind of variety displayed in Figure 2 constitutes part of the input that the bilingual children in this study are exposed to.

Furthermore, there are interesting observations with respect to sub-group and individual behaviour in the production of /r/'s (Appendix 1). First, three out of four of the L2 adults regularly produce a variant that sounds more like an approximant than a tap but that may lack lip rounding, tongue bunching and/or retroflexion that are typical of [ɹ]. The variant has been labeled [ɾ̞] as it is assumed that it is produced following an incomplete or lack of contact that is typical of a tap articulation. Further acoustic investigation confirms that [ɾ̞] realizations are indeed more approximant in nature than stop-like due to the formant structure that they display in the majority of cases, but more importantly, that they are indeed different from the English [ɹ] due to the lack of F2 and F3 lowering that they exhibit (Figures 3 and 4). Of course, the difference between [ɾ] and [ɾ̞] was not always clear-cut or categorical, as there were tokens that had clearly audible taps but that displayed gaps filled with formants indicating incomplete closure, while other tokens were heard as approximants but displayed signs of a gap and/or faint bursts. The two types of production are therefore better seen as part of a continuum ranging from full closure and burst at one end to absence of gap and full formant structure at the other.

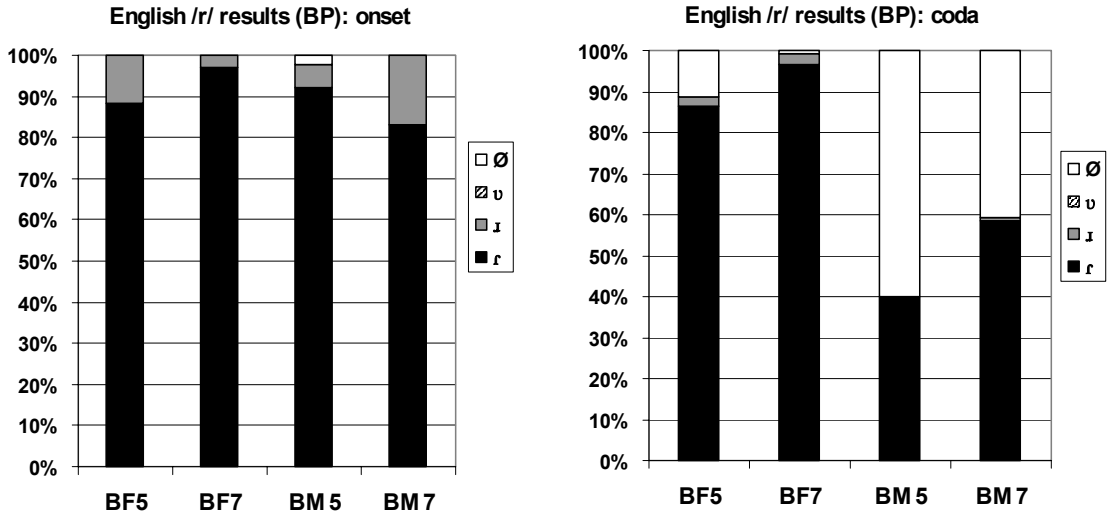

Figure 2: Results for the different /r/ variants produced by the bilinguals' parents. **'Ø'** includes deletions and other realisations. N = 354 (onset) and 500 (coda).

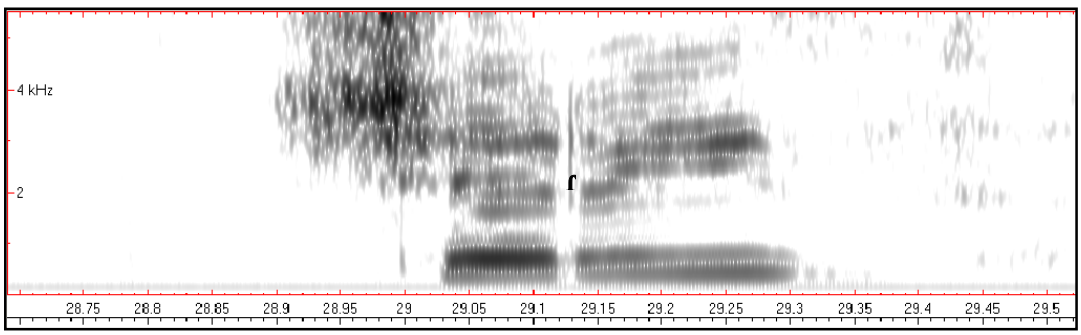

Figure 3: Spectrogram for the word 'cherries' produced with a tap [ɾ].

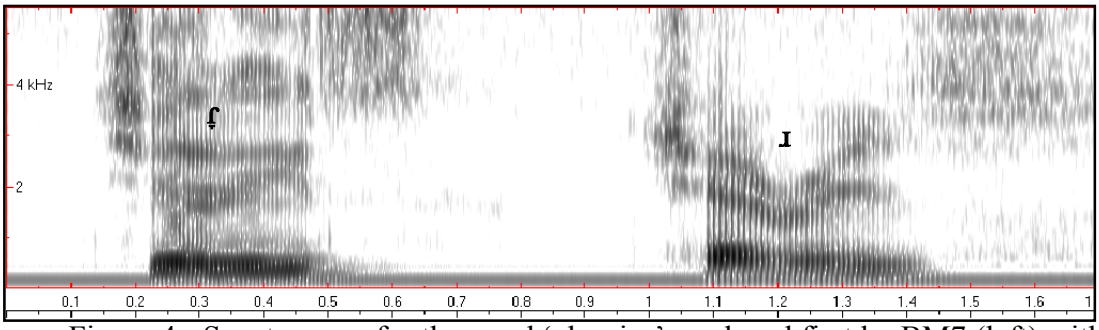

Figure 4: Spectrogram for the word 'cherries' produced first by BM7 (left) with a weak tap [ɾ̥] (F2 = 1790Hz; F3 = 2605Hz), and then by EM7 (right) with an approximant [ɹ] (F2 = 1363 Hz; F3 = 1892Hz).

9.3 Children: monolinguals

Figure 5 shows the individual results for the monolingual children's /r/ patterns during the picture naming and story telling activities. Apart from the overwhelming use of the [ɹ] variant by all three children, two developmental patterns might be taking place in their production. First, the percentage of the labial variant [ʋ] gradually decreases as the age of the children increases. Such a result is to be expected knowing that the production of [ɹ] involves physically complex articulations and usually emerges late in children's speech. As mentioned in Section 4.3, children acquiring [ɹ] frequently replace it by [w] and [ʋ], and the children in this study are no exception.[4] The second developmental feature is /r/ deletion in onsets which, like [ʋ] production, decreases as the age of the children increases. Deletion is expected among children acquiring /r/, and normally takes place in consonant clusters and in medial positions. Examples from this study include [ǧiːn] 'green', [ˈpaɪde] 'Friday', [ˈdʒanui] 'January', and [fɔg] 'frog' by E5, and [ˈbəʊkən] 'broken', [ˈeɪpəɬ] 'April' by E7.

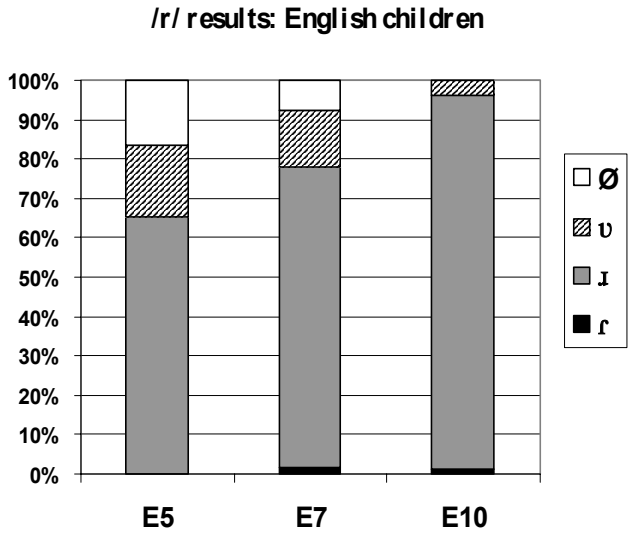

Figure 5: Results for the different /r/ variants produced by the monolingual English children. **'Ø'** includes deletions and other realisations. N = 213.

[4] Although [ʋ] was also found in the production of one of the adults, there is no evidence in the literature or from the other adults in this study to show that it is part of the accent of the community.

9.4 Children: bilinguals, English produced in the English-only sessions

Figure 6 shows the individual results for the bilingual children's /r/ production patterns when speaking English. As can be seen, the overwhelming variant used is the approximant [ɹ], which shows that the bilinguals have not adopted the /r/ patterns that were produced by their parents and are displaying very little interference from Arabic (note the small percentage of taps produced). More interestingly, all three bilingual children have a non-rhotic accent in English, though all their parents are predominantly rhotic. The patterns for the bilinguals seem very similar to those of the monolingual English children, mainly with regards to the use of [ɹ] and the gradual decrease in the use of [ʊ] and deletions as the children grow older. It is interesting to note that the youngest bilingual (B5) produced fewer deletions than the English 5-year-old (3% for B5 (2 out of 63 tokens) compared with 17% for E5 (12 out of 72 tokens)). B5's two tokens listed in the category 'other' (Appendix 1) consist of [w] realizations in [ˈmɪwə] 'mirror' and [ˈskwiːmɪŋ] 'screaming'. One token that was not included in Appendix 1 is the only post-vocalic /r/ production by B5 during the picture-naming and story-telling activities ([ˈkʰɑɻtʉːn] 'cartoon').

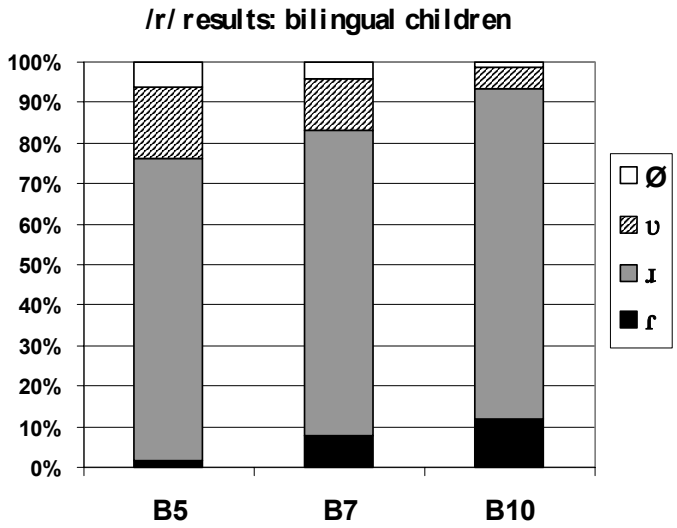

Figure 6: Results for the English /r/ variants produced by the bilingual children during the English sessions. **'Ø'** includes deletions and other realisations. N = 217.

The main difference between the English and the bilingual child groups is the use of a small number of tap variants by the bilingual children, though each of E7 and E10 also produced one token with a tap (in 'married' and 'through' respectively). B5 also produced only one token with a weak tap, while B7 produced weak taps in 6 out of 77 tokens (8%) and B10 taps and weak taps in 9 out of 77 (12%). B7 mainly produced taps in word-medial or consonant cluster positions like in [ˈkʰaɻət] 'carrot', [əmˈbɻɛlːa]'umbrella', and [fɻɔg] 'frog', and, like B5, had one post-vocalic /r/ production during the picture-naming and story-telling activities ([ˈɔtʰɚ] 'otter'). B10 produced taps mainly in word-initial position like in [ˈɾʉstʰəɻ] 'rooster' and [ɾɛd] 'red', but also in consonant clusters like [θɾʉ] 'through', and [əmˈbɻɛla] 'umbrella'. B10 also had two post-vocalic /r/ tokens during the picture-naming and story-telling activities, [ˈɾʉstʰəɻ] 'rooster' and [dʒɑːɻ] 'jar'.

