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The Development of Coda Consonants in the Speech of a Bilingual Child: A Case Study

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Abstract

This paper reports on the findings of a study that explored the development of consonants in coda position in the speech of a bilingual child. The data were collected through parental diaries. The researcher traced the development of English and Arabic consonants in coda position in her own child's production between the ages of 1.4 and 5. The analysis suggests that frequency of occurrence in the child's input plays a major role in the early appearance of particular sounds in coda position in the child's production. The analysis also reveals that the most used English consonants in coda position in the child's production are those that prefer coda position to onset position. Due to the absence of studies about the distribution of Arabic sounds within onset and coda positions, the factor that the author has adopted analyzing the development of Arabic consonants in coda position is the frequency of occurrence in the child's input (parental speech). The analysis assures that the Universal Grammar Constraints also have a role in the development of some English and Arabic consonants in coda position.

Keywords: Acquisition, Bilingual, Coda Position, Consonants, Frequency, Universal Grammar

1. Introduction

A number of accumulated research attested that the child's first syllable production is of a CV type (Velten, 1943; Leopold, 1947; Smith, 1973; Ingram, 1974). In other words, in the first stage of the child's production, every target utterance in the adult speech is reduced to a consonant followed by a vowel (CV) with no coda even if that target utterance is of CVC structure in the input. Throughout the course of language development, the child's grammar gradually develops to match the grammar they have in their input (Tesar and Smolensky, 1998). Researchers have suggested different logical explanations to account for this coda deletion phenomenon. One well -documented interpretation of this phenomenon is that final consonant deletion is a result of the function of the innate constraint in the child's grammar. Doing so, the child tries to conform the target utterance to the universally preferred syllable structure CV (Demuth and Fee, 1995; Faingold, 1990; Levelt et al., 2000; Mowrer and Burger, 1991; Ohala, 1992; Vihman and Ferguson, 1987; Zamuner et al, 2005). Ohala (1992) suggests an additional explanation for this deletion. He believes that the reason the child drops codas is because of a production constraint which hypothesizes the fact that sounds in coda position need more advanced planning as compared to sounds in onset position which in turn makes it difficult for the child to produce the sound in this position resulting in deleting or dropping it.

This current study aims at tracing the development of the types of Arabic and English consonants in word- final coda position in the speech of a bilingual child. Previous research has revealed that children's early codas are often obstruent sounds (Fikkert, 1994; Goad, 1997; Salidis and Johnson, 1997; Velten, 1943). Others have noted that voiceless obstruent sounds and nasals have special status in coda position as compared to voiced obstruent sounds (Bernhardt and Stemberger, 1998; Kehoe and Stoel-Gammon, 2001). Data from such previous studies were collected either from monolingual children, or from the database in CHILDES.

Two main hypotheses have been adopted throughout the course of explaining the early acquisition of particular sounds in coda position word-finally and the late acquisition of the others. The first hypothesis is the Universal Grammar Hypothesis (UGH). Lombardi (1991) states that the unmarked voiced feature in coda position is actually voiceless; therefore, we assume that, according to UGH, children start producing voiceless consonants before voiced ones in coda positions. Furthermore, in their study, Zamuner et al (2005) test the Universal Grammar Hypothesis (UGH) in their endeavor of explaining the early emergence of particular consonants before the others in word-final coda position. They state that the UGH hypothesizes more production of coronal codas (t,d,s,z,n,l,r) as compared to labial and dorsal, and more production of sonorant codas (m,n.l,r) as compared to obstruent codas in word-final position which seems to contradict the assumption that voiceless obstruent sounds have a special status in coda position. They conclude that the explanation offered by UGH is neither adequate nor exhaustive. This is so because their study shows that UGH cannot account for their results that show no preference for such type of codas in their children's production.

On the other hand, the second hypothesis is the Specific Language Grammar Hypothesis (SLGH), which assigns a major role to the frequency in the child's input trying to account for the acquisition of particular consonants in coda position word-finally (Zamuner et al 2005). It is well -known that the exposure to coda consonants in a particular language makes it easy for the child to acquire these consonants. Lleo (2003) states that English and German children produce consonants in coda position in initial stages of their production by virtue of the high frequency of codas in the said languages. In comparison, Japanese (Ota 2003) and Spanish (Lleo 2003) children's production lack consonants in initial stages of word production due to the lower frequency of codas in such languages.

Notwithstanding the apparent direct influence of frequency of input in Lleo et al and Ota's studies stated above, a vast number of research that has examined the role of frequency in the acquisition of consonants in coda position has yielded mixed results. Bernstein-Ratner (1994) cited in Zamuner et al (2005) has found no relationship between the child's production and the frequency of codas in their input. Stoel-Gammon, 1998, also cited in Zamuner et al (2005), has shown that although the class of fricatives is frequent in the input, fricatives are acquired late. Contrastively, Stoel-Gammon's findings have shown that some certain fricatives are acquired early. Stites et. al.'s study (2004) has shown that the production of one of their sample children is consistent with (SLGH)- frequency- while the other child's production is consistent with the UGH that is shaped by the role of markedness. Zamuner et al however state that their statistical analyses of their data have pointed out "significant relation between children's coda production and the frequency of codas in English" (Zamuner, 2005: 1419).

Very few studies have tackled the acquisition of Arabic (Omar 1973; Badri 1983; Al-Amayreh 1994; Daana 2009; Salim and Mehawesh 2014). None of them has studied the early production of Arabic consonants in word-final coda position. Amongst the very few studies that had investigated the acquisition of Jordanian Arabic sounds is Salim and Mehawesh (2014). They conducted a case study tracing the stages of acquisition in their Jordanian Arabic subject. They traced and described the general stages of the acquisition of Jordanian Arabic. Daana (2009) studied the acquisition of onset cluster, stress and the plural morphemes by her Jordanian subjects. Al-Amayreh's (1994) studied the acquisition of Jordanian Arabic sounds regardless of their position in words and regardless of the syllable structure of children's utterances. Because Al-Amayreh's research is the only research that has tackled the acquisition of consonants *per se* in Jordanian Arabic, it will be referred to and consulted when needed. Therefore, as far as frequency of the input is concerned, this research is restricted to the frequency of occurrences of target utterances in the child's input (parental speech) when it comes to the Arabic Language. This is because of the scarcity of research on the frequency of occurences of Jordanian sounds in onset and coda positions.

