Remarks on the Speech of Arabic-speaking Children with Cleft Palate

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Abstract

Speech samples were obtained from three Arabic-speaking children with cleft palate, and two questions were asked. First, are the characteristics of the children's speech like those reported for cleft palate speakers of other languages? This is of interest because cleft speech data for Arabic is so far unreported. Many characteristics appear to be similar, but implosive airstream, oral stop devoicing, and labiodental stopping for /f/ also occurred. Second, do pharyngeal and glottal compensatory articulations, frequently reported for cleft palate speakers, occur in Arabic? Since Arabic has phonemic /ħ ʕ/ and /h ʔ/, we might expect that they do not, to avoid phonetic neutralization of phonemic contrast. In the samples, one child produced compensatory pharyngeal articulation. Two produced compensatory glottal articulation. The former did not result in phonetic neutralization, but that seems to have been incidental. The latter resulted in much neutralization. As the children's uvular backed compensatory articulations also resulted in neutralization, it seems their productions were insensitive to the phonemics of the language. This is consistent with the conclusion elsewhere that the characteristics of cleft speech are universal.

1. Introduction[1]

The characteristics of cleft palate speech include hypernasality, nasal emission, weak or strong expiratory air, weak pressure consonants (oral obstruents, e.g., stops, fricatives, affricates), and compensatory glottal replacement, glottal reinforcement, and backing (e.g., Bzoch 1997; Trost-Cardamone 1997; Bernhardt and Stemberger 1998). These are biomechanically based. All stem from velopharyngeal impairment (VPI), which leads to lack of adequate closure of the velopharyngeal port. The first two stem from resulting nasal airflow (e.g., Bradley 1997). Weak and strong expiratory air are two strategies for decreasing nasal resonance (McWilliams et al. 1984; Warren et al. 1988; Moon and Kuehn 1997). Weak pressure consonants occur because the pressure leak at the

[1] I thank the Ramallah Women's Association for facilitating this research.

velopharyngeal port compromises intraoral pressure (Trost 1981a; Bradley 1997). Glottal compensatory articulations involve valving at the glottis to yield oral obstruent percept for targets with place of articulation too forward in the vocal tract for successful obstruent articulation, given the velopharyngeal leak (Trost 1981b; Bronsted et al. 1994). In some backing compensatory articulations, the back or blade of the tongue is raised for 'lingual assist' in velum raising, or blockage of palatal fistula (Trost 1981b, 1986; Gibbon and Hardcastle 1989; Trost-Cardamone 1990; Bronsted et al. 1994). In others, pharyngeal productions result (e.g., Trost 1981b, Trost-Cardamone 1997), providing valving as for glottal compensatory articulations. These characteristics do not result directly from structural deficit, but are results of "strategies adopted by the speech production system to overcome or minimize the effects of this deficit" (Bronsted et al. 1994:113). After the physical problem is eliminated, they often persist due to habituation (e.g., Chapman 1993; Bzoch 1997).

Cleft speech patterns have been considered universal, i.e., occurring for cleft palate speakers regardless of language (e.g., Harris and Cottam 1985; Bronsted et al 1994). The question remains, however, whether data from languages different from those on which descriptions of cleft speech are based – e.g., English, Russian, Dutch, Danish, Swedish, Norwegian (see above references), Cantonese (Stokes and Whitehill 1996; Gibbon et al. 1998) – will indicate otherwise.

This paper presents informal, non-clinical observations on speech data from three monolingual Arabic-speaking children with cleft palate. Two questions were asked. First, are the characteristics of the Arabic children's speech similar to those reported for cleft palate speakers of other languages? This is of interest because cleft speech data for Arabic is so far unreported. Second, did the children produce pharyngeal and glottal compensatory articulations, frequently reported for cleft speakers? Since Arabic has phonemic pharyngeals and glottals, we might expect they would not, to avoid phonetic neutralization of phonemic contrast. This would mean there is influence of the target language, *contra* the universality conclusion mentioned above, so that compensatory articulations observe phonemic distinctions of the language. There is support for this possibility from Gibbon et al. (1998), who found phonetically distinct productions for target /s/ vs. /ʃ/ for English cleft speakers, but not Cantonese, indicating phonetic distinction for the language (English) in which /s/ and /ʃ/ phonemically contrast. The remarks of this paper are compiled in the hope that they will contribute to the cleft speech database, and towards a crosslinguistic speech pathology (Ryalls 1996), though they await confirmation from clinical study.