Still, apart from the few tap productions which constitute only a small percentage of the bilinguals' overall /r/ production in English, the three bilingual children do have overall similar /r/ patterns to those of the monolingual English children in this study. These findings were also supported by results from the free-play sessions between the children, which are discussed in more detail in Khattab (2002b). The patterns that emerged from the sessions where each bilingual was paired with a monolingual support the results that were found in Section 9.3 and 9.4 and that show that the approximant [ɹ] is the majority variant for both monolingual and bilingual children. Furthermore, the free-play session between B7 and B10 showed that the two brother used English most of the time and produced only ten short code-switched utterances between them during the 45-minute play session. On the whole, their productions patterns when interacting with each other were largely similar to those they exhibited when interacting with their English friends. But that is not the whole picture (see Section 9.5).

9.5 Children: bilinguals, English produced during the Arabic sessions

As mentioned in Section 8.4, all the English tokens from the Arabic sessions were analysed separately due to the stark differences in the patterns that they display compared with English spoken in the English sessions. Examples (1) and (2) illustrate the types of code-switches that occurred.

(1) Mother (pointing at a dress):	[ʃu haɪda]?	
	What that (masc.)?	
	What is that?	
Child:	[dɾɛs]	
	dress	
(2) Child (describing a an action):	[ˈnɑtˁtˁɪt mɪnɪl ˈ**ʤɑɾ**]	
	*jump-past-fem. out-of-the **jar***	
	she jumped out of the jar	

Figure 7 shows the results for the bilingual children's /r/ patterns in English tokens produced during the Arabic sessions. There is a stark contrast between the results from these sessions and those found in Figure 6, as the main variant used by the bilinguals this time is the tap rather than the approximant, and there are a lot of post-vocalic productions (Appendix 1). The two patterns of production in Figures 6 and 7 can be seen as belonging to different language modes, and this issue will be discussed further in Section 12.3.

In terms of other realisations, B5's production displays developmental features that are normally typical of (i) English acquisition, e.g. affrication ([tʃamp] 'tramp'); (ii) Arabic acquisition, e.g. lateralisation ([ˈsˠk̟liːmɪŋ] 'screaming'); or (iii) both, e.g. /r/ deletion ([ˈtʃɛiːh] 'cherry'). Figure 8 shows a spectrogram of the word 'trainer' [ˈtʃr̝eɪnəʰ] produced by B5 during the Arabic session, with a mixture of English features, including a highly affricated /t/ and a non-rhotic production, and Arabic ones including an alveolar trill following the affricated /t/. It is interesting to note that /r/ lateralisation in B5's production was restricted to the Arabic sessions.

While during the English sessions the bilinguals had a predominantly non-rhotic accent, the three subjects produced a considerable number of post-vocalic /r/'s in the Arabic sessions, ranging from 44% of all possible post-vocalic /r/'s for B5, to 72% and 78% for B7 and B10 respectively. B7 also produced retroflex taps (e.g. 'jar' [dʒɑɽ]). In order to illustrate the difference between the bilingual children's English

productions in each of the English and the Arabic sessions, a sample of the words that were produced in both sessions by each child were extracted and transcribed in Appendix 2. Apart from the different /r/ realisations depending on the language session, the children's productions display noticeable differences with regards to vowels, consonants, and stress patterns. These are discussed in more detail in Khattab (2002b). Finally, while the three bilinguals produced a small number of the alveolar approximant typical of their production in the English-only sessions, B7 also produced two tokens with a labial approximant, while B10 produced one token with a retroflex approximant ([ɖɻɛs] 'dress'), which adds to the variety of /r/'s produced by the bilinguals during the Arabic sessions.

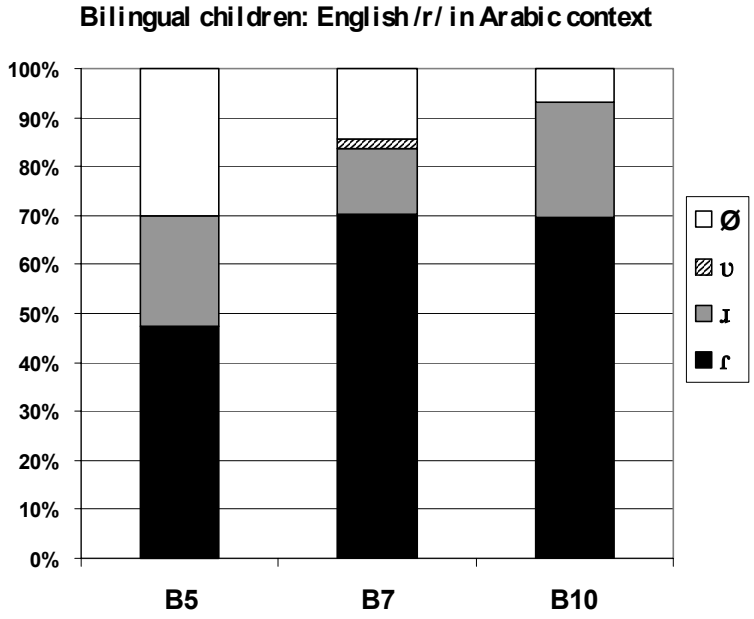

Figure 7: Results for the English /r/ variants produced by the bilingual children during the Arabic sessions. **'Ø'** includes deletions and other realisations. N = 180.

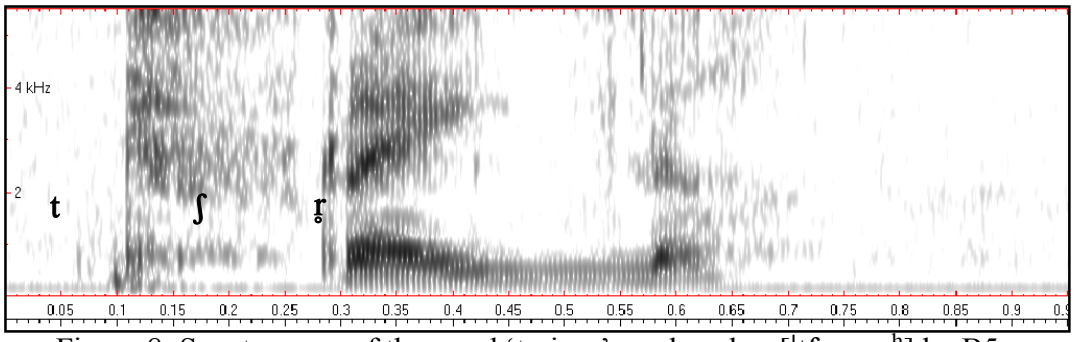

Figure 8: Spectrogram of the word 'trainer' produced as [ˈtʃɻ̊eɪnəʰ] by B5 during the Arabic session.

10. Arabic results

10.1 Adults

Figure 9 shows the results for the /r/ variants used by each of the monolinguals' parents and the bilinguals' parents speaking Arabic. On the whole, the two groups

look homogenous with respect to their /r/ production patterns, which is expected knowing that the bilinguals' parents are all native speakers of Arabic.

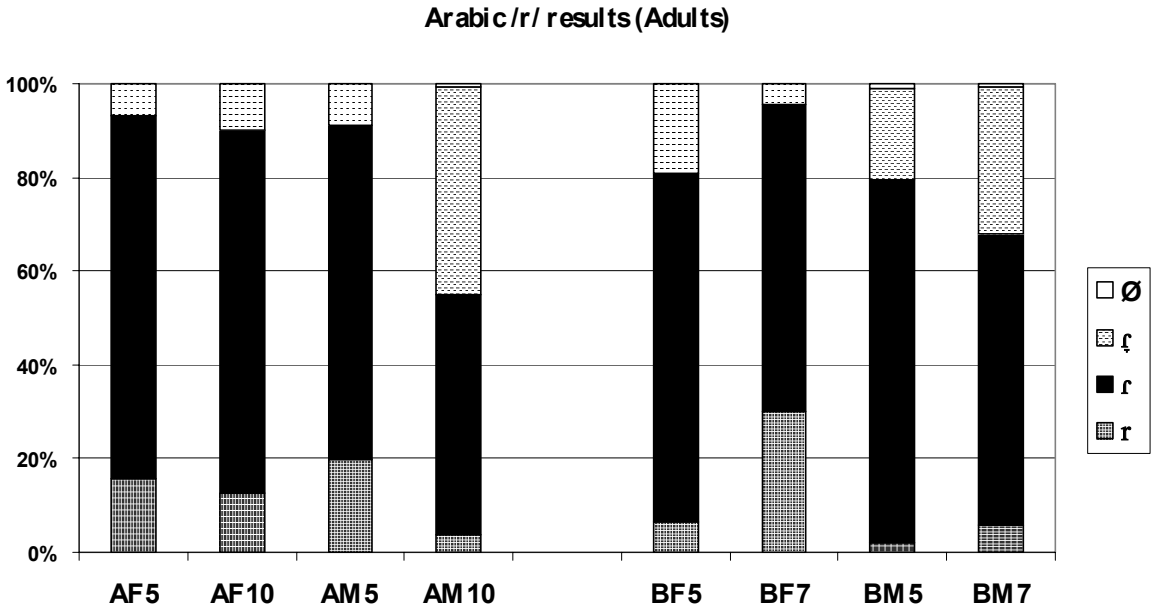

Figure 9: Results for the different /r/ variants as produced by the monolinguals' parents (left) and the bilinguals' parents (right). N = 958.

The most frequent variant produced by all the adults is the tap. As for the weak tap and the trill, their production shows that there are idiosyncratic preferences for one type over the other, especially with regards to AM10 and BF7. For instance, AM10 produces weak taps frequently regardless of syllable or word position (Appendix 1). His preference for a weak tap articulation is also accompanied with avoidance of trill articulations, and even his geminated /r/'s are sometimes produced with one long tap that shows on the spectrogram as a long filled gap (Figure 10). BF7 on the other hand, produces very few weak taps, and shows preference for trill realization both in onsets and codas regardless of whether the target is a geminate or not (Figure 11).

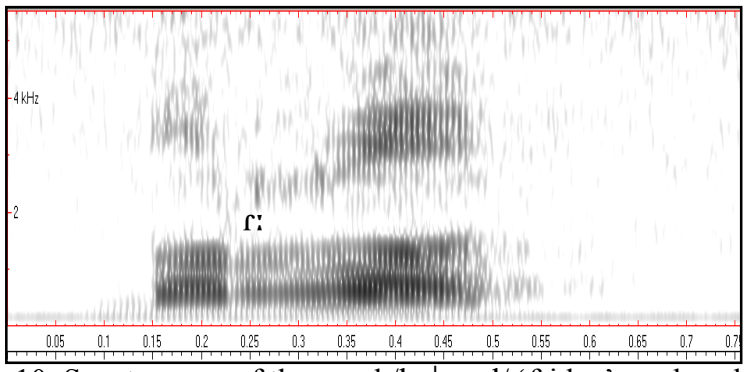

Figure 10: Spectrogram of the word /baˈrːaːd/ 'fridge' produced by AM10 as [baˈɾːaːd].

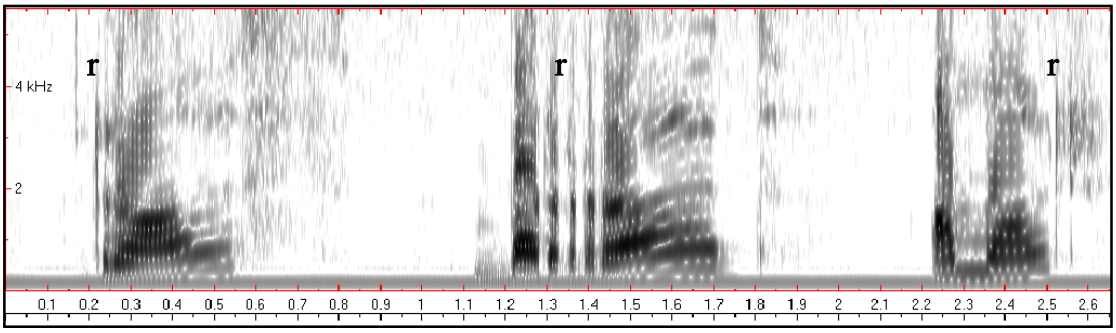

Figure 11: spectrogram of the words [rɑ̟ːs] 'head', [baˈrːaːd̥] 'fridge', and [ˈʔˤɑmaɾ̥] 'moon', produced by BF7 and showing initial, medial, and final trills.