This research is expected to contribute to the field of language acquisition being the first of its kind tackling a particular form of Jordanian Arabic used in the capital city-Amman. It also aims at providing further evidence for the inadequacy of UGH solely accounting for the early production of particular consonants in word-final codas. It also aims at providing further evidence for the importance of SLGH (frequency of the input) accounting for this issue. In

addition, it is the first study to examine the development of consonants in word-final position in the production of a bilingual child who is acquiring Arabic and English.

2. The Study

2.1 Methodology

2.1.1 Research aims and questions

This study aims to examine the development of English and Arabic consonants in coda position in the speech of a bilingual child in order to find out the order in which the types of English and Arabic consonants appear. For the purpose of this study, a coda is defined as a word-final consonant. Therefore, the data considered throughout the study is restricted to word-final codas in monosyllabic CVC words due to the different syllabification of intervocalic consonants (see Zamuner et al 2005 for more details). More specifically, this study seeks to answer the following questions:

1. What is the order in which Arabic consonants appear in coda position?

2. What is the order in which English consonants appear in coda position?

3. What pattern(s) can be detected in the appearance of Arabic and English consonants in coda position?

4. What symmetry/asymmetry can be found comparing and contrasting the appearance of consonants in coda position in both languages?

2.1.2 Data Collection and Analysis

Modern corpora through CHILDES project (http://childes.psy.cmu.edu/) have only recently been available. However, no corpora that include multimedia recordings for children acquiring Arabic are available. Hence, the source of data tackled in this study is parental diary of the researcher bilingual child's spontaneous production starting from his babbling stage until he became five years old. Data collection took the form of audio recordings of spontaneous speech between the mother and the child who was born in the UK. The sessions were audio recorded in the child's room or in the living room. No other person was present during the sessions. The child's English and Arabic production was recorded using a Panasonic RX-M70M3 device. The subject's mother also conducted occasional formal sessions in which she showed the child pictures and asked him to name what he could see. To check the child's comprehension in both languages, he was also asked to point to the pictures named by the researcher. These sessions were conducted over the first five years of the child's age on daily basis. Each session lasted for about 45 minutes. The recordings were phonetically transcribed on site using Charis SIL IPA fonts. They were chronologically saved in computer files. Each file contained the child's production, the adults form, and some details about the context if required. In case of Arabic data, the glossary of the Arabic production was included. The transcription of data was also checked by another PhD candidate who happened to be preparing for his thesis in Phonology at the time.

The child's mother was a PhD candidate majoring in Language Acquisition. Throughout the first nine to ten months, the child spent his time with his grandmother who went to the UK for assistance. The child's father was working and the child's mother was busy studying at that time. Therefore the child was exposed to his grandmother's Ammani Arabic for a long period of time with little English from his mother. This long- hour exposure to Ammani Arabic made of it the child's dominant language. At the age of 14 months, the child was sent to the university day-care nursery. Later, he was sent to a British Nursery close to the child's residency in the UK where he was surrounded by British English for 6 to 7 hours on daily basis. Ammani Arabic was the native language of the child's parents and was mainly used by the child's father. The child's mother used to speak to her child in both languages. No particular bilingual policy was established by the parents. The child was now exposed to more English than Arabic in the nursery and at home either on the national channels on the TV or by his mother who was fluent in English. His exposure to Arabic was restricted to his father's Arabic who used to come back late after work. The subject was also exposed to Jordanian Arabic through a very few Arabic-speaking families who happened to be there with their children. This shift in the long-hour exposure to English had made a shift in the dominant language. At the age of 18 months and although the child was exposed to two languages since his birth and although he comprehended both languages, his preferable language for his responses was English unless he was asked to respond in Arabic. Lieven (2010) discussed the preference of a language over the other by bilingual children. Lieven's study showed that bilingual children may have relatively full competence of both languages; however, variability was expected in their production.

For the purpose of this study, only the utterances that were understood as real words and were used to convey messages were counted as words. Identical forms within the same age were counted as single speech utterance. If the production of a particular sound appeared in coda position four times within the session, and is repeated over two successive sessions, the sound was considered acquired in that position. Since this study is qualitative, the researcher tends to trace the development of English and Arabic consonants in coda position ever since the child started producing consonants in that position in any of the two languages, that is at the age of one year and four months. Tracing this form of development continues until he completely stopped deleting the consonants in coda position in both languages that is at the age of two years and three months. Before the age of 1.4, every single utterance the child produced was of a CV structure no matter the number of syllables the original word consisted and no matter the number of consonants occupied word-final coda position in the input. Utterances produced after the age of two years and three months were in the form of phrases.

3. English and Arabic Sound Systems

English and Arabic are two genetically different languages as they belong to two different families with two different typologies. Some particular Arabic consonants do not exist in English these include: the dental, emphatic voiced and voiceless sounds /ḍ/ and /ṭ/, alveolar emphatic fricative /ṣ/, uvular voiced and voiceless fricatives /ɣ/ and /χ/, pharyngeal

voiced and voiceless fricatives /ʕ/ and /ħ/, and the glottal /ʔ/. Some Arabic vowels do not occur in English. These are: the mid-low front long /eː/ and the low front long vowel /aː/.