2. The Speakers, Data, and Analysis Procedures

The children who produced the data are three monolingual Arabic-speaking children: a girl, Hanin, age 3¼ years, and two boys, Odai, age 5 years, and Mohammad, age 5½ years, each with complete (soft and hard) cleft palate. Each had primary palatoplasty in infancy and no secondary surgical care. Hearing for each was within normal limits (according to conversational statement by the children's speech therapist). Further information about the children was not made available. The speech samples are some 80 words produced, mostly in picture-naming tasks, during speech therapy sessions at the speech pathology center of the Ramallah Women's Association in Ramallah, West Bank. The author (a phonetician/phonologist mostly familiar with normal adult Arabic) was invited to attend and record a one-hour speech therapy session for each child. The sessions were taperecorded using a Sanyo 5E taperecorder with internal mic. The children's lexical productions were transcribed by the author, live during the sessions, and later checked and rechecked with the recordings. Transcriptions were as narrow as possible.[2]

There are several limitations on the present dataset. It comprises mostly words spoken in isolation, not connected speech (cf. Gibbon et al. 1993, who found more substitutions in connected cleft speech than single words). The words are not balanced samples (see Brondsted et al. 1994) nor the same across the three children. Finally, as the speech samples are from a one-hour session per child, it could well be that they are not completely representative of the children's production abilities.

3. Remarks

The production patterns in the samples are summarized in Table 1.[3] (Besides nasal airflow and shortening, vowel patterns are ignored.) In the table, the children are matched with their productions. Example data are provided in (1). Transcription uses the International Phonetic Alphabet (1993, revised 1996), in which the voiceless mid-dorsum

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[2]I also digitized and acoustically analyzed the productions using Multi-Speech 3700® by Kay Elemetrics. However, recording conditions were poor, precluding acoustic analysis for anything more subtle than gross segmentation.

[3]The subscript diacritic ' ̙ ' is used to denote simultaneous pharyngealization and uvularization. Arabic has a set of consonants with those two secondary gestures. They are known as 'emphatics' and include d̙ (or ð̙, depending on dialect) and s̙. Uvular q is often analyzed as emphatic k̙ (e.g., Harrell 1957).

palatal stop (Trost 1981b, 1997) is ‘c’. ExtIPA ‘p̪’ (Ball, Rahilly, and Tench 1996) denotes a voiceless labiodental stop.

Table 1. Productions patterns in the samples
(V = oral vowel, Ṽ = nasal vowel, Vː = long vowel; arrows point from targets to productions; H = Hanin, O = Odai, M = Mohammad)

a. always matched: /m w j ʃ q χ ʁ ħ h ʔ/

b. usually matched: /n/ (see c.xiv), /l/ (see d), /ʕ/ (see d)

c. substitutions:

		characteristic illustrated
i.	V → Ṽ (HOM)	hypernasality
ii.	Vː → V (HOM)	weak expiratory air
iii.	generally weak expiration (OM)	weak expiratory air
iv.	low intensity oral obstruents (HOM)	weak pressure consonants
v.	r → ɾ (HOM)	weak pressure consonants
vi.	r → l (O)	lateralisation*
vii.	b → m (H)	nasal emission
viii.	b → b̥ (HOM), d/d̘→ d̥ (HM)	devoicing
ix.	d → c (M)	devoicing, backing
x.	t/t̘→ k (H)	backing
xi.	t̘ → q (HO), d → q (M), k → q (HM)	backing
xii.	k → ʡ (M)	backing
xiii.	s → ɕ (HO)	backing
xiv.	n → ɲ (H)	backing
xv.	b → ʔ (OM), t d k → ʔ (O), t̘ → ʔ (M)	glottal replacement
xvi.	t̘ → t (HO), d̘ → d (H), b̘ → b (M)	omission of secondary gestures*
xvii.	f → p̪ (HO)	stopping
xviii.	k → ƙ (OM)	implosive airstream

d. sometimes omitted: /r/* (HM), /l/* (H), /ʕ/* (M), syllable* (M)

