Poznań Studies in Contemporary Linguistics 45(2), 2009, pp. 191–210

doi:10.2478/v10010-009-0004-8

SPEECH AND LANGUAGE IMPAIRMENTS OF ARABIC-SPEAKING JORDANIAN CHILDREN WITHIN NATURAL PHONOLOGY AND PHONOLOGY AS HUMAN BEHAVIOUR

SA'DA BADER
Universität Bielefeld
sada.bader@uni-bielefeld.de

ABSTRACT

The present contribution is concerned with a pilot study of empirical issues in the analysis of speech and language impairments in the speech of a sample of Arabic-speaking Jordanian children. The study aims at developing diagnostic tools for assessing the developmental status of the phonological processes in the child's disordered speech based on the chronology of their development in normally developing children. It also aims at providing a sound linguistic basis for this development. The theoretical linguistic basis for the study is taken from Natural Phonology (NP) and Phonology as Human Behaviour (PHB). Additionally, one of the theoretical goals is to provide further external evidence for developing the NP theory. The results of this study confirm, on one hand, some of the common patterns that are reported in the literature concerning phonological disorders language-universally, and on the other hand, they show some Arabic language specific features as well.

KEYWORDS: Speech and language impairments; phonological processes; Natural Phonology; Phonology as Human Behaviour; language universal rules.

1. Introduction

A long-standing concern of speech-language pathologists has been whether or not speech and language impairments (SLI) are simply the result of delays in the normal acquisition process (Ingram 1976; Leonard 1973). This is an important question, because, depending on this distinction and the exact definition of the disorder, it would be possible to decide on the planning and the execution of a prospective intervention program. The ability to answer this question depends on the availability of descriptions of both the available disordered systems as well as the descriptions of normally acquired systems at various stages of development in the relevant language system. Therefore,

this study provides a source of descriptive information on early developing systems and from such a description on normally as well as disordered systems, specific properties of linguistic systems could be then held for a comparison, showing the similarities and differences within and across these children.

Therefore, efforts are made in this study to contribute to answering this question and to providing further descriptions of both normally acquired and disordered systems in Jordanian Arabic. This paper specifically describes the natural phonological processes in the speech of seven children who have been previously diagnosed on the basis of standard medical production and hearing tests as having speech and language impairments. These natural phonological processes are analyzed, and compared with the processes in the speech of age-matched normally developing (AMN) children in order to characterize their phonological disability.

This study contributes to the studies that have explicitly compared specific aspects of normal and disordered systems cross-linguistically. In one study, Hodson and Paden (1981) studied the phonological processes among normal and disordered children and found them to be highly similar. In two other studies (Ingram 1980; Schwartz et al. 1980), the phonetic inventories and syllable shapes of normal and disordered language systems were explicitly compared. The researchers found that both groups used basically the same number of sounds, moreover they noted that the most frequently occurring sounds and syllable shapes were the same for both groups. More specifically, the phonetic inventories of most subjects in both groups demonstrated the inclusion of nasals, glides, voiced and voiceless stops, and at least one fricative. Therefore, this analysis will extend this comparison with the main focus on the phonological differences between AMN and SLI children in Jordanian Arabic.

A brief account of the previous studies of SLI in Jordanian Arabic, though applying other frameworks, is presented in Section 2, followed by an overview of Arabic phonology in Section 3. In Section 4, the methodological design of the present study is discussed; the participants and the methods of data collection, recording, saving, transcription and annotation will be explained. The major results regarding the chronology of the phonological processes in normal development, along with an explanation of the occurrence of these processes in disordered speech (Table 1) are discussed in Section 5. In the same section, the lenition vs. fortition functions of the phonological processes in decreasing or increasing the phonetic properties of the segments will be explained according to NP and PHB principles. Finally, the most important remarks regarding the nature of this phonological disability and its resemblance, confirmation or divergence from language universals and language-specific features will form the conclusion in Section 6.

2. Previous work on Jordanian Arabic

A very limited and few studies have been conducted in the field of phonological disorders in Jordanian Arabic. Amayreh and Dyson (2000a) analyzed the phonological errors

Table 1. Representative examples of SLI articulations in Jordanian Arabic.

Normal articultaion	SLI articulation	English gloss
[ɻuz]	[ʁuʤ]	'rice'
[ˈkfuuf]	[ˈku.faf]	'gloves'
[ˈχu.biz]	[ˈʔu.biz]	'bread'
[na.ˈðˁiij.fiin]	[naðˁ.ˈðˁaa.fiin]	'they are clean'
[ˈʁa.na.mih]	[ˈkʰa.ma.mih]	'a goat'
[χa.ˈzaa.nih]	[ˈnaa.nih]	'a closet'
[ˈθũm]	[ˈnũm]	'a mouth'
[ˈli.saan]	[ˈtil.saan]	'a tongue'
[naðˁ.ˈðˁaa.ɻaat]	[dan.ˈdaa.laat]	'glasses'
[ˈmaɻ.wa.ħah]	[ˈmaħ.la.wah]	'a fan'
[ma.ˈsˁaa.ɻij]	[ma.ˈlaa.sij]	'money'
[ʔa.ˈʁas.sil]	[ʔa.ˈʔʰas.sil]	'I am washing'
[ˈʔʰaʃ.qaɻ]	[ˈhas.dal]	'blond'
[ˈfatˁ.buwl]	[ˈfad.buwl]	'a football'
[ˈʁa.zaal]	[ħa.saal]	'a dear'
[ˈðajl]	[ˈθajl]	'a tail'
[ˈlaf.ħah]	[ˈfaf.ħah]	'a scarf'

and sound changes in Arabic-speaking normally developing children aged between 2;0 and 4;4. Amayreh and Dyson (2000a) determined in their study the percentages of the consonants that are articulated in a non-standard manner and the percentages of the consonants that have been changed from Educated Spoken Arabic.