On the other hand, some English consonants do not exist in Ammani Arabic. These are / θ, ʤ, ʧ, ŋ, ð, g, and v /. Vowels that occur in English but not in Arabic are /ɑː, Ɔ, Ʌ, ə/. English diphthongs do not occur in Arabic.

4. Results

Table 1. The development of English and Arabic consonants in coda position

Age	Arabic Sounds				English Sounds				
1.4	[X]	[m]							
1.5	[s]	[k]			[k]	[n]	[s]		
1.6	[b]				[ŋ]				
1.7	[ṣ]								
1.8	[m]*								
1.9	[ħ]	[j]	[f]	[n][1]	[t]	[n]*			
1.10	[t]*				[d]	[t]*			
1.11					[v]	[z]	[g]		
2	[t]	[q]			[z]	[ʔ]	[θ]	[g]*	[k]*
2.1	[d]	[ð]	[p]*		[ʃ]	[l]			
2.2	[j]*				[j]*				
2.3	[z]	[ʔ]*	[l]		[p]	[w]*			
5	[r]	[l]			[l]				

[1] Sounds with asterisk were actually used by the child to replace other sounds in coda position.

As noticed in Table 1, the child had started producing consonants in coda position at the age of one year and four months starting with the Arabic /χ/ and /m/. New segments started to appear and their number increased gradually. At around the age of two years and three months almost all words that were produced were identical to their input in terms of syllable structure. Those segments were produced properly and occurred at least four times during the session. Arabic /l/ was replaced by [j]. Arabic /r/ was replaced by [j] or /l/. Whereas English /l/ was replaced by [w] in coda position. This replacement continued until around the child's fifth birthday when he started producing them correctly. It is worth pointing out that all consonants listed in the table above were part of lemmas, they were not suffixes except for the /z/ sound which morphologically occurred in [kɑ:z] *cars* as a suffix.

5. Data Analysis

In this section, each group of data (English and Arabic) was qualitatively analyzed to show the development of various types of consonants in coda position. Arabic and English sets of data were analyzed in subsections in terms of the child's age.

5.1 One Year and four Months

At this age, all single words that were produced were of a CV or CV: structure whether they were English words or Arabic words. The only two segments that were produced in coda position at this age were Arabic /χ/ in the word [kɪχ] 'dirty' and /m/ in the Arabic word [na:m] 'slept or sleep: imperative'. Although there were very few occasions in which the words appeared without consonants in coda position, the faithful production of the words outnumbered the production of them without codas.

5.2 One Year and Five Months

At this age, /n/, /k/ and /s/ appeared in coda position in the English word [ʌn] 'one', /s/ in both English and Arabic [ʃɛs] *chips* and /k/ in both English and Arabic [kɔ:k] *cake*. It is worth noting that the words chips and cake are used in Arabic and in English. Hence, they are considered Arabic if used in Arabic context and English if used in English context.

5.3 One Year and Six Months

One month later, /b/ appeared in coda position in the Arabic word [ba:b] 'door'. In addition, English /ŋ/ appeared in [nɔ:nɪŋ] *morning*.

5.4 One Year and Seven Months

At the age of one year and seven months, Arabic emphatic alveolar voiceless fricative /ṣ/ appeared in the Arabic word [baːṣ] 'bus'.

5.5 One Year and Eight Months

One month later, the Arabic word /maj/ 'water' which had been produced as [ma] so far, was occasionally produced as [mam] instead of /maj/.

5.6 One Year and Nine Months

At the age of one year and nine months, /ħ/ appeared in [taːħ] for the Arabic word /muftaːħ/ 'key'. /j/ appeared in the Arabic word [haːj] 'this one'. /f/ appeared in [ʔaff] for /ʔaraf/ 'disgusting'. Whereas, /t/ appeared in [væbɪt] for *rabbit*. /s/ appeared in a new word [æs] for *horse*. [n] was used instead of /m/ in [miːn] for the Arabic word /ħammaːm/ 'toilet'. [n] was also used to replace /v/ in [faɪn] *five*.

5.7 One year and ten months

At the age of one year and ten months, /t/ which had appeared earlier in coda position in the word [væbɪt] now [bæbɪt] *rabbit* was also used to replace /ʃ/ in *fish* which was produced as [fɪt], and it appeared in the word [æt] for *hat*. In Arabic, however, the [t] sound appeared to replace the /b/ sound in /ktaːb/ 'book' that was produced as [baːt]. /d/ appeared in English [bɜːd] *bird*. /k/ appeared in more English words as in [bæk] for *bike* and [bɔk] *book*. It also appeared in [baːk] for the Arabic word /ʃʊbbaːk/ 'window'. The English word *egg* was produced as [ɛg].

5.8 One year and eleven months

One month later, three new consonants appeared in coda position. /v/ was now correctly used in [fav] *five*; /z/ appeared in [ka:z] for *cars*; and /g/ appeared in [ɛg] instead of [ɛgk] for *egg*. As far as Arabic consonants are concerned, no new consonant appeared at this age

5.9 Two years old

At the age of two years, more words with new consonants in coda position were produced. In English, /θ/ appeared in [nu:θ] for *mouth*. /z/ sound appeared in [nəʊz] *nose*. /f/ also appeared in the Arabic word [χa:f] for /χa:jɛf/ 'I am scared'. The English word /aʊt/ was produced as [aʊt] or even as [aʊʔ]. /k/ sound was used in words like [nʊk] or [wʊk] for *look* and in [dʌk] for *duck*. /k/ also appeared in the Arabic word /heɪk/ for 'just like that'. Once more /s/ appeared in new Arabic and English words such as [dɪs] *this* and [jɛs] *yes* as well as [ki:s] for Arabic 'bag'. Furthermore, Arabic emphatic dental /ṭ/ appeared in the Arabic word [ħʊṭṭ] for 'put'. The Standard Arabic uvular stop /q/ appeared in the word [fɔ:q] 'above'.