Note that the occurrence of the weak tap was also influenced by syllable position, as word-final position induced more incomplete closures than other positions. In medial position, the weak tap often appeared on the spectrogram as a formant-like structure with no visible gap or burst in some cases (Figure 12, left), or with a sign of a gap that is filled with formants and/or a faint sign of a burst (Figure 12, right). In final position, the weak tap appeared in the form of slight formant continuation or friction typical of a word-final tap (Figure 13). As mentioned before, though the auditory distinction between taps and weak taps was more or less clear, it was not always easy to distinguish between them spectrographically, and the features they showed seem to operate along a continuum ranging from a strong tap articulation with a gap and a burst on the one hand, to no sign of a gap or burst on the other.

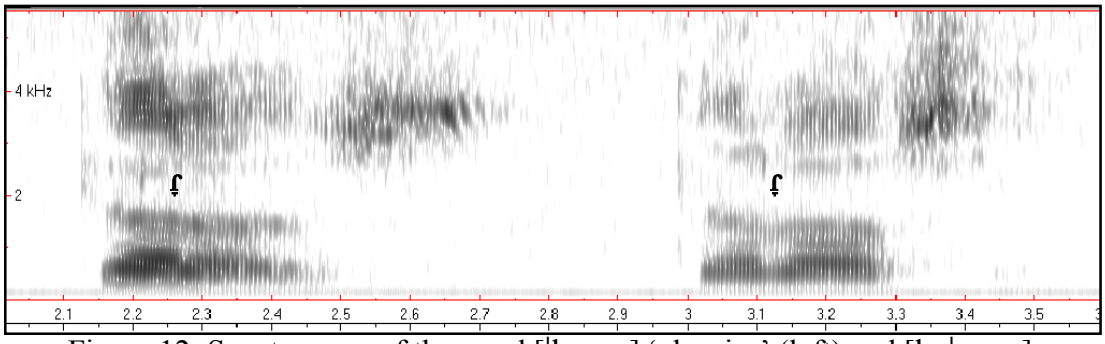

Figure 12: Spectrogram of the word [ˈkaɾ̥aʒ̥] 'cherries' (left) and [kaˈɾ̥aːse] 'chairs' (right) as produced by AM10.

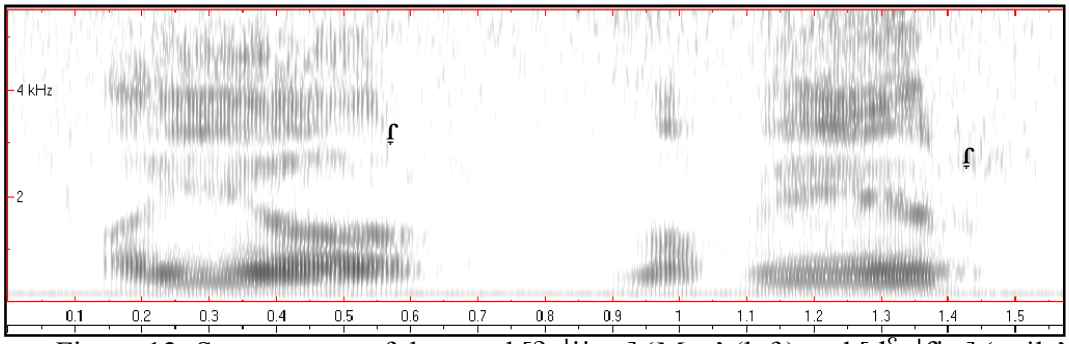

Figure 13: Spectrogram of the word [ʔaˈjjaːɾ̥] 'May' (left) and [dˤɑˈfiːɾ̥] 'nails' (right) as produced by AM10.

Having discussed certain idiosyncrasies about the parents' choice of /r/ pattern, we will see in the next section how the children's adoption of /r/ variants in Arabic might be influenced by those of the parents. For instance, BM7 produces fewer trills than BF7 and more frequent weak taps. As BF7 and BM7 are parents of the two of the bilinguals (B7 and B10), the next section will investigate how each of the parents' productions may be influencing one child or the other in terms of /r/ production patterns. The same applies for EM10 and his son, A10.

10.2 Children: monolinguals

Similarly to the results found for the parents, the three monolingual subjects produce a considerable number of weak taps alongside strong taps, regardless of context (Figure 14). Looking at A5's results first, one can find obvious developmental features in her production in that a high proportion of her /r/'s are omitted (18%), and 6% consist of other realisations. Omissions occur mainly in word-final position, e.g. [daˈfːiː] for [dˤɑˈfiːɾ] 'nails', but also in medial position, e.g. [ˈwɛ̰ːʔa̰] for [ˈwaɾʔa] 'paper'. Other realisations consist mainly of [l] substitution of /r/, e.g. [b̰anaˈd̰uːla] for [banaˈduːɾa] 'tomatoes', [ˈla̰ʔb̰e] for [ˈɾaʔbe] 'neck', and assimilation, e.g. [maˈttaħ], for [matˤˈɾaħ] 'place', [fɪˈʃʃeːje] for [fɪɾˈʃeːje] 'brush', which was also realised with a rhotic vowel [fɾˈʃeːje]. /r/ lateralisation is common among children acquiring Arabic (Dyson & Amayreh, 2000: 89-91; Omar, 1973: 56). Trill production is limited in A5's production and geminate /r/'s are often produced as one long tap. Interestingly, A5's production also included five tokens that sounded like retroflex approximants, but, after instrumental inspection, showed signs of a gap in between the formants.

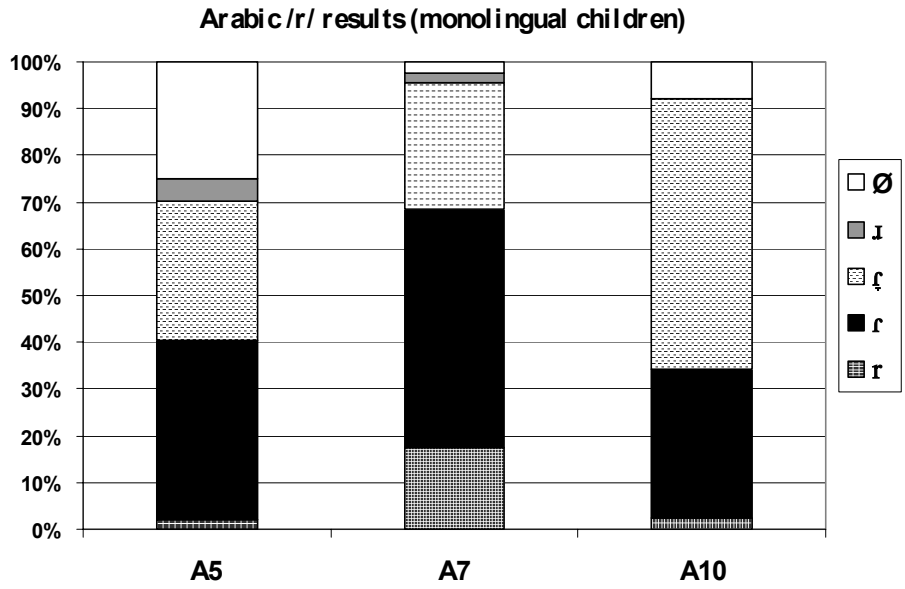

Figure 14: Results for the different /r/ variants produced by the monolingual. **'Ø'** includes deletions and other realisations. N = 382.

A7, on the other hand, did not omit any of the /r/'s he produced, and made fewer /r/ substitutions than A5, possibly showing signs of development compared with the five-year-old. Substitutions included three lateralisations (e.g. [maˈbaʕlɪf] for [maˈbaʕɾɪf] 'I don't know') and one gliding ([maˈbaʕjɪf] for [maˈbaʕɾɪf] 'I don't

know'). Moreover, A7 produced more trills than A5, and in fact more than A10 as well, which may again suggest that [r] is not only a contextual variant of /r/ (occurring in geminate /r/'s), but also varies in the frequency of its production according to individual differences. 24% of A7's /r/ tokens were produced as trills regardless of syllable position (Figure 15). Finally, like A5, A7 produced 2 /r/ tokens that sounded like a retroflex approximant but that showed signs of a gap or reduction in amplitude in between the continuing formants with F3 lowering (Figure 16).

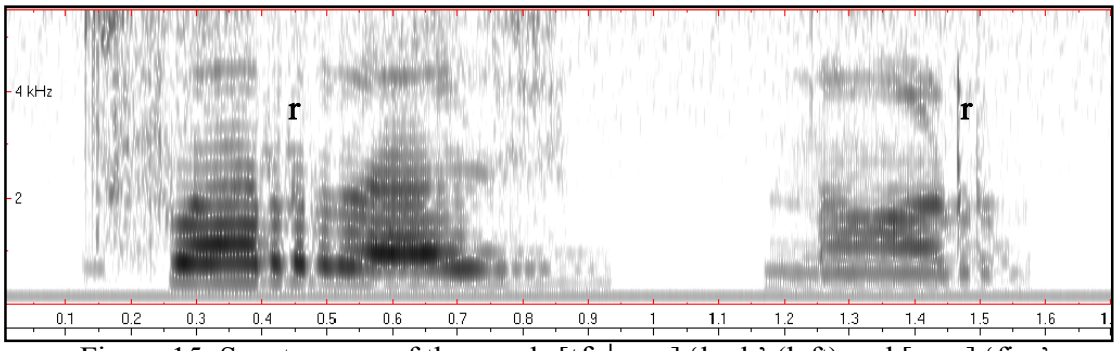

Figure 15: Spectrogram of the words [tfaˈrraʒ] 'look' (left) and [naːr] 'fire' (right) as produced by A7.

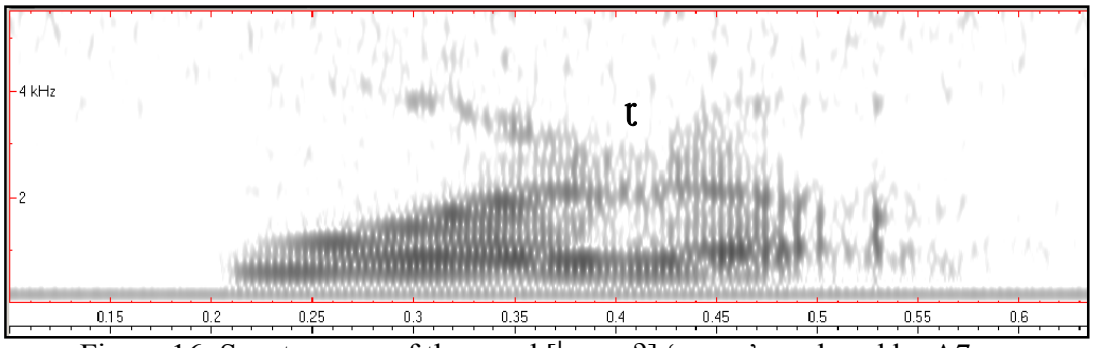

Figure 16: Spectrogram of the word [ˈwaɾaʔ] 'paper' produced by A7.

As for A10, the high percentage of weak taps that he produces (58%) is similar to that of his father (AM10), who also produces frequent weak realisations (44%). Note that A10 also produces a small number of trills compared with A7 (2% for A10 *versus* 17% for A7). When analysed instrumentally, most of A10's productions show as filled gaps with continued formants and, in rare cases, a faint sign of a burst (Figure 17). A10 also omitted nine /r/ tokens, six of which were in final position (e.g. [ˈnɪmə] for [ˈnɪmɪɾ] 'tiger'; [xjaː] for [xjaːɾ] 'cucumber'), and the other three were cases of /r/ assimilation (e.g. [tɪˈʃːiːn] for [tɪˈʃɾiːn] 'October'; [ˈʃaʒːa] for [ˈʃaʒɾa] 'tree). Finally, even A10 produced a token with /r/ lateralisation ([ˈmleːje] for [mɾeːje] 'mirror'), suggesting that developmental features can persist even till the age of ten.