Mitleb (1987a) provided a thorough phonetic analysis of a sample of twenty Arabic-speaking misarticulating children examining the phonological processes of substitution applied by those children. Mitleb provided seven rules for the processes of substitution, supporting the approach of Generative Phonology in his analysis and agreeing at the same time with Jackobson's theory of the natural order in which the child acquires his phonetic inventory.

Mitleb (1992) also examined, within the framework of Generative Phonology, the variability of the misarticulations of two Arabic-speaking Jordanian children. In summarizing his results, Mitleb (1992) claims that it is the violations of the markedness constraints that characterize the speech functional misarticulations. Such misarticulations might result from non-ambient underlying representations and constraints being placed on the child's phonetic inventory, thus restricting his ability to produce certain consonants found in normal speech.

Table 2. Standard Arabic consonants and common dialectical variants used in Jordan (in brackets). Source: Amayreh and Dyson (1998: 653).

Manner	Place of articulation																	
	Bilabial		Labiodental		Dental		Alveo-Dental		Palatal		Velar		Uvular		Pharyngeal		Glottal	
	V	VL	V	VL	V	VL	V	VL	V	VL	V	VL	V	VL	V	VL	V	VL
Stop	b						d dˤ	t tˤ			(g)	k		q				ʔ
Fricative				f	ð ðˤ	θ	z	s sˤ	(ʒ)	ʃ			ʁ	χ	ʕ	ħ		h
Affricate									dʒ	(ʧ)								
Nasal		m						n										
Liquid																		
Lateral								l										
Tap/Trill								r										
Glide		w								j								

3. Arabic phonology

Arabic is a Semitic language spoken by more than 420 million native speakers, according to Ethnologue, 246 million including second language speakers (1999 est.). Modern Standard Arabic (MSA), a modernized version of classical Arabic, is the largest living Semitic language with 27 sub-languages. Today MSA is commonly used in all Arab speaking countries in science, learning, literature, press and in the mass media. MSA is not the language of everyday speech; people in different Arab countries speak different dialects of the Arabic language. There are big differences in the phonology, morphology and syntax between these dialects, thus verbal communication between these regional dialects can sometimes be difficult. Consequently, adequate knowledge and competence in MSA is necessary to ensure good communication and understanding between speakers of different Arabic dialects.

The consonant inventory of Modern Standard Arabic includes 29 consonants (Table 2), including nine stops, twelve fricatives, two affricates, two nasals, two liquids and two glides, with three long vowels (/aː/, /iː/, /uː/) and their short cognates (/a/, /i/, /u/) (Al-Ani 1970; see Table 3). Moreover, considering the dialectal variant spoken in Jordan, which is the major concern of this work, one more stop consonant, two fricatives, and one affricate must be added to the phonetic inventory of the Jordanian Arabic dialect, as has been found in the Amayreh and Dyson (1998) study of the phonetic inventories of young Arabic-speaking children. There are four emphatic, or pharyngealized consonants – sounds that are produced with a secondary articulation, with the root of the tongue retracted toward the back wall of the pharynx. These emphatics include: /dˤ/, /tˤ/, /sˤ/, /ðˤ/ (Shahin 1996, as cited in Amayreh and Dyson 1998; Al-Ani 1970).

Table 3. Arabic long and short vowels. Source: Al-Ani (1970: 23–25)

	Short	Long
Hight front unrounded	i	iː
High back rounded	u	uː
Low central unrounded	a	aː

Syllables in Modern Standard Arabic can have five possible shapes: CV, CVC, CVV, CVVC, and CVCC. The first four shapes can occur in all syllable positions, whereas the fifth shape occurs only word-finally or in isolation. Epenthesis is occasionally applied in casual speech to simplify the CVCC syllable shape to be pronounced as CVCVC, as in (1) below:

(1) /ˈχubz/ ‘bread’ → /ˈχu.biz/

In other cases, deletion of the short vowel will create a CCV(C) shape instead of CVCVC, as shown in (2) below:

(2) /ˈdʒi.baːl/ ‘mountains’ → /ˈdʒbaːl/

Consonant clusters consisting of two elements usually occur only word-medially and finally, but never initially as explained by Al-Ani (1970). Every word in Arabic has an “inherently-stressable syllable”, which receives the primary stress. The location of this syllable varies according to the number and the types of the syllables in the word. Al-Ani (1970: 88) explains the rules governing the lexical stress as follows:

(1) When a word is made up of a string of the CV type syllables, the first syllable receives the primary stress and the remaining syllables receive weak stresses:

kátaba	ˈCV-CV-CV	‘he wrote’
dárasa	ˈCV-CV-CV	‘he studied’

(2) When a word contains only one long syllable, the long syllable receives the primary stress and the rest of the syllables go unmarked receiving weak stresses:

káatib	ˈCVV-CVC	‘a writer’
muʕállimahu	CV-ˈCVC-CV-CV-CV	‘his teacher’

3. When a word contains two long syllables or more, the long syllable nearest to the end of the word receives the primary stress (the very last syllable does not count), and in most cases the one closest to the beginning receives the secondary stress:

raʔiísuhunna	CV-ˈCVV-CV-CVC-CV	‘their chief’ (fem. pl.)
mustawdaʕáatuhum	CVC-CVC-CV-ˈCVV-CV-CVC	‘their deposits’ (masc. pl.)