5.10 Two Years and One Month

English fricative /ʃ/ appeared in *fish*. English /l/ appeared in coda position in [ku:l] for *school*. In Arabic, /ð/ appeared at this age in the proper name /muʕa:ð/ that was produced as [ʔa:ð]. Arabic /d/ appeared in coda position in [χɔ:d] 'you take'.

5.11 Two Years and Two Months

No new consonants appeared in coda position at this age neither in English nor in Arabic. Except for the /j/ sound which appeared to replace /l/ in Arabic words.

5.12 Two Years and Three Months

English /p/ appeared in coda position in [sænʌp] *stand up*, in [ʃɔp] or [θɔp] *shop*, in [ʃi:p] *sheep* and in [kʌp] *cup*. /w/ was used to replace /l/ in *apple, which* was produced as [æpʊw]. Arabic /l/ appeared in words such as [faḍḍal] 'come in' and in [zaʕtal] to replace the /r/ in

/zaʔtar/ ‘thyme’. [ʔ] was used to replace Arabic /ʕ/ in /tabaʕ/ 'belongs to' that was produced as [tabaʔ]. Arabic /z/ appeared in the proper name [fafa:z] instead of /fawa:z/.

5.13 Two Years and Four Months

One month later, all codas appeared properly with no deletion or no replacement in both languages except for Arabic /l/ which was replaced by [j], Arabic /r/ which was replaced by either [j] or [l]in coda position, and except for English /l/ which was replaced by [w] in coda position. This replacement continued until the child was five years old. It was only then that he could properly produce these two sounds.

6. Discussion

The present study aimed to answer four questions. In this section, we will answer the questions with reference to the findings presented in the previous section.

Question 1. What is the order in which Arabic consonants appear in coda position?

The data revealed that the first sounds to appear in coda position in Arabic were /m/ in the word [na:m] ‘slept’ and /χ/ in the word [kɪχ] ‘dirty’. The former was sometimes produced without a coda [na:] and some other times as [na:m].These were the only two segments that appeared in coda position in the child's speech at this particular age. The finding that /m/ was the first to appear is consistent with Al-Amayreh's study (1994) in which he classified /m/ as an early sound by virtue of the fact that it appeared early in his study. The finding pertaining /χ/, however, does not match Al-Amayreh's result. In his study, he stated that /χ/ developed at the age of four. By contrast, it was found to have appeared at the age of one year and four months. This, however, is consistent with Pye et al. (1987) who stated that in Quiche, the back fricative was one of the sounds that developed first. The early appearance of /χ/ in the speech of the subject in this study contradicts the UGH prediction as voiceless coronal codas are expected to be used more than dorsal codas (see Zamuner et al 2005). The early appearance of /χ/ can be interpreted by the fact that the child used it in the most frequent childish word /kɪχ/ ‘dirty’. /kɪχ/ was frequently used by the child's mother, as cleanness had always been one of her prior concerns. So the appearance of this dorsal fricative can be attributed to frequency in the child's input. As mentioned earlier, since no studies investigating the frequency of the appearance of Arabic sounds in coda position have been conducted, frequency parameter used in this study is the appearance of the utterance itself in the child’s input.

The data also revealed that /s/ and /k/ were to appear next in [ʃɪs] 'chips' and [kɔk] for /keɪk/ 'cake' respectively, in addition to the sounds /χ/ and /m/ mentioned above. Five months later /k/ appeared in the Arabic word [ba:k] for /ʃʊbba:k/ 'window'. Al-Amayreh (1994) also stated that /k/ developed early. On the other hand, the /s/ sound appeared at the age of four in Al-Amayreh's study; whereas in this study it appeared much earlier. This sound was followed by /b/ in the word [ba:b] 'door'. Investigating the nature of these sounds one can say that /s/ is expected to appear in codas more often, but not /k/ in light of UGH. However, words such as 'chips' and 'cake' are two words for the most preferred kind of snacks by children at this age. In addition, the word /ba:b/ 'door' is also a term used on daily basis. Therefore, frequency here can account for this early appearance of such sounds.

The data surprisingly revealed the early development of emphatic /ṣ/, which was found to have developed at the age of six in Al-Amayreh's study. /ṣ/ was produced in the word [ba:ṣ]/ 'bus' as early as this age by virtue of the fact that the child and his family used to commute between the university and home by bus. They used to spend times waiting for the bus to arrive, used to feel happy at the sight of the bus, used to feel excited climbing up the bus, and used to feel annoyed getting off the bus. However, this word was produced as [ba:] twice after the appearance of the coda and before it constantly added the coda. This variability in early word production or this overlapping period has been attested significant in previous studies (Vihman 1993). In fact, many studies have shown that the same child may produce some words with consonants in coda position and some others without consonants in coda position at the same stage and in the same session (Kehoe & Stoel-Gammon, 2001; Stites, Demuth & Kirk, 2004).

The data also showed that [m] sound was used to replace /j/ sound in the word /maj/ 'water'. Although water is a very frequent and important term in the child's life, it was used with [m] to replace the glide /j/. This is considered a form of consonant harmony.

Furthermore, the data showed that /j/ correctly appeared only one month later in the demonstrative pronoun [ha:j] 'this F'. The early production of /j/ here is expected as /j/ is predicted to appear early by the UGH in terms of its sonority. Arabic voiceless fricatives /f/ and /ħ/ developed at the age of a year and nine months. These two sounds were also found to appear early in Al-Amayreh's study. However this appearance does not correspond with

the UGH prediction as the former is labiodental and the latter is pharyngeal. By investigating the words in which these two sounds appeared, we find that the word [ʔaff] 'disgusting' is a very frequent word used by the child's mother to warn him against what is not clean or not healthy to touch or to eat. The word [ta:ħ] for /mʊfta:ħ/ 'key' was also used on daily basis.