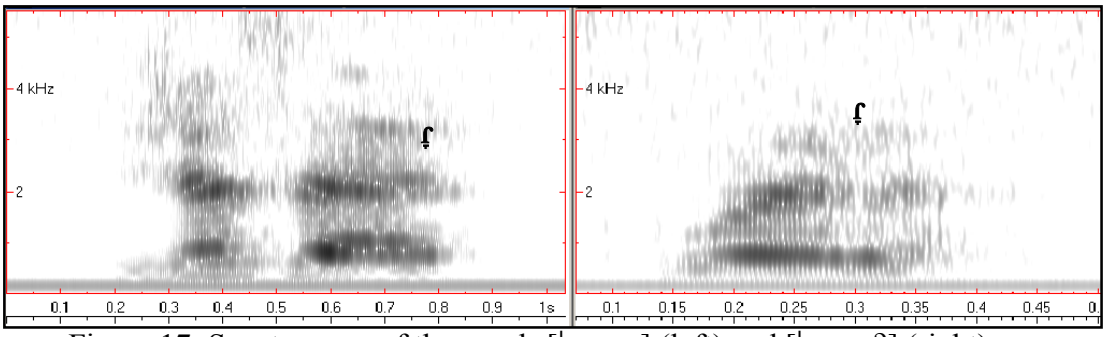

Figure 17: Spectrogram of the words [ˈʒazaɾ̥] (left) and [ˈwaɾ̥aʔ] (right) as produced A10.

10.3 Children: bilinguals

Figure 18 shows the individual results for /r/ production by the bilingual children speaking Arabic. On the whole, the bilinguals' production in Arabic is similar to that of the monolinguals and does not show any influence from English.

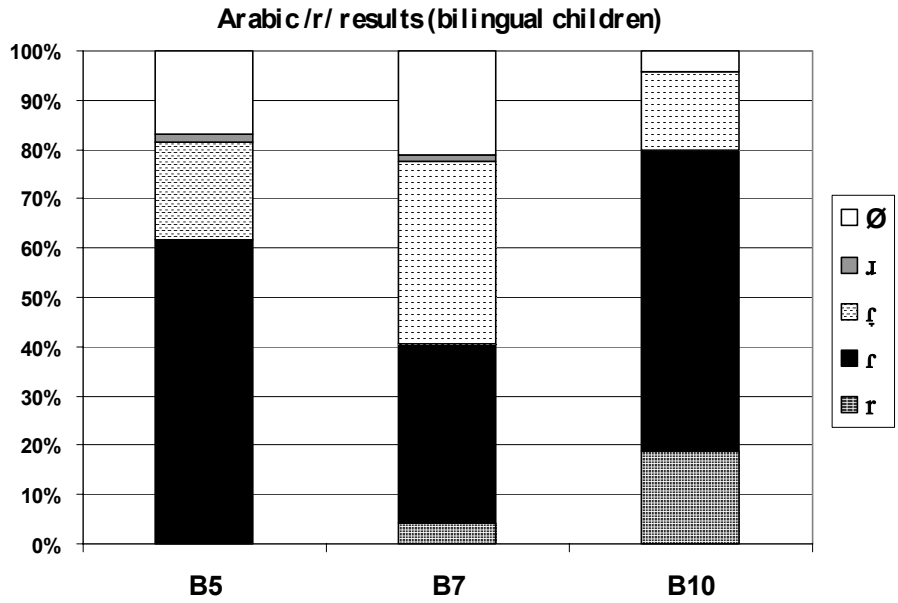

Figure 18: Results for the different Arabic /r/ variants produced by the bilingual children. **'Ø'** includes deletions and other realisations. N = 344.

Starting with B5, one noticeable feature in her production is the high percentage of strong taps, and the near lack of omitted /r/ tokens as opposed to the high number of omissions that A5 has produced. However, apart from /r/ variants, B5 produces frequent other realisations that include common substitutions such as [l] (e.g. [bliːʔ] for [bɾiːʔ] '(tea)pot'), and [n] ([mɪnˈxaːn] for [mɪnˈxaːɾ] 'nose'), but also less common ones including retroflex taps [ɽ], e.g. [ˈbiːɽa] for [ˈbiːɾa] 'beer'; [tiˈjɐːɽɐ] for [tˤɪˈjːɑːɾa] 'plane'; [mbaˈɽːaːd] for /baˈrːaːd/ 'fridge', and rhoticised vowels e.g. [ħaˠ] for [ħar] 'chillies'; [ʔɑˠd̪ˤ] for [ʔɑɾədˤ] 'earth'. These productions sound slightly

foreign accented and suggest that, although B5 is more advanced than A5 in terms of the number of omissions, she might be using a wider repertoire of realizations.

Similarly to B5, B7 produces a number of uncommon realizations including not only the retroflex tap [ɽ] (14 out of the 21 tokens under the 'other' category), but also the retroflex approximant [ɻ] (2 tokens) e.g. [baˈɻːaːd] for [baˈrːaːd] 'fridge', showing possible influence from English. B7 also produces common substitutions such as lateralisation (4 tokens) e.g. and [kabˈliːte] for [kabˈɾiːte] 'matches', and one [n] substitution ([ˈmneːje] for [ˈmɾeːje] 'mirror'). In terms of the tap variants, B7 produces a high number of weak taps as opposed to B10, who mainly produces strong taps and trills. It is interesting to note that the parents of the two brothers might be part of the influence on their adoption of strong or weak taps and trills. BF7, the bilinguals' mother, produces a great number of trills and very few weak taps, while BM7, the father, often produces weak taps and very few trills. As for the children, B7's Arabic /r/'s generally sound like his father's, whereas B10's /r/'s generally sound like his mother's. Finally, B10 produced few substitutions and omissions, which suggests that /r/ patterns are more adult-like than those of B5 and B7.

11. Summary

An attempt will now be made to answer the four questions that were raised in Section 3.

1 Do English-Arabic bilinguals acquire separate /r/ production patterns for each of their languages?

The bilinguals in this study did acquire in general separate /r/ production patterns for each of their languages. They mainly produced approximant types of /r/ in English, whereas they mainly produced taps and trills in Arabic. Moreover, their accent in English was mainly non-rhotic, whereas in Arabic /r/ was produced in all pre- and post-vocalic positions.

2 Are their patterns of production in each language similar to those of the monolingual controls in the study?

The patterns produced by the bilinguals were on the whole similar to those of the monolinguals. In English, both groups of children mainly produced the alveolar approximant [ɹ], while [ʊ] showed a gradual decrease across age groups. While in another investigation (Khattab, 2002a) /l/ vocalisation in the children's production increased with age and showed signs of being acquired as an accent feature, in this study [ʊ] seems to be a developmental feature that is phasing out of the children's productions.

One minor difference between the two groups was noted in the small number of taps and post-vocalic productions that the bilinguals produced, which may be due to influence from Arabic. These do not decrease with age, and are present both in isolated word productions and running speech. Note, however, that two of the monolinguals produce sporadic taps as well. Moreover, although the recordings took place during English-only sessions and the bilinguals did not speak Arabic, the subjects were not necessarily in a monolingual English mode, as I was the one who conducted the sessions and they knew that I am bilingual. However, results from the free-play sessions with monolingual English friends revealed similar results, which suggests that English was the highly active language during those sessions, but also

that Arabic may have been slightly active too. More importantly, the bilingual children's /r/ patterns during the English sessions were markedly different from those of their parents', who mainly produced tap variants and had a rhotic accent.

In Arabic, both groups of children produced mainly taps and trills, and sporadic productions of the approximant [ɹ]. Within tap production, there was a weak variant [ɾ̞] that was also found in the adults' production (see next question). This variant is normally mentioned in the literature as an approximant [ɹ] realisation of the Arabic /r/ (Shaheen, 1979), but this study suggests that there is an articulatory and acoustic difference between the two types of realisations. It was therefore important to find out that this variant was not only produced by the bilinguals and therefore was not a result of influence from English. The most frequent productions of weak taps by one of the monolinguals (A10) and one of the bilinguals (B7) actually appeared to be correlated with frequent weak tap productions by one of their parents, though more investigation is needed to confirm this observation.

Developmental features such as omissions, assimilations, and substitutions appeared in the productions of both groups of children. However, there were two minor differences between the two groups. First, developmental features in the monolingual group decreased with age whereas in the bilingual group, B7 had more omissions and other realisations of /r/ than B5. Still, B10 had the lowest number of omissions and other realisations. Second, other realisations by the monolinguals included variants normally reported in the literature for children acquiring Arabic, e.g. [l], [j] and [n] realisations of /r/, assimilation to a following obstruent, etc. (Dyson & Amayreh, 2000). The bilinguals, on the other hand, produced these and other realisations not normally reported for monolingual Arabic children, including retroflex taps, retroflex approximants, and rhoticised vowels e.g. [ə˞], [ɾ˞], and [a˞]. These realisations suggest that the bilinguals have a wider repertoire of /r/ sounds than that of the monolinguals and it would be difficult to pin down the influence as coming from English, Arabic, or even other varieties that the children may be exposed to. What is important, though is that the bilinguals' /r/ patterns in Arabic are still different from the ones discussed in English on the one hand, and the English production during the Arabic sessions on the other (see question four).

3 Are the patterns for the monolingual subjects in this study similar to the ones normally described in the literature and therefore expected for each language?

In English, although there were suggestions that Yorkshire /r/ is realised as a tap (Wells, 1982), data from the IViE corpus and from monolingual English friends and their parents suggest that the alveolar approximant is the most common variant for /r/ in this small community. This in turn suggests that the taps that are reported for Yorkshire have either undergone change or are restricted to certain age groups and/or social classes. Developmental features include omission and production of a labial approximant, both of which seem to decrease as the age of the children increases. Note, however, that [ʊ] was also found to be frequent in the production of one of the monolinguals' parents who comes from London (E10) and may therefore be part of his accent. This observation, together with the patterns found for the bilinguals' parents, constitutes an example of the kind of variety in productions that bilingual children are likely to be exposed to when the parents speak English as an L2 and the families live in urban cities where the children might encounter a wide range of English accents outside the home.

Moving on to the Arabic results, data from the monolinguals' parents and the bilinguals' parents, for whom Arabic is the native language, suggest that the tap is the most common variant, followed by the trill and the weak tap, both of which proved to be interestingly related to individual preferences by the speakers. The weak tap is not mentioned in the literature, but was suggested in this study because its auditory and acoustic characteristics did not fit any of the other variants normally associated with Arabic /r/. Instrumental analysis of [ɾ̞] revealed a continuum of forms ranging from a filled gap with a sign of a burst like for a tap, to a formant-like structure with no sign of gap or burst and therefore closer to an approximant production, but lacking F2 and F3 lowering that are typical of English approximants.

The weak tap appeared to be frequent in some but not all of the speakers' productions. While some speakers like AM10 have a preference for weak articulations of the Arabic /r/ and produce very few trills, others like BF7 have a strong preference for trills and strong tap articulations, and produce no weak taps at all. More interestingly, some of the children's patterns suggest that they may be adopting preferences from their parents, as A10 produces a number of weak taps that is comparable to that of his father (AM10), while each of the two bilingual brothers seems to be influenced by one of the parents' productions, B10 producing strong tap and trill articulations like his mother (BF7), and B7 producing weak tap articulations like his father (BM7). More investigation of this variant is needed in order to determine whether it is correlated with gender, dialect or other social stratification.

4 Are there signs of influence from one language onto the other in the bilinguals' production and what are the factors that affect such influence?

Two types of influence are noted here: the first one concerns the small number of taps that were produced by the bilinguals in English, and the various types of /r/ realisations in Arabic that included common ones that were also found for the monolingual Arabic controls but also less common ones. This first type of influence was minimal and did not show a great deal of interaction between the two languages.