4. Objectives of the field study

The field study reported here aims at observing the differences in the phonological processes between normally developing and SLI children in Jordanian Arabic. The analysis starts by observing the patterns of the chronology of the phonological processes in the normal development of four 2–5-year-old Jordanian Arabic-speaking children. These patterns are fundamental in evaluating and assessing the phonological abilities in the seven members of the 4–7-year-old SLI population and in identifying the

deviations from the normal expected patterns in Arabic. The analysis aims to provide a functional explanation of the phonological processes of SLI with reference to the NP and PHB principles. This study summarizes the phonological characteristics of this disordered speech in order to be accounted for and considered as the symptomatology of the phonological disorder in Jordanian Arabic. More specifically, this analysis aims at specifying the nature of the phonological characteristics of this particular disability. In other words, the fieldwork-based analysis tests the hypothesis of this study, namely that SLI in Jordanian Arabic can be characterized by frequent application of lenitive phonological processes. Therefore, this study specifies whether these phonological processes in the SLI participants' productions are lenitions or fortitions in terms of the nature of their application, as well as with reference to their functions according to NP simplification and reduction-definition criteria.

5. Methods

A systematic dual-component pilot corpus was created as a preliminary step before creating a larger scale corpus at a later point. Advanced statistical examination of this small corpus is not possible, but initial theoretically-motivated questions have been sharpened by a close analysis of the corpus. The design, collection, recording and storage of the corpus were carried out according to the recommendations of Gibbon et al. (1997), as proposed by the Expert Advisory Group on Language Engineering Standards (EAGLES). Accordingly, recordings based on different kinds of systematic elicitation were used: about 10 minutes each of speech from four AMN children, two males and two females, in the age range of 2–5 years old, were recorded. Additionally, about 20 minutes each of speech from 7 SLI children, 6 males and one female, in the range of 4–7 years old, were recorded. Longer sessions were necessary with the SLI children because of the temporal properties of the impairments, the need for somewhat different test types, concentration problems and the need to provide motivating breaks and to maintain a friendly atmosphere.

For the AMN children, spontaneous narration plus single-word articulation tests were used to collect data on almost all the Arabic consonants in word-initial, medial and final positions (following the study of Arabic consonant acquisition by Amayreh and Dyson 1998); see Table 4. For the SLI children, the same procedures were used, plus flash card sets routinely used in the clinics where children were undergoing treatment, selected from five different flash card sets by different authors. In addition, two further types of stimulus were used: first, an Arabic encyclopaedia for children from 1 to 4 years old, focusing on human body parts, family, household objects, kitchen objects, colours, clothes, fruit and vegetables, animals, shapes, means of transport, jobs, and selected opposites; second, various colourful toys representing household and kitchen objects (particularly for shy children). Following the list of the recommendations and standards in Gibbon et al. (1997: 170–172), the recordings were annotated using the

Praat phonetic workbench, first at a broad phonetic level, then at the narrow phonetic level for selected extracts as "this level, the narrow phonetic transcription, of representation, will be far more accurate as a record of what was said" (Gibbon et al. 1997: 160).

Table 4. Test words (Amayreh and Dyson 1998).

Arabic consonants	Word Initial	Word Medial	Word Final
/b/	/ba.ˈnaːt/ 'girls'	/ħi.ˈbaːl/ 'ropes'	/dub/ 'a bear'
/t/	/ta.la.ˈfawn/ 'a telephone'	/mif.ˈtaːħ/ 'a key'	{/ba.ˈnaːt/}[1]
/t/	/tˤaː.ˈjaː.ra/ or /ˈtˤaː.ʔi.ra/ 'an airplane'	/ˈma.tˤar/ 'rain'	/batˤ/ 'ducks'
/d/	{/dub/}	/ˈmad.ra.sa/ 'a school'	/ˈwa.lad/'a boy'
/dˤ/	/ˈdˤif.dˤaʕ/ 'a frog'	/ˈbaj.dˤa/ 'an egg'	/ˈʔab.jadˤ/ 'white'
/k/	/ˈkur.si/ 'a chair'	/ˈsa.ma.ka/ 'a fish'	/ʃub.ˈbaːk/ 'a window'
/q/	/ˈqa.lam/ 'a pencil'	/ˈba.qa.ra/ 'a cow'	/ˈwa.raq/ 'paper'
/ʔ/	/ˈʔa.sad/ 'a lion'	/ru.ˈʔuːs/ 'heads'	—[2]
/m/	/mawz/ 'banana'	{/ˈsa.ma.ka/}	{/ˈqa.lam/}
/n/	/naːr/ 'fire'	/ˈʕi.nab/ 'grapes'	{/ta.la.ˈfawn/}
/f/	/fiːl/ 'an elephant'	/sa.ˈfiː.na/ 'a ship'	/χa.ˈruːf / 'a sheep'
/θ/	/θal.ˈlaː.dʒa/ 'a refrigerator'	/mu.ˈθal.laθ/ 'a triangle'	{/mu.ˈθal.laθ/}
/ð/	/ˈða.nab/ 'a tail'	/dʒu.ˈðuːr/ 'roots'	—
/ðˤ/	/ðˤahr/ 'a back'	/naðˤ.ˈðˤaː.ra/ 'glasses'	/ˈħaː.fiðˤ/ 'a boy's name'
/s/	/ˈsaː.ʕa/ 'a watch'	{/ˈʔa.sad/}	/ˈdʒa.ras/ 'a bell'
/sˤ/	/ˈsˤuː.ra/ 'a picture'	/ˈħi.sˤaːn/ or /ʔiħ.ˈsˤaːn/ 'a horse'	/baːsˤ/ 'a bus'
/z/	/za.ˈraː.fa/ 'a giraffe'	/ɣa.ˈzaːl/ 'a deer'	/ʁaːz/ 'an oven or a stove'
/ʃ/	{/ʃub.ˈbaːk/}	/fa.ˈraːʃa/ 'a butterfly'	/ʕuʃ/ 'a nest'
/χ/	{/χa.ˈruːf/ }	/ˈʔaχ.dar/ 'green'	/ˈbatˤ.tˤiːχ/ 'watermelon'
/ʁ/	{/ʁa.ˈzaːl/}	/ju.ˈʁas.sil/ or /ˈjaɣ.sil/ 'he washes'	—
/ħ/	{/ħi.ˈsaːn/}	/tuf.ˈfaː.ħa/ 'an apple'	{/mif.ˈtaːħ/}
/ʕ/	{/ˈʕi.nab/}	{/ˈsaː.ʕa/}	/ˈʔisˤ.baʕ/ 'a finger'
/h/	/ha.ˈdij.ja/ 'a gift'	/zu.ˈhuːr/ 'flowers'	/wu.ˈdʒuːh/ 'faces'
/dʒ/	/ˈdʒa.mal/ 'a camel'	/da.ˈdʒaːdʒ/ 'chicken'	{/da.ˈdʒaːdʒ/}
/l/	/laj.ˈmuːn/ 'lemon'	/ˈtaː.wi.la/ 'a table'	{/fiːl /}
/r/	{/ru.ˈ ʔuːs/}	{/ˈba.qa.ra/}	{/naːr/}
/w/	{/ˈwa.lad /}	/mar.wa.ˈħa/ 'a fan'	—
/j/	/jad/ 'a hand'	{/ˈʔab.jadˤ/}	—