The word /ħamma:m/ 'toilet' was not only reduced to one syllable, but also /m/ in coda position was replaced by [n] as in the child's production [mi:n]. The development of /n/ was detected early by Al-Amayreh. In addition, the replacement of /m/ with [n] is also consistent with the UGH in terms of the place of articulation of both sounds.

The data showed that the first [t] sound to appear in the child's Arabic coda position was to replace /b/ sound in /kta:b/ 'book' which was produced as [ba:t]. Al-Amayreh's study detected this early appearance of /t/ sound. This type of replacement may be explained to have resulted from metathesis. /k/ also appeared in [ba:k] for the Arabic word /ʃʊbba:k/ 'window'.

The Arabic data also revealed that at the age of one year and eleven months no new Arabic consonant appeared. [t] was used to replace /b/ in /kta:b/ 'book' which was produced as [ba:t] an example of metathesis, and [k] was used to replace /b/ in [kak] for /kalb/ 'dog' an example of consonant harmony.

The emphatic /ṭ/ appeared earlier as compared to Al-Amayreh's findings. In his study, Al-Amayreh showed that the emphatic sounds developed at the age of six years, whereas this study showed that it appeared in the very frequently used term in the child's input /ħʊṭṭ/ 'put' at the age of two. Another even more surprising finding that also contradicted Al-Amayreh's study is the appearance of the standard /q/ sound which was replaced in the family's dialect by the glottal /ʔ/ in the word [fɔ:q] 'above'. There is no way that the child had ever heard the sound /q/ before. The parents' dialect replaced the /q/ sound with /ʔ/. The very few Arabic dialects the child was exposed to at that time in that place replaced /q/ with either /ʔ/, /k/ or /g/. Neither could it be the effect of language heard on the television, because the only channels the family used to watch during their stay there were the four English national channels. In fact, the child produced this term several times over a long period of timed with /q/ in coda position.

Another confusing finding took place at the age of two years and one month when dental fricative /ð/ appeared in the child's cousin's name /mʊʕa:ð/. /ð/ was found to appear at the age of six in Al-Amayreh's study. It is worth noting here that the parents' dialect replaces the /ð/ sound with /z/ every time they uttered that proper name. One possible explanation of the occurrence of /ð/ even though it does not exist in Ammani Arabic is that it could be produced as dental [z̪]. /p/ also appeared in coda position in the word [kʌp] for /kalb/ 'dog'. The voiceless bilabial stop /p/ is not a phoneme in Arabic; however, it was used as a result of assimilation- devoicing. Arabic /t/ was used to replace /ʔ/ in /ʔasu:ʔ/ 'I drive' that was produced as [su:t]. This complies with the UGH prediction of the earlier appearance of coronal codas.

The data showed that the first appearance of Arabic lateral /l/ was a form of replacement in the child's proper name /jana:l/ which was produced as [jana:j]. Brown (2000) considers the /r/ and /l/ complex sounds that are acquired at the age of five. The UGH, by contrast, considers /l/ codas unmarked thus expected to appear earlier than other sounds. A-Amayreh's study showed that the /l/ sound developed as early as two years of age, but this has not been the case in the current study in which the child was able to produce /l/ correctly at the age of five. All other consonants that were produced by the child in coda position were constantly and accurately produced with no replacement or with no trace of any other phonological processes, except for /t/ sound which was replaced by [k] in the Arabic word /ʒakeɪt/ produced as [zɛkeɪk] 'jacket', another example of consonant harmony.

At the age of two years and three months /l/, /ʔ/ and /z/ appeared in coda position in Arabic. [l] appeared in [zaʕtal] to replace /r/ in /zaʔtar/ 'thyme'. Glottal /ʔ/ appeared to replace the pharyngeal fricative /ʕ/ in the word /tabaʕ/ 'belongs to' produced as [tabaʔ]. Arabic /z/ appeared in the proper name /fawa:z/ which was produced as [fafa:z]. However, /ʕ/, /ʔ/ and /z/ sounds were detected to appear at a later age in Al-Amayreh's study, later than two years. Nonetheless, only /z/ was predicted to appear more than other consonants in word-final codas by the UGH.

By the age of five, the child could produce consonants in coda position accurately and with no problem. The /l/ and /r/ sounds also appeared in coda position with no replacement. These were the most difficult sounds to be mastered in this position and were not produced neither fully nor accurately but only at this age. In fact the child used to replace all his Arabic /l/ with [j] and his Arabic /r/ with [j] or [l] not only in coda positions but also in onset position. It is worth noting that the child at the age of five was sent to KG2 where he experienced a form of peer pressure that helped him stop replacing /r/ and /l/ (see Brown, 2000 for more information about peer pressure).

Nevertheless, some sounds that have not been listed in the table above. For example, dental voiceless fricative /θ/ has not been mentioned here simply because the child's parents' dialect replaces this sound with /t/. Pharyngeal fricative /ʕ/ was replaced by /ʔ/, this could be attributed to the consonant low rate of frequency of occurrence as stated by Al-Amayreh. Sounds like /ʒ/, /ʃ/, /ḍ/, /h/ and /ɣ/ were also missing due to their low rate of frequency of occurrence in Arabic as stated by Al-Amayreh.

Question 2. What is the order in which English consonants appear in coda position?

As far as the English data is concerned, consonants in coda position appeared one month after the appearance of consonants in coda position in Arabic; that is to say, the appearance of English consonants in coda position started at the age of one year and five months. This relatively late production of English could be attributed to the child's exposure to Arabic during his first few months of age. The child's input, at during these months, was based on his grandmother's Arabic. The first sounds to appear in English words were /k/, /s/ and /n/ in [kɔ:k] for *cake*, [ʃɛs] for *chips* and [ʌn] for *one*. Coronal codas like /s/ and coronal, sonorant codas like /n/ are predicted to appear more than dorsal codas like /k/ in light of the UGH as stated in Zamuner et al (2005). Once again, *cake* and *chips* have turned out to be one of the most frequent words in the child's input. This is so because the most preferred snacks for kids at this age were cake and chips. As mentioned earlier, these words were considered English if they were used in English context, and Arabic if used in Arabic context.