The second type of influence concerns the bilinguals' English productions during the Arabic sessions. As opposed to the /r/'s produced during the English sessions, the majority variant used for the English tokens from the Arabic sessions is the tap, along with a considerable number of post-vocalic productions and only a small proportion of the alveolar approximant. Figure 19 combines the results for /r/ patterns by the bilinguals from the controlled and free English sessions, the Arabic sessions, and the English produced during the Arabic sessions. The results from the three contexts suggest that different language modes were operating in the bilinguals during each context, with obvious overlap. This issue will be discussed further in Section 12.3.

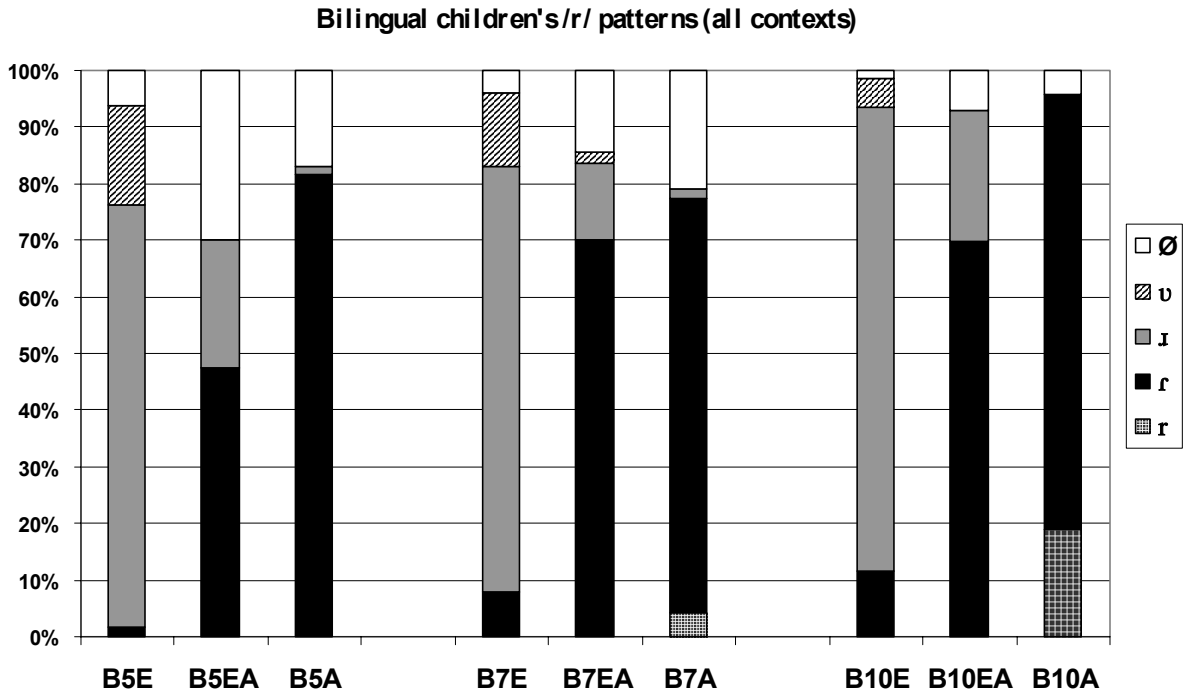

Figure 19: Summary of the /r/ patterns found for the bilinguals in the three different language contexts (E = English; EA = English in Arabic context; A =Arabic).

12. Discussion

12.1 Phonological knowledge

In order to establish a realistic account of the kind of phonological model(s) that is (are) available for the bilingual, one first needs to be aware of the difficulty in doing that in monolingual situations, as expressed by Vihman (1996: 5):

> "There is, to my knowledge, no evidence that adult speakers of a language share an identical grammar, despite nativist assumptions. On the contrary, individual differences are exhibited in adults as well as children in performance on experimental phonological tasks and in second language learning, retention of spelling patterns and a host of other skills indirectly drawing on phonological knowledge."

This view points to the difficulty in establishing a definable set of target phonological representations for the child to acquire in monolingual situations, let alone bilingual situations. Adult input to the child has been reported as being extremely variable. The sources of this variability may be linguistic (e.g. contextual and coarticulatory changes), or non-linguistic, i.e. related to speaker characteristics (e.g. voice quality, vocal tract length) and social factors such as the speaker's age, gender, geographical background, speaking style (Docherty et al, 2002; Pisoni, 1997).

Contrary to what is assumed in many accounts of phonological learning, children do not only acquire the full inventory of adult phonological oppositions, but may also preserve fine phonetic details and specific characteristics of the speech input (e.g. Docherty & Foulkes, 2000; Foulkes et al, 1999; Local, 1983; Williams & Kerswill, 1999; Roberts & Labov, 1995). This allows them to imitate and reproduce speech patterns heard in their surrounding environment, and therefore provides them with a huge benefit in acquiring the phonology of the local dialect from speakers they are exposed to early in life (Pisoni, 1997: 28; Pisoni & Lively, 1995: 439). Yet, the

tradition in most bilingual research has been to treat the two languages that the bilingual seeks to acquire as homogeneous sets of well-defined phonological representations (often consisting of a set of abstract phonemes some of which are exclusive to one language while others are 'shared' between the two languages). The child's productions are therefore judged against these targets, and 'unexpected' patterns in one language are often attributed to influence from the other, imperfect learning, or developmental problems.

The bilinguals from this study regularly hear tap and trill realisations of English /r/ as produced by their parents in contexts where an approximant will be produced by most monolinguals around them. However, they seem to have opted for the community variants, which shows signs of their development of socio-phonetic competence (Kerswill & Williams, 2000). Moreover, their English accent is non-rhotic despite the prevalence of post-vocalic /r/'s in their parents' productions. Nevertheless, this does not necessarily mean that, as Chambers (2002) suggested, the children have an 'accent filter' which prevents them from acquiring foreign-accented features in their parents' speech. These features do occasionally surface in the children's interactions with monolingual English speakers as found in the study (e.g. tapped /r/'s, clear final /l/'s, etc.). More importantly, the features are heavily used in certain social contexts where the bilinguals consider that acceptable, for example in code-switches during interactions with the parents. This suggests that the children have learned to produce all varieties and may have encoded them in memory, and that part of their sociolinguistic competence involves deciding which patterns to use in which situations.

12.2 Storing sound structures

In this study, it was found that the bilinguals' acquisition of language- and dialect-specific aspects of their phonologies is deeply influenced by the phonetic detail of input that they receive. Since recent research suggests that variability in speech can be encoded within phonological representation (Johnson, 1997) and that listeners encode fine stimulus details about the talker and use them during word recognition and sentence perception (Pisoni, 1997), this detailed information in the speech signal may become part of the memory representation for spoken language. Thus, in Figure 20, I have tried to incorporate the kind of knowledge that the bilinguals from this study might acquire based on the input that they receive from their environment. I refer to the production of /r/ in English for illustration, but the kind of knowledge discussed may apply in principle to all sounds in both languages. The figure is based on Docherty, Foulkes, Tillotson, & Watt (2002) schematic view of tasks in learning about sound structure in monolingual acquisition.

From type A input, a child learning English deduces information about lexical contrast, including the semantic and phonological distinction between words (e.g. 'ran' *versus* 'ban'), and phonotactic rules specific to the language. It is this sort of information that is usually considered crucial to the development of the child's phonological system.

Type B input represents sociolinguistic knowledge which reflects variation in pronunciation linked to age, sex, etc. As Docherty et al (2002) suggest, this is the kind of knowledge that has to be learned but that is usually considered outside the scope of phonology itself. The bilinguals in this study will learn to associate tapped /r/ productions with input from their parents, and approximants with input from monolinguals in their environment.

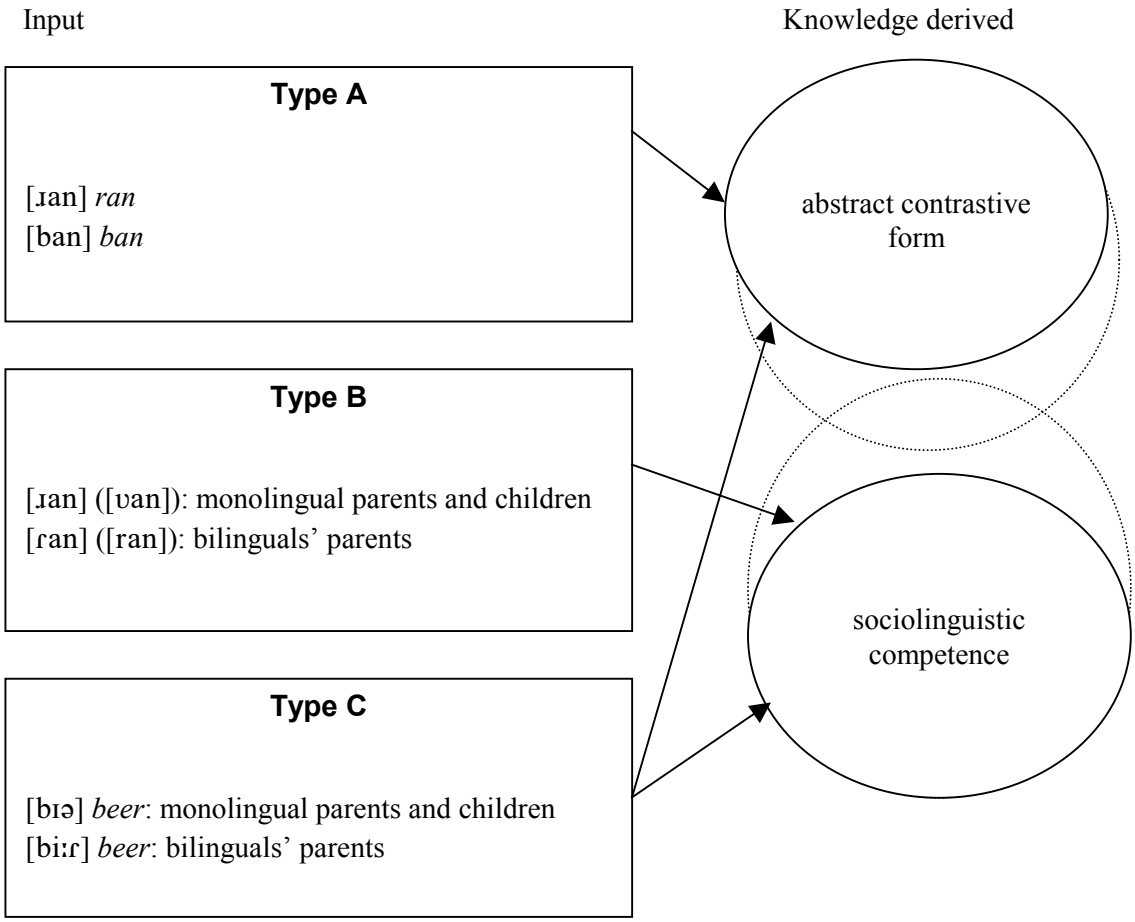

Figure 20: Schematic view of tasks in learning about sound structure by bilinguals. Adapted from Docherty et al (2002).

Type C input deals with both kinds of knowledge, as bilinguals will experience input forms which simultaneously encode contrastive and sociolinguistic information. In the case of /r/ production, examples such as [bɪə] and [biːɾ] will be present in the input. On the one hand, these forms provide information about potential phonotactic distribution of /r/. On the other, the alternative forms also have clear sociolinguistic associations since the latter will mainly be produced by the children's parents. The bilinguals may therefore learn multiple representations of sounds and associate them with particular speakers, languages, styles, situations, etc. As Docherty et al (2002) point out, children may look for sound-meaning associations of all sorts within the ambient sound patterns without great advantage being allocated to lexical meaning. In light of this, the authors suggest that children might start off with a single assimilated store of knowledge, containing information about phonological contrast and sociolinguistic information that is encoded phonetically (hence the dotted ellipses showing overlap in Figure 20). Subsequently, the two types of information may gradually become separated (although Docherty et al also entertain the possibility that some degree of overlap remains permanently).