[1] Second occurrence in {}. The child needed to produce them just once.

[2] No representative example in this position was found from the child's ambient language.

6. Results and discussion

6.1. Chronology of the phonological processes in normal development of Jordanian Arabic

Amayreh and Dyson (1998) made some remarkable findings, highlighting the differences in the acquisition of the standard consonant sounds and their acceptable forms. They noticed that the acquisition of standard Arabic consonants develops gradually; thus they refer to three main acquisition developmental periods: early, intermediate and late. The consonants /b/, /t/, /d/, /k/, /f/, /ħ/, /m/, /n/, /l/, and /w/ were observed to be acquired in the early developmental stage. Therefore, four non-emphatic stops, two non-emphatic fricatives, both nasals, the lateral liquid and the lateral glide are to be normally acquired in the age group (<2:0 to 3:10). In turn, /s/, /ʃ/, /χ/, /ʁ/, /h/, /r/, and /j/ – five non-emphatic fricatives, the tapped and trilled /r/, and the palatal glide were found to be acquired in the intermediate period (around 4:0 to 6:4). Amayreh and Dyson (1998) observed that /tˤ/, /dˤ/, /q/, /ʔ/, /θ/, /ð/, /ðˤ/, /z/, /sˤ/, /ʕ/, and /ʤ/ – all the emphatic consonants, the interdental fricatives, and /ʕ/ and the palatal affricate /ʤ/ have a tendency to be lately acquired in the age group after 6:4.

As obviously noticeable from these findings, Arab children usually acquire the emphatic consonants later than their non-emphatic cognates. Amayreh and Dyson (1998) found that the acceptable dialect forms of the Arabic consonants were generally acquired, in the normal developmental norms, before their equivalent Standard Arabic consonants. Amayreh and Dyson observed that Arab children will acquire medial consonants more accurately than both initial and final consonants, with no differences in the accuracy of acquisition between initial and final consonants. No significant differences in the acquisition accuracy with regard to gender differences at any age level were noticed; thus both male and female children have quite the same acquisition accuracy in the different developmental stages.

As has been explained in the introduction, the first stage of the current analysis is concerned with analyzing the phonological processes in the normal development in Jordanian Arabic. Therefore, the phonetic inventory and the substitution patterns at each particular developmental level in AMN were studied. More specifically, speech samples collected from the four AMN children observed in this study – two boys and two girls, aged two to five years old – were studied. Based on the results derived from this analysis and compared with the results reported in Amayreh and Dyson's (1998) study, some generalisations on the chronology of the phonological processes in the normal development were found and pointed out (Table 5). This list includes the major and the minor natural processes that occur in the acquisition of a language system (Tobin 1997, as adapted from Grunwell 1987; Ingram 1990).

Table 5. The chronology of the phonological processes in normal development in Jordanian Arabic. ● indicates that the relevant process is often used at this age. ▲ indicates that the child applies this process only in dialectical forms. ▒ indicates that the child applies this process inconsistently but is able to articulate the relevant sound correctly in other positions.

Phonological processes	Age in years			
	2	3	4	5
Substitution processes				
Processes reflecting the substitution of active articulators				
Fronting	●	●	●	▲
Backing	●	▲▒	▲▒	▲▒
Processes reflecting changes in the degree of turbulence /airflow				
Stopping	●	▲	▒	
Spirantisation	●	●	●	
Glottal replacement	●	▲▒	▲▒	▲
Gliding	●			
Lateralisation	▒			
Vowel neutralisation	▒			
Processes influencing syllable structure				
Weak syllable deletion	●			
Initial consonant deletion	●			
Final consonant deletion	●	▒		
Metathesis	●	▒		
Epenthesis	▒			
Assimilation processes				
Consonant harmony				
Labalization	●			
Velarization	▲▒	▲▒	▲▒	▲▒
Nasalization	●	▒	▒	
Prevocalic voicing	▲▒	▲▒	▲▒	▲▒
Final consonant devoicing	●	▒	▒	

6.2. The phonetic inventory of children with phonological impairment

This section provides a description of the Phonetic Inventory profile (PIP) of each SLI child in the studied data, and offers a comparison to the standard Arabic consonants and the common Jordanian dialectical variants, as studied by Amayreh and Dyson (1998: 653; see Table 2).

Table 6. The most frequently missing phonemes in the phonetic inventory of the SLI subjects.