The data also showed that at the age of one year and six months velar nasal /ŋ/ appeared in the most frequently used word in the child's input *morning* that was pronounced as [nɔ:nɪŋ]. This contradicts the UGH prediction by virtue of its being dorsal, however.

The data showed that no new English consonants developed in coda position during the two following months. At the age of a year and nine months, /t/ appeared in the word [væbɪt]

rabbit. [n] was used to replace /v/ in *five* that was produced as [faɪn]. The appearance of /t/ is predicted by the UGH. Considering the place of articulation of these sounds, the child's replacement of /n/ with [v] may be explained by the UGH as well. /v/ was not one of the sounds to appear in codas at early stages.

The English data revealed that, at the age of a year and ten months, coronal /d/ appeared in coda position in [bɜ:d] *bird*. /t/ was used to close the last syllable in *flower* which was produced as [fɛwɛt]. This act of closing the last open syllable by adding /t/ appeared only once, hence ignored. /t/ appeared in [æt] for /hæt/; however, it did not appear in *cat* which was produced as [kæ]. This variability in the child's production that is shown at the same time was predicted by Vihman 1993, Kehoe & Stoel-Gammon 2001, and by Stites, Demuth & Kirk 2004. The same sound, which had accurately appeared earlier in coda position in the word [væbɪt] now [bæbɪt], was also used to replace /ʃ/ in *fish* that was produced as [fɪt].This, however, is not consistent with Chiat (1989) whose case study found that his subject. Stephen who was at the age of 4:7-4.10 replaced the fricative /s/ with the stop /t/ in onset position but not in coda position. This stopping of fricative in final position also contradicts Rvachew and Andrews' (2002) finding. They reported that their subject –Allison- stopped the fricatives in onset position but not in coda position. /k/ appeared in more English words as in [bæk] for *bike* and [bɔk] *book*. The English word *egg* was produced as [ɛgk]. This may be attributed to the fact that /k/ is distributed more than /g/ in codas (Kessler and Treiman 1997); consequently, the child chose to add the /k/ to conform to the language preference. Alternatively, even it could be that /k/, being voiceless, is unmarked as opposed to /g/ (Lombardi 1991).

The data also showed that, at around his second birthday, more new consonants appeared in coda position either correctly or as a replacement of other consonants. One of the newly appeared consonants was /θ/ which appeared in [nu:θ] for *mouth*. Variability in production may also be found in the production of /v/ in coda position; although /v/ was used at this age in [aɪv] for *five*, the same word was sometimes produced as [feɪ]; besides, the word *move* was produced without a coda [məʊ]. /z/ sound developed in [nəʊz] *nose*, which had earlier been produced as [nɔ:]. It also morphologically appeared in /ka:z/ for *cars*. This relatively

late production of the unmarked /z/ in coda position contradicts the UGH, however. The English word /aʊt/ had earlier been produced as [aʊ], but at this age it appeared as [aʊt] or even as [aʊʔ] influenced by the regional dialect. [t] was used to replace /d/ in [hæt] *hand* a form of devoicing and cluster simplification. However, /t/ correctly appeared in other English words such as *feet*, *eight*, *cat*, and *hat*. /n/ appeared in more words such as *ten*, *done* and [nan] *nine* in addition to [ʌn] for *one*.

The English word *socks* was sometimes produced as [sɔt] and some other times as [sɔs]– the former resulted from fronting either /k/ to [t] conforming with the UGH or fricative stopping /s/ produced as [t], the latter resulted from reducing the cluster by deleting the /k/ and preserving the /s/. Although one month earlier the sound /d/ had appeared in *bird* and this month it appeared in [hɛd] *head*, it was replaced by [k] in [ɛkk] for *red*. Sounds like /k/ continued to appear as replacements of other consonants. It was also used to replace /ɡ/ in *dog. [k] was also used* to replace /ɡ/ in *leg* which was produced as [nɛk] and to replace /ŋ/ in *tongue* which was produced as [tɛk].This replacement is consistent with Kessler and Treiman's (1997) finding which stated that /k/ prefers coda position while /ɡ/ prefers onset position. It also reflects a preference for the unmarked voiceless /k/ over /ɡ/ and /ŋ/ Lombardi (1991). /ŋ/ however was not replaced by /k/ or by any other sound in the word [sɪŋgə] for *finger*. [k] was also used to replace /ʃ/ in *fish* which was produced as [fɪk]; this, as stated above, contradicts Rvachew and Andrews' (2002) finding. Whereas, /k/ was correctly used in words like [nʊk] for *look* and in [dʌk] for *duck*. Nonetheless, /ɡ/ correctly appeared in [ɛg] instead of [ɛgk] *egg*. As we could see above, /s/ appeared in new English words such as [dɪs] and [jɛs] for *this* and *yes* respectively.

The data revealed that at the age of two years and one month more constants were correctly used in coda position at this age. Less replacement of consonants was detected. The word *five* witnessed a number of variations as far as consonants in coda position is concerned. /f/ and /t/ were used interchangeably in [faf]– a form of consonant harmony and [fat]– a form of

fricative stopping for *five*. English fricative [s] replaced /k/ in [fɪk] that became [fɪs] for *fish* which also appeared as [fɪʃ] some time later. The word *red* which had been produced as [ɛk] was produced as [æd] at this age. The word *school* which had sometimes been [ku:] and some other times [ku:s] was now [ku:l].