For bilinguals, we expect that the extent of sociolinguistic information is even greater than that for monolinguals. For example, they have available to them a variety of phonological models for /r/ in each language due to the fact that they are exposed to language input from home and from society. This input varies between standard, non-standard, and non-native varieties from different speakers and different contexts,

and there is an uneven amount from each variety depending on the speakers that the bilingual is exposed to the most. Therefore, the phonological representations that the bilinguals will develop will be different from either monolingual model (which we know is variable in itself), and from other bilingual models.

What this section has served to establish is that input contains overlapping sources of information; some information is about lexical contrast, while other information is sociolinguistically relevant. It may or may not be the case that sociolinguistic information is learned simultaneously, as Docherty et al suggest, but both types of information clearly must be learned. If we take the broad view of what 'phonological knowledge' is, i.e. knowledge about the production and perception of sounds, then sociolinguistic information becomes all the more relevant for bilinguals, as they learn to associate the perception and production of sounds with different sources of input and different sociolinguistic contexts. There is therefore little room to assume overlap between the bilinguals' phonological systems. This becomes more obvious when one considers that the sounds that the bilinguals learn in their two languages differ not only in their detailed phonetic features, but also in the phonological and phonotactic rules that govern their production, and the social overtones that are associated with their use.

12.3 Language use by bilinguals

Grosjean (1998) suggests that the state of activation of the bilingual's languages operates along a continuum ranging from monolingual to bilingual depending on who the bilingual is speaking or listening to, the situation, the topic, and so on, and that each language mode will have an impact on the bilingual's production. This study supports his hypothesis from a phonological point of view, and points to the fact that some language modes that operate in bilinguals are the result of their linguistic background and therefore differ from one child to the other.

The base language that the bilinguals from this study regularly find themselves in is English, since they live in the UK and frequently interact with monolingual speakers of English. Note that even when two of the bilinguals were taped in free-play sessions, they mainly spoke English and rarely code-switched to Arabic. The three subjects are English-dominant, and, as a result of that, very little influence from Arabic was found in their English production, regardless of whether the sessions were conducted with a bilingual (myself) or a monolingual.

Arabic, on the other hand, is the subjects' weaker language, and results from this study suggest that the bilinguals' English language remains strongly activated when Arabic is the base language. Evidence was found from the frequent code-switching that took place during the Arabic sessions. While the /r/ variants that the children produced during the English-only sessions differed from those produced during the Arabic sessions, the English tokens that were produced in the Arabic sessions contained a mixture of features that belong to both languages. There are different ways to explain this phenomenon. On the one hand, the children might not be aware that these are English words, as they might simply have learned their parents' pronunciations of these words. Evidence for this stems from the fact that the five-year-old, who has limited reading skills, produced words with post-vocalic /r/'s like [ˈmaɾbəˠz] 'marbles' though her pronunciation in the English sessions is non-rhotic.

On the other hand, the children might have borrowed these words from English in cases where they could not recall or did not know the Arabic equivalent, and consequently applied Arabic phonetic and phonological rules to their production. Evidence for this can be found in cases where the child produced a word in English

but the mother insisted on the Arabic equivalent, so the child repeated the same 'English' word but used Arabic features in its production (e.g. 3). Note that during those Arabic sessions, the parents were always struggling to get the children to speak Arabic while the latter were trying to resist because they did not feel comfortable with it. Therefore, from time to time, the bilinguals came up with the realisations which, although produced in English, sounded like they were part of the children's effort to include Arabic features in order to please the mothers while still using English. However, not all the children's English productions in Arabic were borrowings, as some of these productions displayed a change not only at the lexical but also at the phonetic level; this type of switch is reported by Grosjean (2000: 454) as being possibly due to the flexibility of the production mechanism.

(3) Mother (pointing at a picture of a waiter):	[miːn haɪda]?
	Who that (masc.)?
	'Who is that?'
Child:	[ˈweɪtə]
	WAITER
Mother:	[laʔ bɪlˈʕaɾabe]
	No in-Arabic
	'No, (say it) in Arabic'
Child:	[ˈweɪtaɾ]

A third possible explanation is that the children were accommodating to the mothers' productions in English. Evidence for this option stems from observing the children explaining English utterances to their mothers or repeating an English utterance slowly after detecting misunderstanding on the part of the parents. Evidence also comes from the fact that some of the bilinguals' productions included features that are not only common in Arabic, but are also particular to the idiosyncratic L2 features that the parents produced and that the children would most likely have heard from them (e.g. [a] for schwa in 'waiter' [ˈweɪtaɾ], geminate /l/ for 'umbrella' [ʌmˈbɾɛlːa], etc.). The fact that the bilinguals produced these realisations only during the Arabic sessions and not the English ones suggests that they may have imitated the parents' English productions. B7 and B10's parents also note that the two brothers often use 'more complicated English' when they are playing together than when they are speaking to their parents. Accommodation is a sign of communicative competence that has often been mentioned as being part of the behaviour of the bilingual (Fantini, 1985: 116; Hamers & Blanc, 2000: 253; Hoffmann, 1991: 180). Bilinguals are known to be able to 'accommodate' their speech according to the needs of their interlocutors. This can take place by either choosing the language that suits the participant or, within the chosen language, adapting the speech to the level of the listener (e.g. speaking slowly, emphasising the pronunciation of words).

Regardless of the reasons discussed above for the code-switches and borrowings, the main point to be made in this study about the phonetic patterns that were found in these code-switches and borrowings is that they cannot simply be considered a result of interference between the two languages of the bilinguals, as they only apply to the English produced in the Arabic sessions. It is important to view such patterns as the product of strategies employed by children to enhance communication in their weaker language (Grosjean, 1982: 191). If the language mode is accounted for, then only deviations from the norms that cannot be controlled by the bilingual and that take place during conversations with monolingual speakers could be considered interferences. For the subjects in this study, interferences were in the form

of taps in English that were produced during interactions with the monolingual English children. These were small in number and occasionally occurred in the monolingual children's productions. As Watson (1995) observes, it is difficult to be sure that a bilingual is doing something that a monolingual would never do, as monolingual norms are themselves constructs that conceal potentially wide variation.

Grosjean (1982: 293) notes that even if a bilingual has the language competence of a monolingual in both languages, he or she will rarely be able to keep the two languages completely separate when talking to a monolingual; from time to time, they will influence one another, even if only momentarily. When the bilingual has achieved a stable level of fluency, breakdowns are much less frequent. But despite the fact that in this study bilinguals' systems are still developing, the Arabic influence on their English production does not cause any break down in communication and, in fact, often goes unnoticed. Impressionistic judgements from the bilinguals' teachers and a group of native English listeners revealed that most the listeners were confident the children had a native accent, while only a small number of listeners spotted certain non-native features in their speech (Khattab, 2002b). Watson (1995: 38) notes that it is possible for bilinguals to use different production routines from monolinguals in their two languages without being perceptible to other native speakers.

13. Conclusion

The results obtained from this study offer important observations related to methodological issues in the study of bilingual phonological acquisition specifically and phonological acquisition in general. First, any examination of bilingual speech needs to take account of the difficulty in specifying the phonological targets that are available to the bilingual for each language. Bilinguals are exposed to input that normally ranges between standard, non-standard, and non-native varieties; these varieties consist of overlapping phonological systems that create fuzzy boundaries for a given phonological target. Even in monolingual situations, a speech community consists of multiple overlapping sound systems, reflecting non-linguistic factors such as gender, age and others which influence the social interactions of speakers (Docherty et al, 2002; Scobbie, 2002). An account of the knowledge that is acquired by the child that is based on multiple-trace models may allow the encoding of such variability within the acquired phonological representations. Each speaker's knowledge of their language will therefore consist of a personal system compiled from their unique experience of the output from other systems that are more or less similar to each other. In bilingual situations, there will be two sets of systems for the child to choose from. Following these considerations, the mental representation of two languages for a bilingual is clearly different from that of a monolingual but certainly not the simple combination that would result from compiling two systems into a place normally assumed as being occupied by one. The languages of bilingual children need not be, nor are they likely, to develop entirely autonomously or interdependently. Certain aspects might develop interdependently, while the rest develops autonomously (Genesee, 2001: 159).

Second, variability is also recognised as one of the most obvious characteristics of children's speech, so this issue needs to be taken into consideration when interpreting bilingual children's production. Developmental factors are exerted on all phonological representations as children enlarge their knowledge of language and its structure, expand their resources for using language and communicating effectively, and mature in their social interactions. Similarly, bilingual children draw on their multiple representations that pertain to knowing and using language as they continue

to develop more complete representations for each language they are learning (Bialystok, 2001: 120). Like monolingual children, they make do with whatever linguistic resources they have available to express themselves, the only difference being that, unlike monolingual children who are limited to the resources of one language, bilingual children can draw on two (Genesee et al, 1995: 629). Linguistic development is a continuous process, sensitive to the context and the sociolinguistic circumstances around the child. Ultimately, the order and rate of acquisition of one or more languages lies on environmental, social, and psychological factors, and depends on the amount and quality of the input the child receives from the environment with respect to the linguistic forms. Given sufficient exposure to two languages, bilingual children can reach the proficiency level in each of their languages as monolinguals in the long run (White & Genesee, 1996).

Third, children acquiring the phonology of their language(s) do not only gain knowledge of lexically-contrastive phonological features, but also incorporate sociophonetically relevant aspects of linguistic competence (Docherty et al, 1997; 2002). As Schieffelin (1990: 17) points out, the processing of linguistic knowledge goes hand in hand with the processing of social knowledge. Bilingual children learn how to become members of their community and to communicate effectively with different interlocutors from different language and social backgrounds. Based on findings from recent studies of sociolinguistic variation (e.g. Docherty et al, 1997; 2002; Scobbie, 2002; Thomas, 2000), the results from this study confirm the productive outcome of linking experimental phonetics and sociolinguistics for a more refined description of language- and dialect-specific phonological patterns. The difficulty that was involved in conducting instrumental analysis using 'home' as opposed to 'laboratory' speech was outweighed by the benefit of more natural speech and therefore a more realistic representation of the patterns that are normally produced by the speakers.

Fourth, the context in which bilinguals produce their languages is very important in determining their phonological/phonetic behaviour. Interaction between the two languages should be interpreted in conjunction with whether it occurred when the bilinguals were communicating with monolinguals or other bilinguals. In the case of bilingual conversations, factors such as the base language, the degree of activation of each language, and the dominant language of the bilingual will all play a role in phonological patterns observed. When these factors are taken into consideration , it can be concluded that the bilinguals in this study did acquire separate production patterns for each of their languages in relation to the variables examined. In each language, the patterns were similar to those of the monolingual controls in the study when the productions occurred in the corresponding language sessions. During these sessions, signs of influence between the two languages were minimal and point to the bilinguals' overall ability to keep the phonologies of their languages separate. During the Arabic session with the mothers, the bilinguals used communicative strategies such as code-switching and borrowing in order to avoid dysfluency and to keep the communication going. Since these strategies were used only with interlocutors that also spoke and understood the two languages, the bilingual subjects can be said to have shown signs of sociolinguistic competence at a fine-grained phonetic level. This can also be seen in the way the bilinguals exhibited awareness of and adopted accent features that part of their community and that are undergoing change.

References

Agnihotri, R.K. (1979). *Processes of Assimilation: a Sociolinguistic Study of Sikh Children in Leeds*. Unpublished PhD dissertation, University of York.

Al Ani, S.H. (1970). *Arabic Phonology: An Acoustical and Physiological Investigation.* Paris: Mouton.

Amayreh, M.M. & Dyson, A.T. (1998). The acquisition of Arabic consonants. *Journal of Speech and Language Hearing Research*, **41**: 642-653.

Anani, M. (1985). Differences in the distribution between Arabic /l/, /r/, and English /l/, /r/. *Papers and Studies in Contrastive Linguistics*, **20**: 129-133.

Ball, M.J., Müller, N., & Munro, S. (2001). The acquisition of rhotic consonants by Welsh-English bilingual children. *International Journal of Bilingualism*, **5(1)**: 71-86.

Bar-Adon, A. & Leopold, W. (eds.) (1971). *Child Language*. Englewood Cliffs, NJ: Prentice-Hall.