	SLI Subjects						
Phonemes	A	B	C	D	E	F	G
Stop	q, ɡ, k, dˤ tˤ	q, ɡ, dˤ,	q, ɡ, k, dˤ, tˤ	q, ɡ, k, dˤ tˤ	q, ɡ, k, tˤ	dˤ	q, ɡ, k, dˤ, tˤ
Fricative	ðˤ, sˤ,ʃ, ʁ, x, ʕ	sˤ	θ, ðˤ, sˤ, ʁ, ʕ	ð, θ, ðˤ, sˤ, ʁ, χ ,ʕ, ħ	ð θ, ðˤ, s, z, sˤ, ʃ, ʁ, χ ʕ, ħ		ðˤ, sˤ, ʁ, ʕ
Affricate	ʤ		ʤ	ʤ			ʤ
Trill	r		r	r	r	r	r

After analyzing the recordings and studying the annotations of the SLI children's articulations, the following remarks were made. The following features of the phonetic inventories can be considered as characteristic of this phonological impairment in Jordanian Arabic as represented in the speech of the seven SLI children studied:

- Generally, oral stops, along with fricatives – emphatic and non-emphatic – in all syllable positions are the two most difficult types of articulations among all the subjects analyzed in this study. More specifically, back places of articulation (non-apical) – alveo-dental, palatal, velar, uvular, and pharyngeal – are more challenging than front places of articulation. In contrast, glides (/w, j/), nasals (/m, n/) and the lateral /l/ are the only phoneme classes that the SLI children in this study mastered in all syllable positions.

- It is obvious from the findings represented in Table 6 that the SLI subjects were limiting their oral stops to the voiced bilabial /b/ and the voiced and the voiceless alveo-dental /d, t/, in addition to the glottal stop /ʔ/. Voiced and voiceless velar, uvular as well as the emphatic alveo-dental oral stops /q, ɡ, k, dˤ, tˤ/ presented considerable articulatory difficulty for most of the subjects and therefore are mostly missing.

- Both the voiceless dental fricative /θ/ and the voiced fricatives; the uvular and the pharyngeal /ʁ, ʕ/ are missing, thus representing a gestural complexity in most of the subjects; more specifically, in five subjects out of seven subjects. Obviously, the least problematic fricative sounds for all of the subjects are the voiceless labiodental /f/ and the voiceless glottal /h/; they are present in all the studied inventories in all syllable positions.

- The voiced palatal affricate /dʒ/ presents clear articulatory difficulty for most of the subjects, which explains its absence in all syllable positions. As a result of this articulatory difficulty, /dʒ/ has often been substituted with the voiced alveo-dental stop /d/. Moreover, the trill /r/ also presents articulatory difficulty for almost all of the subjects, consequently forming a context for gliding. Secondary articulation is also problematic; emphatic consonants are very often missing in all cases as a result of their gestural articulatory complexity.

6.3. Summarizing results of the occurrences of the phonological processes in the studied SLI subjects

The occurrences of each process in each subject's recording, and the percentages of these occurrences among all subjects with SLI in this field study were analyzed in detail. From these initial results, the following specific observations regarding the distribution of the three main types of the phonological processes and their specific representative frequencies of occurrence were found, as represented in Figure 1 in the Appendix:

- Substitution processes; both of the active articulators and in the degree of the turbulence/airflow, are the most frequently used processes among all subjects. More specifically, lateralization, stopping, fronting, glottal replacement, backing, and deemphasis are the most frequent substitution processes. More precisely, after lateralization, fronting was found to be the second most frequently applied substitution process in this disordered speech.

- Among the processes substituting the degree of the turbulence/airflow, it was noticed that affrication, gliding and vowel neutralization were rarely applied among all subjects.

- Processes changing the syllable structure were applied less frequently than other processes among all subjects. More specifically, initial and final consonant deletions were applied more frequently than the other syllable-structure-changing processes.

- Among assimilation processes, voicing and devoicing were applied more frequently than consonantal harmony processes.

- The least used processes were vowel neutralization and gliding among all the SLI subjects.

6.4. Analysis of the phonological processes in disordered speech within NP and PHB

The seven speech recordings from Arabic-speaking children with SLI were analyzed thoroughly. Below, the most frequent phonological processes that were noticed in the recorded speech samples are discussed, providing a reflection of the phonological disorder when compared chronologically with the findings in Table 5. Many of these processes have been noticed to a certain extent during the normal developmental stages. The most frequent processes are presented in this section, with phonetically transcribed Arabic representative examples from the recordings. The examples will be explained, and their lenition vs. fortition function will be clarified within the framework of Natural Phonology (NP; e.g. Stampe 1969, 1980; Donegan 1978; Donegan and Stampe 1979; Dressler 1985; Dziubalska-Kołaczyk 2002a, 2002b; Ingram 1990, 1986) and Phonology as Human Behaviour (PHB), a theory which investigates both segmental and prosodic phonology and phonotactics. PHB has adopted the phonological processes proposed by NP to apply them for analysis and investigation in the clinical domain (e.g. Diver 1979, 1995; Tobin 1997, 2002; Tobin et al. 2006).

6.4.1. Processes reflecting the substitution of the active articulators

It was noticed in this analysis that among the two possible substitution processes of the active articulators, the SLI children show more frequent application of fronting. "Back (non-apical) consonants are substituted by apical consonants usually preserving the same manner and voicing values"(Tobin 1997, 2002). Fronting is considered to be the earliest substitution process of the active articulators. This tendency confirms language universal rules, as according to both NP and PHB, apical consonants are favoured because the apex of the tongue is the most flexible and sensitive, and the easiest articulator to control among all active articulators. Therefore, fronting is a lenition process according to its proposed definition in Kul (2007: 155): "lenition is reduction of the three criteria: energy, complexity or aerodynamic unnaturalness". The examples in (3) and (4) represent this lenition pattern in the SLI recordings:

(3) [tˤaa.ˈqij.jih] as [tˤaa.ˈdij.jih] 'a hat'
(4) [ˈʃam.ʔah] as [ˈθam.ʔah] 'a candle'

Backing is not considered a normal process; it is described as an idiosyncratic pattern (cf. Grunwell 1987), normally occurring only during the first developmental stage (at two years of age). It has been noticed that backing is frequently used in disordered speech, and mostly achieved through glottal replacement. This pattern was found in this analysis to deviate from language-specific rules in certain contexts of application, as according to Amayreh and Dyson's (1998) findings, /ʁ/ will normally be acquired at the intermediate stage (around 4:0 to 6:4), whereas /ʕ/will be acquired in the late age group (after 6:4). Examples (5) and (6) represent this idiosyncratic pattern in the SLI speech:

(5) [ʁun.ˈnij.jih] as [ʕun.ˈnij.jih] ‘a song’
(6) [ʁas.ˈsaa.lih] as [ʔas.ˈsaa.lih] ‘a washing machine’

6.4.2. Substitution processes reflecting changes in the degree of the turbulence/airflow

The most obvious process in this respect is the frequent use of stopping, as represented in (7) and (8), respectively, which are examples from disordered speech. Stopping in this sense confirms language universals, as according to NP and PHB, through the process of stopping, the maximum constriction is preferred, and thus it is easier to control stops than stable fricatives. As less effort is required in producing stops, it is a lenition process through the reduction of the unnaturalness of the aerodynamics involved in the relevant articulation (cf. Kul, 2007).

(7) [ˈfun.dʒaan] as [ˈfun.daan] ‘a cup’
(8) [naðˤ.ˈðˤaa.ɻaat] as [naʔ.ˈʔʰaa.laat] ‘glasses’

Examples (9) and (10), in turn, are examples of another lenition process in which the child is removing the second articulatory part in articulating the emphatic sounds; thus the influence of the Arabic-specific rules is shown through the process of de-emphasis, and the use of the sound’s non-emphatic cognate. Additionally, this pattern confirms the PHB principle in which the additional articulators are disfavoured (cf. Tobin 1997, 2002).

(9) [ˈmas.tˤa.ɻah] as [ˈmas.ta.lah] ‘a ruler’
(10) [ˈbaj.dˤah] as [ˈbaj.dah] ‘an egg’

Spirantization is a rather rare process in children’s normal development, though a common process in the pathological speech of individuals having traumatic brain injury (TBI) after a prolonged coma: “[o]ther frequently used articulatory processes by the TBI patients were: incomplete consonant closure (ICC), spirantization and vowel centralisation. The three processes are rare in typical children’s productions” (Połczyńska-Fiszer 2007: 306; cf. Połczyńska-Fiszer and Pufal in press; Połczyńska-Fiszer in press b). Spirantization in the disordered speech presents another particular Arabic-specific feature. As it is evident in many cases, the glottal stop was substituted by the voiceless glottal fricative, as /h/ would normally be acquired before /ʔ/ in Jordanian Arabic. Therefore, the exploitation of more effort in the occurrence of this fortition process can be explained with regard to the Arabic-specific acquisition norm in this particular context. Moreover, fricatives were used as substitutes for stops and glides in some cases, as in (11) and (12), respectively:

(11) [ˈʔaɻ.naḇ] as [ˈhal.naḇ] ‘a rabbit’
(12) [ˈwi.siχ] as [ˈhi.siχ] ‘dirty’

Deaffrication presents patterns of language-specific features and confirms PHB principles in disfavoring the transition between two distinct constrictions in a single phoneme (cf. Tobin 1997, 2002); thus this process is defined as a lenition process. Additionally, it is important to mention that the case of substituting the affricate by the homorganic fricative, especially substituting [ʒ] for [dʒ], is considered to be a more prestigious dialectical form, especially in the spoken Arabic used by females in Jordan. This preference has its influence on the child's normal development, and explains its unusual presence during late stages of normal development, e.g. four and five-year-old speech and even beyond. In contrast, the case of substituting the affricate by the homorganic stop is an abnormal process that was noticed in the SLI speech, but no examples at all were found in the normally developing children. The examples in (13) and (14) represent cases of deaffrication in SLI speech:

(13) [ˈdʒaa.kajt] as [ˈʒaa.tajt] or [ˈʃaa.tajt] 'a jacket'
(14) [ˈdʒa.bal] as [ˈda.bal] 'a mountain'

6.4.3. Processes influencing syllable structure

Reduction of a consonant cluster to one consonant was not noticed to be a common process in the disordered speech analyzed in the current study, as consonant clusters are not common in Arabic phonology. Therefore, this is an Arabic language-specific tendency, along with the fact that this process reflects the universal CV preference. No examples of this process were found in the disordered speech. In (15) and (16), which are examples from disordered speech, the subject applies another lenition process instead of syllable-final-consonant deletion. The child applies assimilation through consonant harmony to reduce the required articulatory effort, through reducing the involved gestural complexity:

(15) [ˈban.tˤa.luwn] as [batˤ.tˤa.luwn] 'trousers'
(16) [ˈʔʰaɻ.ba.ʕah] as [ˈʔʰab.ba.ʕah] 'four'

NP and PHB also provide another explanation for the deletion of weak (unstressed) syllables. This deletion usually applies in a word initial-position being followed by a stressed syllable, thus keeping the stressed syllable, which is more communicative and more important for perception purposes. The initial unstressed syllable would be the possible candidate for this simplifying deletion process to achieve the aim of reducing the articulatory effort; thus the lower the number of syllables in a word, the less the articulatory effort that will be needed. This lenition process was noticed in both normal and disordered speech in Jordanian Arabic, thus reflecting language-universal patterns, as represented in (17) and (18):

(17) [tit.ˈħam.mam] as [ˈħam.mam] ‘she is having a shower’
(18) [ʔa.ˈmaʃ.ʃitˤ] as [ˈmaʃ.ʃitˤ] ‘I comb’

6.4.4. Assimilation processes

This analysis further shows application of three different assimilation processes under the major description of consonant harmony: labialization, velarization, and nasalization in a C1VC2 syllable structure to reduce the needed articulatory effort while keeping the same number of the sounds simultaneously. Further explanation of the occurrences of these processes is to be included in a more extensive analysis of this work (Bader, in preparation).