The present study also showed that at the age of two years and two months, no new consonants appeared in coda position. Except for the palatal glide /j/ sound which appeared in the child's proper name /jana:l/ to replace the /l/ sound. Nonetheless, the fact that /l/ had appeared in [ku:l] for *school* a month earlier is further evidence for the variability detected by Vihman 1993; Kehoe & Stoel-Gammon 2001, and by Stites, Demuth & Kirk 2004.

The data showed that at the age of two years and three months, English /p/ appeared in [sænʌp] for *stand up*, in [ʃɔp] or [θɔp] for *shop*, in [ʃi:p] for *sheep* and in [kʌp] for *cup*. [w] was used to replace /l/ sound in English *wall*, *ball doll apple* and *circle*. Otherwise, all other consonants in coda position in the child's production matched the consonants in coda position in the child's input.

The study revealed that at the age of two years and four months almost all consonants properly appeared in coda position with no deletion or no replacement in English except for /l/ that was replaced by /w/ in coda position. This replacement continued until the child was five years old. It was only then that he could produce this sound accurately and constantly with no problems in coda position. In fact, /l/ was replaced by /j/ in onset position as well. This late production of the /l/ sound was actually predicted by Brown (2000) where he stated that /l/ and /r/ are considered complex sounds and are not acquired before the age of five. It is worth noting that at the age of five the child joined the KG2 class where he was exposed to a sort of peer pressure that forced him speak accurately (Brown, 2000).

Nevertheless, there are very few consonants that were still missing in the child's data, namely /dʒ/, /tʃ/ and /ʒ/. This could be attributed to the occurrence of such sounds in coda position. Kessler and Treiman (1997) believed that the /dʒ/ sound appeared less frequently in coda than in onset. However, in the same study, they pointed that /tʃ/ appears more frequently in coda than in onset. The reason why the child's data lacks /dʒ/ and /tʃ/ although they prefer different syllable slots is Kessler and Treiman's point about consonants' behaviour as a group. They stated that consonants behave as a group preferring particular

syllable slots. This group behaviour is strong enough to be significant even if one consonant "factors out the consonants for which there is an absolute inviolable restriction as to which slot they can go in" (Treiman, 1997: 10). This fact also explains the reason why /ʒ/ also appears less frequently in word final position.

Question 3. What pattern(s) can be detected in the appearance of Arabic and English consonants in coda position?

As far as the appearance of the Arabic consonants in coda position is concerned, no particular pattern was detected. Coronal fricatives such as /s/ seemed to appear as early as dorsal fricatives such as /χ/. Dorsal stops such as /k/ seemed to appear as early as bilabial stops such as /b/. Amongst the nasal stops, the bilabial nasal /m/ appeared before alveolar /n/. As we could see in question one above, we can freely say that both the UGH and the frequency in the input have been crucial factors to determine the development of one sound before the other. Frequency of occurrence in the child's input played an important role in the early production of the marked sound /χ/ in coda position in /kɪχ/ 'dirty'. This particular word was very frequent. The child used to hear it every time his mother wanted to warn him against something dirty. On the contrary, the appearance of /m/ in /na:m/ 'slept' at the same age is explained by both the UGH and the frequency in the input. The UGH constraint prefers sonorant codas more than obstruent codas (Zamuner et al 2005). By the same token, /na:m/ 'slept' was also a very frequent word that the child's mother used every time the mother answered the child's question "Where is dad?". The child's mother used the same word when she wanted her son to go to bed as it could also be used in the imperative form 'sleep/ go to bed'. /k/ and /s/ also appeared early by virtue of their appearance in two of the most preferred snacks for any child [kɔ:k] 'cake' and [ʃɪs] 'chips' respectively. Since, as mentioned earlier, no study compares between the frequencies of occurrence of the Arabic consonants in onset position and their occurrence in coda position, this factor cannot be used in the explanation of the specific appearance of sounds before other sounds in Arabic. What is meant by frequency in this study was the occurrence of the word in the child's input. The rest of the sounds gradually appeared and the last two sounds to appear in coda position were /l/ and /r/ as liquids were stated to be the most difficult sounds mastered by children (Brown, 2000).

No explanation can be given to account for the appearance of sounds such as /ð/ and /q/ in the child's production. The child produced these two sounds at an early stage in spite of the fact that they do not exist in the child's parental speech. The Arabic dialect under

investigation replaces /ð/ with /z/ and /q/ with /ʔ/. Speakers of this dialect are taught the standard sounds /ð/ and /q/ at schools.

Pertaining to the appearance of the English consonants in coda position, no particular pattern was detected either. Frequency played a major role in the appearance of particular sounds in coda position in particular words. /k/ in *cake* and /s/ in *chips* are examples of the importance of frequency in this matter. As mentioned earlier, they are the most frequently used terms for the preferred snacks children prefer. /k/ was also used to replace /g/ sound in coda position. This can be attributed to both UGH and SLGH. The fact that /k/ is voiceless makes it unmarked (Lombardi 1991), hence it was used to replace the marked /g/. In addition, /k/ appears more in codas than in onsets while /g/ appears more in onset than in coda position as stated by Kessler and Treiman (1997). Therefore, we can see that both hypotheses account for some instances of child's production.

/n/ was also one of the consonants that appeared early as compared to other consonants in the word *one*. This is attributed to the frequency of the word *one* in the child's input either as a number, a determiner or as a pronoun. The use of /n/ in coda position can also be explained in light of the UGH constraint that prefers sonorant codas to obstruent ones. English /ŋ/ appeared early as well in a very frequent word in the child's input *morning*. Furthermore, its early appearance can also be interpreted by the fact that /ŋ/ occurs in coda positions only. The rest of the sounds appeared gradually and the last sound that was found to appear as late as five years old was the /l/ sound.

Question 4. What symmetry/asymmetry can be found comparing and contrasting the appearance of consonants in coda position in both languages?