Bernhardt, B. & Stemberger, J. P. (1998). *Handbook of Phonological Development: from the Perspective of Constraint-based Non-linear Phonology.* San Diego, California: Academic Press.

Bialystok, E. (ed.) (2001). *Bilingualism in Development: Language, Literacy, & Cognition*. Cambridge: Cambridge University Press.

Borden, G.J. & Harris, K.S. (1984). *Speech Science Primer: Physiology, Acoustics, and Perception of Speech* (2nd ed.). Williams & Wilkins: London.

Burling, R. (1971). Language development of a Garo and English speaking child. In A. Bar-Adon & W. Leopold (eds.). *Child Language*. Englewood Cliffs, NJ: Prentice-Hall. pp. 170-185.

Burton-Roberts, N., Carr, P. & Docherty, G. (eds.). (2000). *Phonological Knowledge: Conceptual and Empirical Issues*. Oxford: Oxford University Press.

Chambers, J. (2002). *Sociolinguistic Theory* (2nd ed). Oxford: Blackwell.

Cruttenden, A. (1994/2001). *Gimson's Pronunciation of English* (5th & 6th eds.). London: Arnold.

Deuchar, M. & Quay, S. (2000). *Bilingual Acquisition: Theoretical Implications of a Ccase Study.* Oxford: Oxford University Press.

Docherty, G.J. (1992). *The Timing of Voicing in British English Obstruents*. Berlin & New York: Foris Publications.

Docherty, G.J. & Foulkes, P (2000). Speaker, speech and knowledge of sounds. In N. Burton-Roberts, P. Carr & G.J. Docherty (eds.) *Phonological Knowledge. Conceptual and Empirical Issues*. Oxford: Oxford University Press. pp. 105-129.

Docherty, G.J., Foulkes, P., Milroy J., Milroy L. & Walshaw, D. (1997). Descriptive adequacy in phonology: a variationist perspective. *Journal of Linguistics,* **33**: 275-310.

Docherty, G.J., Foulkes, P., Tillotson J. & Watt D. (2002). On the scope of phonological learning: issues arising from socially structured variation. Paper presented at the Labphon 8 Conference, Yale University, June 2002.

Dyson, A.T. & Amayreh, M.M. (2000). Phonological errors and sound changes in Arabic-speaking children. *Clinical Linguistics & Phonetics*, **14(2)**: 79-109.

Edwards, M. L. (1973). The acquisition of liquids. *Ohio State University Working Papers in Linguistics*, **15**: 1-54.

Fantini, A.F. (1985). *The Language Acquisition of a Bilingual Child*. Clevedon: Multilingual Matters.

Fletcher P. & Garman M. (eds.) (1979). *Language Acquisition*. Cambridge: Cambridge University Press.

Foulkes, F. & Docherty, G.J. (eds.) (1999) *Urban Voices*. London: Arnold.

Foulkes, F. & Docherty, G.J. (2000). Another chapter in the story of /r/: 'labiodental' variants in British English. *Journal of Sociolinguistics,* **4**: 30-59.

Foulkes, F., Docherty, G.J. & Watt. D. (1999). Tracking the emergence of sociophonetic variation: realisations of (t) by Newcastle children. *Leeds Working Papers in Linguistics and Phonetics,* **7**: 1-25. University of Leeds.

Genesee, F. (2001). Bilingual first language acquisition: exploring the limits of the language faculty. *Annual Review of Applied Linguistics,* **21**: 153-168.

Genesee, F., Nicoladis, E. & Paradis, J. (1995). Language differentiation in early bilingual development. *Journal of Child Language,* **22**: 611-31. et al, 1995

Grabe, E. & Nolan, F. (2001). *English Intonation in the British Isles. The IViE Corpus*. CD ROMs produced as part of ESRC grant R000237145.

Grosjean, F. (1982). *Life with Two Languages: An Introduction to Bilingualism.* Cambridge, MA: Harvard University Press.

Grosjean, F. (1995). A psycholinguistic approach to codeswitching: The recognition of guest words by bilinguals. In L. Milroy & P. Muysken (eds.), *One Speaker, Two Languages: Cross-disciplinary Perspectives on Codeswitching*. Cambridge: Cambridge University Press. pp. 259-275.

Grosjean, F. (1998). Studying bilinguals: methodological and conceptual issues. *Bilingualism: Language and Cognition,* **2**: 131-149.

Hamers, J.F. & Blanc, M.H.A. (2000). *Bilinguality and Bilingualism* (2nd ed.). Cambridge: Cambridge University Press.

Heselwood, B & McChrystal, L. (2000). Gender, accent features and voicing in Punjabi-English bilingual children. *Leeds Working Papers in Linguistics & Phonetics,* **8**: 45-70.

Hoffmann, C. (1991). *An Introduction to Bilingualism*. New York: Longman.

Hughes, A. & Trudgill, P.J. (1996). *English Accents and Dialects. An Introduction to Social and Regional Varieties of British English* (3rd ed.). London: Arnold.

Ingram, D. (1979). Phonological patterns in the speech of young children. In P. Fletcher & M. Garman (eds.) *Language Acquisition.* Cambridge: Cambridge University Press.

Ingram, D. (1981/2). The emerging phonological system of an Italian-English bilingual child. *Journal of Italian Linguistics*, 1981/2: 95–113.

Johnson, C.E. & Lancaster, P. (1998). The development of more than one phonology: a case study of a Norwegian-English bilingual child. *The International Journal of Bilingualism,* **2(3)**: 265-300.

Johnson, K. (1997). Speech perception without speaker normalization. In Johnson, K. & Mullennix, J.W. (eds.) *Talker Variability in Speech Processing.* San Diego: Academic Press. pp. 145-165.

Johnson, K. & Mullenix, J.W. (eds.) (1997). *Talker Variability in Speech Processing*. San Diego: Academic Press.

Kerswill, P. & Williams, A. (2000). Creating a new town koine: children and language change in Milton Keynes. *Language and Society*, **29**: 65-115.

Khattab, G. (2002a). /l/ production in English-Arabic bilingual speakers. *International Journal of Bilingualism,* **6 (3)**: 335-354.

Khattab, G. (2002b). *Sociolinguistic Competence and the Bilingual's Choice of Phonetic Variants: Auditory and Instrumental Data from English-Arabic Bilinguals.* PhD Dissertation, University of Leeds.

Ladefoged, P. & Maddieson, I. (1996). *The Sounds of the World's Languages*. Oxford: Blackwell.

Lavoie, L.M. (2001). *Consonant Strength: Phonological Patterns and Phonetic Manifestations*. New York and London: Garland Publishing.

Leather, J. & Allan, J. (eds.) (1992). *New Sounds*. *Proceedings of the 1992 Symposium on the Acquisition of Second-Language Speech*. Amsterdam: University of Amsterdam.

Leopold, W.F. (1941/1970). *Speech Development of a Bilingual Child: a Linguist's Record* (Vol. 2). New York: AMS Press.

Lindau, M. (1985). The story of /r/. In V. Fromkin (ed.). *Phonetic Linguistics*. Orlando: Academic Press. pp. 157-168.

Llamas, M-C. (1998). Language variation and innovation in Middlesbrough: a pilot study. *Leeds Working Papers in Linguistics and Phonetics,* **6**: 98-115.

Local, J. (1983). How many vowels in a vowel? *Journal of Child Language*, **10**: 449-53.

Matthews, B. (2001). *On Variability and the Acquisition of Vowels in Normally Developing Scottish Children (18-36 Months)*. Unpublished PhD Thesis, Queen Margaret University College, Edinburgh.

Mayer, M. (1969). *Frog, where are you?* New York: A Puffin Pied Piper.

Menyuk, P. (1971). *The Acquisition and Development of Language*. London: Prentice Hall.

Milroy L. & Muysken P. (eds.) (1995). *One Speaker, Two Languages: Cross-disciplinary Perspectives on Codeswitching*. Cambridge: Cambridge University Press.

Moskowitz, A.I. (1970). The two-year-old stage in the acquisition of English phonology. *Language*, 46: 426-441.

Nasr, R.T. (1966). *Colloquial Arabic: an Oral Approach*. Beirut: Librarie du Liban.

Omar, M.K. (1973). *The Acquisition of Egyptian Arabic as a Native Language*. Paris: Mouton.

Paradis (2001). Do bilingual two-year-olds have separate phonological systems? *International Journal of Bilingualism*, **5(1)**: 19-38.Pisoni & Lively, 1995

Pisoni, D.B. (1997). Some thoughts on normalization in speech perception. In K. Johnson & J.W. Mullennix (eds.) *Talker Variability in Speech Processing*. San Diego: Academic Press. pp. 9-32.

Pisoni, D.B. & Lively, S.E. (1995). Variability and invariance in speech perception: a new look at some old problems in perceptual learning. In W. Strange (ed.). *Speech Perception and Linguistic Experience: Theoretical and Methodological Issues*. Baltimore: York Press. pp. 433-462.

Roberts, J. (1997). Acquisition of variable rules: a study of (-t, d) deletion in preschool children. *Journal of Child Language,* 24: 351-372.

Roberts, J. and Labov, W. (1995). Learning to talk Philadelphian: Acquisition of short a by preschool children. *Language Variation and Change,* **7**: 101-12.

Sander, E.K. (1972). When are speech sounds learned? *Journal of Speech and Hearing Disorders*, **37**, 55-63.

Scobbie, J.M. (2002) Flexibility in the face of incompatible English VOT systems. Paper presented at the Labphon 8 Conference, Yale University, June 2002.

Shaheen, K. (1979). *The Acoustic Analysis of Arabic Speech*. PhD Thesis. University of Wales.

Smith, N.V. (1973). *The Acquisition of Phonology: A Case Study*. Cambridge: Cambridge University Press.

Stevens, K. N. (1998). *Acoustic Phonetics*. Cambridge, MA.: MIT Press.

Stoddart, J., Upton, C. & Widdowson, J.D.A. (1999). Sheffield dialect in the 1990s: revisiting the concept of NORMs. In P. Foulkes & G.J. Docherty (eds.) *Urban Voices*. London: Arnold. pp. 72-89.

Strange W. (ed.) (1995). *Speech Perception and Linguistic Experience: Theoretical and Methodological Issues*. Baltimore: York Press.

Thomas, E. (2000). Spectral differences in /ai/ offsets conditioned by voicing of the following consonant. *Journal of Phonetics*, **28**: 1-25.

Verma, M.K., Firth, S. & Corrigan, K. (1992). The developing phonological system of Panjabi/Urdu speaking children learning English as a Second Language in Britain. In J. Leather & J. Allan (eds.). *New Sounds*. *Proceedings of the 1992 Symposium on the Acquisition of Second-Language Speech.* University of Amsterdam. Pp. 174-199.

Vihman, M.M. (1996). *Phonological Development: The Origins of Language in the Child*. Oxford: Blackwell.

Watson, I. (1995). The effect of bilingualism on the acquisition of perceptual categories underlying the voicing contrast. *Proceedings of the 13th International Congress of the Phonetic Sciences,* **2:** 710- 713. University of Stockholm.

Wells, J.C. (1982). *Accents of English* (3 vols.). Cambridge: Cambridge University Press.

White, L. & Genesee, F. (1996). How native is near-native? The issue of ultimate attainment in second language acquisition. *Second Language Research*, **12**: 233-265.

Whitworth, N. (2003). Speech rhythm production in three German-English bilingual families. To appear in *Leeds Working Papers in Linguistics and Phonetics,* **9.**

Williams, A. & P. Kerswill (1999). Dialect levelling: continuity vs. change in Milton Keynes, Reading and Hull. In P. Foulkes & G. J. Docherty (eds.). *Urban Voices*. London: Arnold. pp. 141-162.

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Appendix One

Table 1: Detailed figures for the /r/ variants produced by the monolingual English parents.