Two more assimilation patterns are further explained in this section; namely, pre-vocalic voicing and final-consonant devoicing (FCD). Pre-vocalic voicing is also a lenition process, as it reduces the required energy in changing a fortis into a lenis sound “due to the more vigorous resistance offered by the narrowed configuration of the vocal folds to the current of air” (Kul 2007: 166). Examples (19) and (20) show pre-vocalic voicing in disordered speech (excluding voicing in dialect forms in Jordanian Arabic):

(19) [tˤaa.ˈqij.jih] as [tˤaa.ˈdij.jih] ‘a hat’
(20) [ˈbuɻ.tu.qaal] as [ˈbul.daan] ‘orange’

Conversely, final-consonant devoicing (FCD) reduces the number of the active articulators through the deactivation of the vocal folds in the articulation of the final consonant. According to the principles of NP and PHB, devoicing is a lenition process that reduces gestural complexity. Devoicing usually occurs in a word-final position, as this position has the smallest contribution to the word’s communicative force. This tendency was noticed in the SLI speech, as shown in (21) and (22):

(21) [ˈwa.laɖ] as [ˈwa.lat] ‘a boy’
(22) [ˈʔʰaz.ɻag] as [ˈʔʰaz.ɻaʔ] ‘blue’

7. Conclusion

7.1. SLI within Arabic-specific rules; NP and PHB constraints and principles

Based on the annotations, the phonological characteristics of the children’s speech were analyzed, and the symptomatology of the phonological disorder was investigated. Initial analysis of the data shows that some of the observations suggest that the speech and language impairment in Jordanian Arabic can actually be classified as delayed acquisition on one hand, due to the chronological mismatch in the application of the phonolog-

ical processes between AMN and SLI children. But on the other hand, SLI can also be characterized by the frequent application of the simplifying lenitive phonological processes as defined by the three criteria: reduction of energy, complexity or aerodynamic unnaturalness. More specifically, in the current analysis, SLI children applied only one fortition process, namely spirantization, which was explained as a feature of Arabic specific features, clarifying its unexpected presence. Conversely, all the other phonological processes that were noticed in the SLI speech are lenitions in their simplifying function. To summarize, eight lenition processes were applied and explained: fronting, stopping, de-emphasis, de-affrication, voicing, devoicing, consonantal harmony, and weak syllable deletion.

Moreover, this analysis has also investigated other factors. It shows that SLI children may have a different language system, which may involve deviances from specific Arabic phonological rules acquired in normal acquisition.

Finally, the phonological characteristics of the SLI children's speech in the current analysis can be summarized as involving the following specifications:

(1) Different selections from universal phonological processes:

– The frequent application of fronting and stopping, confirming the maximum constriction preference (Tobin 1997, 2002; Tobin et al. 2006).

– The articulatory difficulty could be the explanation for the phonological errors in the production of the emphatic consonants through de-emphasis and for the lateralization of /r/ as well.

– The substitution of glides for fricatives and the gliding of liquids both confirm the maximum aperture preference in reducing articulatory muscle control (Tobin 1997, 2002; Tobin et al. 2006).

(2) The analysis in this paper shows other interesting observations in the occurrence of other phonological processes that differ from universal phonological processes in some pathologically determined patterns:

– Backing, which is frequently used in the disordered speech and mostly achieved through glottal replacement.

– Final consonant voicing, a completely abnormal process.

– The inconsistent pattern of pre-vocalic voicing and devoicing.

– The frequent use of glottal replacement in both normal and disordered speech in our data, though language universally it has been found that such a process is rather in-

frequent. Therefore, this process differs from both language universals and Arabic language specifics and the norms of normal acquisition of the language in the context where it was applied – in the context of substituting certain sounds that must have been acquired earlier according to the normal acquisition norms in Arabic.

3. The disordered speech analyzed in this paper reveals the occurrence of some phonological processes which reflect Arabic language-specific rules in the following ways:

– The use of the dialectal forms helped in making fronting a very frequent process.
–
– De-emphasis, and the use of the sound's non-emphatic cognate. Moreover, this process confirms the PHB principles and the explanation that PHB provides of the occurrence of this phonological process in SLI speech, namely the disfavouring of additional articulators, as explained in Tobin (2000, 2007a).

– Spirantization, particularly substituting /h/ for /ʔ/ and its deviation from the relevant acquisition norms.

– Deaffrication, especially substituting [ʒ] for [dʒ], and its stylistic implications in Jordanian Arabic.

– The rare use of consonant cluster reduction in the disordered speech is another process reflecting Arabic-specific features, as consonant clusters are not common in Arabic phonology.

ACKNOWLEDGEMENT

Thanks to Dafydd Gibbon, Bielefeld Universität, Germany, for his invaluable advice and comments on an earlier version of this paper. Additionally, Der Katholische Akademische Ausländer-Dienst (KAAD) is acknowledged for granting in 2007 a doctoral scholarship to the author without whose financial support this research could not have been carried out.

REFERENCES

Al-Ani, S. 1970. *Arabic Phonology*. The Hague: Mouton.

Amayreh, M. and A. Dyson. 1998. "The acquisition of Arabic consonants". *Journal of Speech and Hearing Research* 41(3). 462–661.

Amayreh, M. and A. Dyson. 2002. "Phonological errors and sound changes in Arabic-speaking children". *Clinical Linguistics and Phonetics* 14(2). 79–109.

Bader, S. In preparation. "Issues in the characterisation of phonological speech impairment vs. delayed acquisition in Arabic-speaking Jordanian children.

Diver, W. 1979. "Phonology as human behaviour". In: Aaronson, D. and R. Reiber (eds.), *Psycholinguistic research: Implications and applications.* Hillside, NJ: Lawrence Erlbaum. 161–186.

Diver, W. 1995. "The theory". In: Contini-Morava, E. and B.S. Goldberg (eds.), *Meaning as explanation: Advances in linguistic sign theory*. Berlin: Mouton De Gruyter. 43–114.