Before attempting to answer the question, it is worth revisiting the comparison between English and Arabic consonant inventories. Ammani Arabic consonant inventory is to some extent similar to the English consonant inventory except for the Arabic emphatic phonemes, which do not exist in English. However, English /s/ is sometimes velarized when followed by a back vowel as in *son*. Arabic /χ/ and /ħ/ do not exist in English either. On the other hand, English phoneme /p/ is an allophone in the Arabic language. When Arabic /b/ is followed by a voiceless sound it is devoiced as in the word /kataḇt/ 'I wrote'. In addition English /ŋ/ and /v/ phonemes do not exist in Arabic neither as phonemes nor as allophones. The /ʔ/ sound is an Arabic phoneme; however, it is an allophone in the British dialect the subject was exposed to. The /θ/ and /ð/ sounds are English phonemes, but replaced by /s/ and /z/

respectively in the parental speech dialect- Ammani Arabic. One further discrepancy is the English language specific phonological constraint, which forbids /r/ appearing in coda position. In the Arabic language, such a rule is not active. This indicates the fact that the Arabic language allows the appearance of /r/ in coda position.

The appearance of some of the English consonants could be interpreted in light of Kessler and Treiman's study (1997) in which they showed the distribution of the English consonants within onset and coda positions. By virtue of the fact that no research shows the distribution of the Arabic consonants within onset and coda positions, and because of the limitation of this study, this interpretation cannot be used to explain the appearance of the particular Arabic consonants in coda position in the production of our child. Instead, the parameter that was defined to account for the frequency factor as far as Arabic is concerned was the frequency of the occurrence of consonants in word-final coda position in the child's input.

The present study revealed that Arabic words with consonants in coda position appeared one month before English words with consonants in coda position by virtue of the dominancy of Arabic over English at this stage. Arabic /m/ appeared before Arabic /n/ because of the frequency in the input. However, English /n/ appeared before English /m/ because /n/ is distributed in more coda position than /m/. The rate of the distribution of /m/ to the distribution of /n/ in coda position is like 127 to 207 respectively (Kessler and Treiman, 1997)

English /l/ appeared before Arabic /l/. Kessler and Treiman (1997) state that English /l/ is distributed in more coda position as compared to onset position the rate is 230 to 135 respectively. However, we cannot apply such interpretation to Arabic /l/. English /d/ appeared before Arabic /d/. In English, the distribution of /d/ in coda position is more than it is in onset position Kessler and Treiman (1997).

The English and Arabic /k/ and /s/ appeared–[kɔːk] and [ʃɪs] respectively- at the same time by virtue of the fact that they both appeared in words that are used in Arabic as well as in English. English /p/ appeared before English /b/ because the distribution of English /p/ in coda position is higher than the distribution of /b/ in the same position -112 to 62 respectively- Kessler and Treiman (1997). Although /p/ is not a phoneme in Arabic, it appeared before English /p/ to replace /b/ because of consonant harmony.

English allophone /ʔ/ appeared before Arabic phoneme /ʔ/. English /z/ appeared before Arabic /z/ by virtue of the fact that /z/ in English has a wider distribution in coda position because of its being a phoneme as well as a plural allomorph. On the other hand, the only Arabic word in the child's input that ends with /z/ is the proper name /fawaːz/.

English /v/ appeared before English /f/ because as stated in Kessler and Treiman (1997) /v/ prefers coda position as compared to /f/, which prefers onset position; even though, /f/ is the unmarked sound of the two sounds. /t/ appeared in English and Arabic to replace other

sounds at the same time. [j] appeared in English and Arabic at the same time as a replacement of liquids in both languages. English /θ/ appeared before /ð/ by virtue of the fact that the former is distributed in more codas than the latter Kessler and Treiman (1997). Besides, the preference of /θ/ over /ð/ can also be attributed to the fact that /θ/ is the unmarked sound of the two. In Arabic, however, as mentioned earlier, /θ/ and /ð/ do not exist in the child's dialect hence the former had not appeared at all, and the latter appeared only in the production of the child's cousin's proper name /muʕa:ð/.

7. Conclusion

The present paper aimed to show an objective account for the emergence of Arabic and English consonants in word-final coda position in the production of a bilingual child. The findings are in partial harmony with Zamuner et. al.'s (2005) findings. The UGH which has so far been adopted to account for children's phonological development cannot solely give us a comprehensive and a reasonable interpretation for the emergence of particular sounds before the others in word-final coda position. It is a complicated issue that cannot be resolved through the sole application of the predictions of the UGH.

In their study, Zamuner et. al. concluded that their "results favor the SLGH over the UGH as an account of children's acquisition of codas in CVC words" (2005:1419). The findings of the present paper suggest that frequency in the input has as an equally important role as the UGH determining which consonant to appear first in word-final coda position. A wide variety of Arabic and English consonants reflects the fact that children gain their phonological knowledge concerning consonants in coda position from their SLGH. That is to say, they build this particular knowledge based on frequency in their input. Thus, a number of consonants which have appeared early in the production of the child in this study is interpreted in light of their frequency in the child's input. Still, the child in this research shows evidence for the universally preferred codas in his production. This is detected from the noticeable number of Arabic and English consonants which have also appeared early in his production conforming with the UGH principles. The universal determining factor is sometimes the sonority of the sound and some other times its place of articulation.

To conclude, we may not deny the role of neither the UGH nor the SLGH determining which sounds are to appear first in children's word-final codas. As we have seen, both hypotheses can be applied to interpret the development of particular sounds before or after other sounds in the said position. Nonetheless, it is obvious that if frequency in the input is not the determiner, the UGH takes over. We can say that frequency is prior to universality; still children's production shows conformity with the latter when the former is a weak determiner. In other words, corresponding with Zamuner et. al. (2005), the results of this study also favor SLGH over UGH.

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