* Also characteristic of normal Arabic child speech (Omar 1973; Dyson and Amayreh 2000).

(1) Example productions (most Vs are $\tilde{V}$)

a. Hanin (7-9 were in connected speech)

	Production	Target	Gloss
1.	qɑbe	t̙ɑbe	'ball'
	tɑb̥e		
2.	b̥əqɑːqɑ	bət̙ɑːt̙ə	'potato'
3.	χaɕː	χasː	'lettuce'
4.	ʃarɛʕ	ʃarɛʕ	'street'
5.	b̥əʃqiɵ	bəʃkiːr	'towel'
6.	ʃæːl	ʃæːl	'shawl'
7.	ʔamjəd̚	ʔʌbjəd̙	'white'
8.	mɪnːi	bɪnːi	'brown'
9.	ħəkːekʊm	ħət̙ːeːthʊm	'(I) put them'
10.	p̪iə	fiːl	'elephant'
11.	ʕaʃə	ʕaʃə	'supper'
12.	ɾawːəħ	rawːəħ	'(he) went home'
13.	p̪ɑː	fɑːr	'mouse'
14.	ʃʊʁɔl	ʃʊʁɔl	'work' (noun)
15.	b̥ətːiːχ	bət̙ːiːχ	'watermelon'
16.	b̥ed̥ə	bed̙ə	'egg'
17.	p̪oːʔ	foːʔ	'up'
18.	ʔaɲə	ʔanə	'I'

b. Odai (6-7 were in connected speech)

	Production	Target	Gloss
1.	ʃɔrəʔ	ʃɔrəb	'drink' (noun)
2.	b̥ətɑqə	bət̙ɑːt̙ə	'potato'
3.	ʔɪɕːwɑrə	ʔɪsːwɑrə	'the-bracelet'
4.	saʕa	saːʕə	'wristwatch'
5.	p̪iəl	fiːl	'elephant'
6.	ʔaħʔ	taħt	'under'
7.	ʔɪʔːafʔal	ʔɪdːʌftər	'the-notebook'
8.	bəʃʔiɾ	bəʃkiːr	'towel'
	bəʃƙiɾ		

c. Mohammad

	Production	Target	Gloss
1.	ʃaci	ʃædi	‘Shadi’ (masculine name)
2.	ʃajə	ʃædiə	‘Shadia’ (feminine name)
	ʃacə		
3.	fəɾɑʃe	fɔrɑːʃe	‘moth, butterfly’
4.	faːʃe	farʃe	‘mattress’
5.	ʔəʃuːf	ʔəʃuːf	‘(I) see’ (subjunctive)
6.	ʃɔfɑːʔ	ʃɔʕfɑːt̙	‘Shu’fat’ (name of town)
7.	qɛsaɾ	kɛsər	‘(he) broke (something)’
8.	ʃʊʔb̥aːʡ	ʃʊbːæːk	‘window’
9.	ʃɔɾəb̥ə	ʃɔrəbə	‘soup’
10.	ʃaq	ʃadː	‘(he) pulled’
11.	b̥əʃqiɾ	bəʃkiːr	‘towel’
12.	ħəʃiʃ	ħəʃiːʃ	‘grass’
13.	b̥ɔɾʃa	bɔrʃɑːr	‘popcorn’
14.	b̥ab̥	b̙ɑb̙ə	‘daddy’
15.	ʃɛƙɪl	ʃeːkɪl	‘shekel’
16.	b̥ɪd̥ːi	bɪdːi	‘(I) want’
	b̥ɪd̥̚		
17.	ʃa	ʃaʕər	‘hair’