Donegan, P. 1978. *On the Natural Phonology of vowels*. New York: Garland.

Donegan. P. and D. Stampe. 1979. "The study of Natural Phonology". In: Dinnsen, D. (ed.), *Current approaches to phonological theory*. Bloomington: Indiana University Press. 126–173.

Dressler, W.U. 1985. "Explaining Natural Phonology." *Phonology Yearbook* 1. 29–50.

Dziubalska-Kołaczyk, K. 2002a. "Speech is in the ear of the listener: Some remarks on the acquisition of second language sounds". Paper presented at the 6th Annual LLL College-wide Graduate Student Conference, University of Hawai'i at Mānoa.

Dziubalska-Kołaczyk, K. 2002b. *Beats-and-Binding Phonology*. Frankfurt am Main: Peter Lang.

Enbe, C., J. Gurlekian and Y. Tobin. 2006. "A laboratory analysis of suprasegmental features in normal and pathological speech of Buenos Aires Spanish according to the theory of Phonology as Human Behaviour". In: Díaz-Campoz, M. (ed.), *Selected proceedings of the 2nd Conference on Laboratory Approaches to Spanish Phonetics and Phonology.* Somerville, MA: Cascadilla Proceedings Project 85–103.

Gibbon, D., R. Moore and R. Winski (eds.). 1997. *Handbook of standards and resources for spoken language systems*. Berlin: Mouton de Gruyter.

Grunwell, P. 1987. *Clinical phonology*. Kent: Croom-Helm.

Hodson, B., and E. Paden. 1981. "Phonological processes which characterize unintelligible and intelligible speech in early childhood". *Journal of Speech and Hearing Disorders* 46. 369–373.

Ingram, D. 1976. *Phonological disability in children*. London: Arnold.

Ingram, D. 1980. "A comparative study of phonological development in normal and linguistically delayed children". *Proceedings of the First Annual Wisconsin Symposium on Research in Child Language Disorders*. Madison, WI: University of Wisconsin-Madison. 23–33.

Ingram, D. 1986. "Phonological development: Production". In: Fletcher, P. and M. Garman (eds.), *Language acquisition*. Cambridge: Cambridge University Press. 223–239.

Ingram, D. 1990. *Phonological disability in children*. London: Whurr.

Kul, M. 2007. The principle of least effort within the hierarchy of linguistic preferences: External evidence from English. (Unpublished PhD dissertation, Adam Mickiewicz University, Poznań.)

Leonard, L.B. 1973. "The nature of deviant articulation". *Journal of Speech and Hearing Disorders* 38. 156–161.

Maddieson, I. 1999. "Phonetic universals". In: Hardcastle, W.J. and J. Laver (eds.), *The handbook of phonetic sciences*. Oxford: Blackwell. 619–639.

Mitleb, F. 1987. *Articulation disorders in Arab children*. Kuwait: The Kuwaiti Committee for Arab Children Development.

Mitleb, F. 1992. "Misarticulations of two Jordanian children". *Journal of the International Association* 21(2). 57–65.
Połczyńska-Fiszer, M. 2007. First and second language dysarthria in TBI patients after prolonged coma. (Unpublished PhD dissertation, Adam Mickiewicz University, Poznań.)
Schwartz, R.G., L.B. Leonard, M.K. Folger and M.J. Wilcox. 1980. "Early phonological behaviour in normal-speaking and language disordered children: Evidence for a synergistic view of linguistic disorders". *Journal of Speech and Hearing Disorders* 45. 357–377.
Stampe, D. 1969. "The acquisition of phonetic representation". In: Binnick, R. et al. (eds.), *Papers from the Fifth Regional Meeting of the Chicago Linguistic Society*. Chicago: Chicago Linguistic Society. 443–454.
Stampe, D. 1980. *A dissertation on Natural Phonology*. New York: Garland.
Tobin, Y. 1997. *Phonology as human behavior: Theoretical implications and clinical applications*. Durham, NC: Duke University Press.
Tobin, Y. 2002. "Phonology as Human Behavior: Theoretical implications and cognitive and clinical applications". In: Fava, E. (ed.), *Clinical linguistics*. Amsterdam: Benjamins. 3–22.

APPENDIX

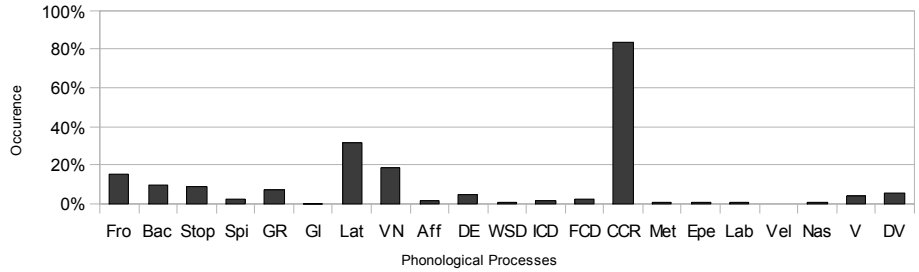

Figure 1. Summary of the distribution of the phonological processes in the SLI speech recordings. Abbreviations: Fro: fronting; Bac: backing; Stop: stopping; Spi: spirantization; GR: glottal replacement; Gl: gliding; Lat: lateralization; VN: vowel neutralization; Aff: affrication; DE: deemphasis; WSD: weak syllable deletion; ICD: initial consonant deletion; FCD: final consonant deletion; CCR: consonant cluster reduction; Met: metathesis; Epe: epenthesis; Lab: labialization; Vel: velarization; Nas: nasalization; V: voicing; DV: devoicing.

Address correspondence to:
Sa'da Bader
c/o Prof. Dr. Dafydd Gibbon
Fakultät für Linguistik und Literaturwissenschaft
Universität Bielefeld
Postfach 100131
33739 Bielefeld, Germany
sada.bader@uni-bielefeld.de