	EF5			EF7			EF10			EM5			EM7			EM10		
	read	story	N	read	story	N	read	story	N	read	story	N	read	story	N	read	story	N
ɹ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
ɾ	1	0	1	2	1	3	0	1	1	0	0	0	0	0	0	0	1	1
ɻ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ɪ	50	48	98	53	59	112	47	63	110	67	36	103	52	51	103	55	41	96
ɻ̩	0	5	5	2	11	13	0	1	1	4	3	7	0	9	9	11	3	14
weak ʊ	1	1	2	0	3	3	0	0	0	7	3	10	0	2	2	2	1	3
ʊ	0	0	0	0	1	1	3	0	3	0	0	0	0	0	0	13	2	15
Ø	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
other	0	0	0	2	1	3	0	0	0	0	0	0	0	0	0	0	0	0
Total	52	54	106	59	76	135	50	65	115	78	42	120	52	62	114	81	49	130

Table 2: Detailed figures for the /r/ variants used by the bilinguals' parents in onset (O) and coda (C) position in English.

	BF5					BF7					BM5					BM7				
	read		story			read		story			read		story			read		story		
	O	C	O	C	N	O	C	O	C	N	O	C	O	C	N	O	C	O	C	N
ɹ	1	0	0	0	**1**	25	23	2	3	**53**	3	1	1	0	**5**	0	0	0	0	**0**
ɾ	33	27	28	7	**95**	28	56	41	24	**149**	30	17	28	1	**76**	26	9	25	9	**69**
ɻ̩	11	39	4	11	**65**	0	2	3	12	**17**	15	29	6	1	**51**	16	29	21	26	**92**
ɪ	10	2	0	0	**12**	1	1	2	2	**6**	5	0	0	0	**5**	11	0	7	1	**19**
Ø	0	5	0	1	**6**	0	0	0	1	**1**	0	30	0	40	**70**	0	21	0	12	**33**
other	0	5	0	0	**5**	0	0	0	0	**0**	0	4	2	0	**6**	0	18	0	0	**18**
Total	**55**	**78**	**32**	**19**	**184**	**54**	**82**	**48**	**42**	**226**	**53**	**81**	**37**	**42**	**213**	**53**	**77**	**53**	**48**	**231**

Table 3: Detailed figures for the /r/ variants used by the monolingual English children during the picture-naming (pic) and story-telling (story) activities.

	E5			E7			E10		
	pic	story	N	pic	story	N	pic	story	N
ɾ	0	0	**0**	1	0	**1**	0	1	**1**
ɻ̩	0	0	**0**	0	0	**0**	0	0	**0**
ɪ	36	11	**47**	33	15	**48**	48	21	**69**
ɻ̩	0	0	**0**	1	0	**1**	0	4	**4**
weak ʊ	4	1	**5**	5	0	**5**	1	0	**1**
ʊ	5	3	**8**	2	2	**4**	1	1	**2**
Ø	6	6	**12**	3	1	**4**	0	0	**0**
other	0	0	**0**	1	0	**1**	0	0	**0**
Total	**51**	**21**	**72**	**46**	**18**	**64**	**50**	**27**	**77**

Table 4: Detailed figures for the /r/ variants used by the bilingual children during the picture-naming (pic) and story-telling (story) activities in English.

	B5			B7			B10		
	pic	**story**	**N**	**pic**	**story**	**N**	**pic**	**story**	**N**
ɾ	0	0	**0**	0	0	**0**	5	2	**7**
ɽ	0	1	**1**	2	4	**6**	1	1	**2**
ɹ	25	22	**47**	33	23	**56**	40	23	**63**
ɻ	0	0	**0**	0	2	**2**	0	0	**0**
weak ʋ	3	1	**4**	8	0	**8**	3	0	**3**
ʋ	4	3	**7**	2	0	**2**	1	0	**1**
Ø	2	0	**2**	1	1	**2**	0	0	**0**
other	2	0	**2**	0	1	**1**	1	0	**1**
Total	**36**	**27**	**63**	**46**	**31**	**77**	**51**	**26**	**77**

Table 5: Detailed figures for the /r/ variants used by the bilinguals in onset positions for the English words produced in the Arabic sessions.

Onset	**N**	**ɾ**	**ɾ**	**ɽ**	**ɹ**	**ʋ**	**Ø**	**other**
B5	25	3	7	3	8	0	1	3
B7	47	0	24	10	11	2	0	0
B10	26	0	11	4	10	0	0	1
Total	**98**	**3**	**42**	**17**	**29**	**2**	**1**	**4**

Table 6: Detailed figures for the /r/ variants used by the bilinguals in coda positions for the English words produced in the Arabic sessions.

Coda	**N**	**ɾ**	**ɾ**	**ɽ**	**ɹ**	**ʋ**	**Ø**	**other**
B5	16	0	5	1	1	0	9	0
B7	49	0	20	13	2	0	12	2
B10	17	2	9	4	0	0	2	0
Total	**82**	**2**	**34**	**18**	**3**	**0**	**23**	**2**

Table 7: Detailed figures for the /r/ variants used by the monolingual Arabic parents and bilinguals' parents speaking Arabic in onset (O) and coda (C) positions.

	AF5					AF10					AM5					AM10				
	read		**story**			**read**		**story**			**read**		**story**			**read**		**story**		
	O	**C**	**O**	**C**	**N**	**O**	**C**	**O**	**C**	**N**	**O**	**C**	**O**	**C**	**N**	**O**	**C**	**O**	**C**	**N**
ɾ	3	7	7	4	**21**	3	4	2	5	**14**	2	3	8	14	**27**	1	1	1	2	**5**
ɾ	28	16	44	15	**103**	27	13	36	11	**87**	27	19	41	11	**98**	15	11	32	8	**66**
ɽ	1	0	3	5	**9**	2	5	0	4	**11**	1	4	4	3	**12**	17	13	15	12	**57**
Ø	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	1	**1**
Total	**32**	**23**	**54**	**24**	**133**	**32**	**22**	**38**	**20**	**112**	**30**	**26**	**53**	**28**	**137**	**33**	**25**	**48**	**23**	**129**

	BF5					BF7					BM5					BM7				
	read		**story**			**read**		**story**			**read**		**story**			**read**		**story**		
	O	**C**	**O**	**C**	**N**	**O**	**C**	**O**	**C**	**N**	**O**	**C**	**O**	**C**	**N**	**O**	**C**	**O**	**C**	**N**
ɾ	2	0	5	0	**7**	14	10	5	6	**35**	2	0	0	0	**2**	1	4	1	1	**7**
ɾ	28	17	25	12	**82**	21	16	26	13	**76**	25	15	26	14	**80**	28	10	27	8	**73**
ɽ	2	6	2	11	**21**	0	0	1	4	**5**	5	8	2	5	**20**	3	9	10	15	**37**
Ø	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	1	**1**	0	0	0	1	**1**
Total	**32**	**23**	**32**	**23**	**110**	**35**	**26**	**32**	**23**	**116**	**32**	**23**	**28**	**20**	**103**	**32**	**23**	**38**	**25**	**118**

Table 8: Detailed results for the /r/ variants used by the monolingual Arabic children during the picture-naming and story-telling activities in onset and coda positions.

	A5					A7					A10				
	pic		story			pic		story			pic		story		
	O	C	O	C	N	O	C	O	C	N	O	C	O	C	N
ɾ	2	0	0	0	**2**	15	9	4	2	**30**	3	0	0	0	**3**
ɾˤ	13	9	17	1	**40**	23	11	34	12	**80**	22	6	13	3	**44**
ɻ̣	13	5	11	2	**31**	10	16	1	13	**40**	12	17	19	21	**69**
ɹ	3	0	0	0	**3**	0	0	0	0	**0**	0	0	0	0	**0**
ɹ̣	0	0	2	0	**2**	0	0	2	0	**2**	0	0	0	0	**0**
Ø	5	13	0	0	**18**	0	0	0	0	**0**	2	3	1	3	**9**
other	5	1	0	0	**6**	2	0	1	1	**4**	1	0	0	0	**1**
Total	**41**	**28**	**30**	**3**	**102**	**50**	**36**	**42**	**28**	**152**	**40**	**26**	**33**	**27**	**126**

Table 9: Detailed results for the /r/ variants in onset and coda positions used by the bilingual children during the picture-naming and story-telling activities in Arabic.

	B5					B7					B10				
	pic		story			pic		story			pic		story		
	O	C	O	C	N	O	C	O	C	N	O	C	O	C	N
ɾ	0	0	0	0	**0**	2	2	1	1	**6**	11	10	3	3	**27**
ɾˤ	22	10	6	0	**38**	23	13	14	0	**50**	26	24	28	9	**87**
ɻ̣	3	5	4	1	**13**	27	8	13	3	**51**	2	3	12	6	**23**
ɹ	0	1	0	0	**1**	1	0	0	0	**1**	0	0	0	0	**0**
ɹ̣	0	0	0	0	**0**	0	0	1	0	**1**	0	0	0	0	**0**
Ø	0	0	0	1	**1**	1	5	1	1	**8**	0	1	0	3	**4**
other	6	2	2	0	**10**	13	6	1	1	**21**	0	0	1	1	**2**
Total	**31**	**18**	**12**	**2**	**63**	**67**	**34**	**31**	**6**	**138**	**39**	**38**	**44**	**22**	**143**

Appendix Two

Sample English tokens produced by B5, B7 and B10 in Arabic sessions compared with different productions of the same tokens in English sessions

B5	Gloss	Arabic sessions	English sessions
Pre-V	raspberry	ˈrɑːʐbˠɾiː	ˈɹaʐbˠiː
	raincoat	ˈrɛɪnkʰot	ˈɹɛɪnkʰəʊʔ
	rainbow	ˈərɛːnːboː	ˈɹeɪnbəʊ
Post-V	shark	ʃɑːɹk	ʃɑːk
	pepper	ˈpʰɛpʰəɾ	ˈpʰɛpə
	jumper	ˈdʒʌmpʰəɾ	ˈdʒʊmpʰəh
	garden	ˈgɑːɾtən	ˈgɑːdən / ˈgɑːd̪ən
	thunder	ˈθʌndəɾ	ˈθʊnda
	marbles	ˈmaɾbəʐ	ˈmɑːbɬʐ

B7	Gloss	Arabic sessions	English sessions
Pre-V	red	ɾɛd̥	ɹɛd̥
	grandma's	gˤˈɾãmɑz̥	ˈgɹanniz̥
	cherries	ˈtʃeɾiː	ˈtʃeiz̥
	grapes	gɾeɪps	gɹeˑps
	carrot	ˈkɐɾ̥ət	ˈkʰaɹət
	fridge	fˤˈɾɪdʒ	ˈfɪ̃ɪdʒ
	drumming	dːəˈɾəmɪŋ	ˈdʒɹʊmɪŋg
Post-V	butterfly	bətəɾ̥ˈflaɪ	ˈbʌtˤflaɪ
	cucumber	kuˈkʌmbəˠ	ˈkʰʜkˣʌmbə
	beer	bːiəɾ	bɪə
	butter	ɓʌˈtʰəɾ	ˈɓʌtʰə
	fingers	ˈfɪ̃ŋgəɾz̥	ˈfɪ̃ŋgəz̥
	purple	ˈpɜːpəl	ˈpɜːpɵ
	singer	ˈsɪŋgaɾ	ˈsɪŋgə
	marble(s)	ˈmaːlbəɾ	ˈmɑːbɬz̥
B10	**Gloss**	**Arabic sessions**	**English sessions**
Pre-V	present (noun)	ˈpʰɾ̥ɛzɛ̃nt	ˈpʰʏ̆ɹzənʔs
	microphone	ˈmaɻkɾəfõ	ˈmaɪkʰə̥fə̃ũn
	umbrella	ʔʌmˈbrɛlːə	ˈ̃mˈbɹˑɛlə
Post-V	beer	biɾ̥	bɪə
	circus	sɜɾˈkʰas	ˈsɜːkə̥s
	star	stɑˑɾ	stɑːz̥
	waiter	ˈweɪtɐ̬ɾ	ˈweɪtə
	fireman	fɛjɛɾ̥ˈmãnː	ˈfaɪəmən
	guitar	gʲiˈtɐ̬ˑɾ̥	gɪˈtʰɑː
	deer	diːɾ	dɪə
	scarf	skɑ̬ɾ̥f	skɑˑf