The first question of this paper concerned the general characteristics of the Arabic children’s speech in the recorded samples. The characteristics which are as reported in previous studies, as cited in the Introduction, are hypernasality, nasal emission, weak expiratory air (identified based on very quiet voice and apparent low energy in producing words), weak pressure consonants, glottal replacement, and backing. Glottal replacement was observed only for stops, not for fricatives or affricates as reported by Trost-Cardamone (1997). Backing was observed for stops and fricative /s/, not for other fricatives or affricates as reported by Trost-Cardamone. (It was also observed for nasal /n/ in the Hanin sample.) These discrepancies could be due to the imbalance and small size of the present dataset. Postvelar /q χ ʁ ħ ʕ h ʔ/ were matched by the subjects, as expected, since those consonants’ constrictions are below the velum. Characteristics which, to my knowledge, are so far unreported are implosive airstream, oral stop devoicing, and labiodental stop [p̪] for target /f/. On the biomechanical bases of the first, it could be that implosives yield effective valving, sacrificing airstream mechanism for match of all other properties. However, Keller (1993) reports free variation between [ʔ͡d] and [ɗ] in normal adult Brao (a language of Laos and Cambodia). This suggests the subjects' implosive [ƙ]s could be intended glottal reinforcement of [k] ([ʔ͡k]) with the implosive airstream an aerodynamic coincidence, as start of voicing with such simultaneous constrictions can require implosive airstrem (Jansen 2000). The [ƙ]s occurred in [bəʃƙir] for target [bəʃkiːr] 'towel' and [ʃɛƙɪl] for target [ʃeːkɪl] 'shekel'. A glottal reinforcement explanation is plausible if the subjects' /k/s were implemented with -VOT. The bases for the two other new observations could be: as voiceless consonants have higher intraoral pressure than voiced ones (Warren 1997), devoicing increases intraoral pressure to counteract velopharyngeal leak; given the weakening of pressure consonants, a labiodental stop, with at least weak burst, is more perceptually salient than a labiodental fricative.

As for the second question, compensatory pharyngeal stop [ʡ] occurred for one of the children, compensatory glottal stops for two. The expectation was that such compensatory articulations do not occur in Arabic cleft speech, to avoid phonetic neutralization of phonemic contrast. Note that stop [ʡ] is distinct in manner from Arabic voiced /ʕ/, which is fricative/approximant,[4] so no neutralization results from [ʡ]. However, this seems to be incidental, as the different manner of [ʡ] seems to reflect instead retention of stop manner of the target segment it replaces (/k/) and only incidental preservation of the distinctness of Arabic /ʕ/. In fact, phonetic neutralisation is rampant in the speech samples. This is seen from a look at the stop consonants, facilitated by Tables 2-4. Table 2 presents the stop consonants of normal adult Arabic, Table 3 the stop consonants produced by the three children, Table 4 the full consonantal inventory of adult Arabic.

Table 2. Arabic stops

bilabial	labiodental	interdental	alveolar	postalveolar	palatal	velar	uvular	pharyngeal	glottal
			t t̙			k	q		ʔ
b			d d̙						

[4]Pharyngeal ʕ has been clarified as phonetically epiglottal, not pharyngeal, by Esling (1996). That study found that the constriction at which manner of articulation is effected for ʕ is at the aryepiglottic sphincter, not higher up in the pharynx. As this clarification applies to pharyngeals in general, both ʕ and ʡ are phonetically epiglottal.

Table 3. Stops in the speech samples of the Arabic children with cleft palate

bilabial	labiodental	interdental	alveolar	postalveolar	palatal	velar	uvular	pharyngeal	glottal
	p̪		t		c	k ƙ	q	ʡ	ʔ
b̥ b			d̥ d						

Table 4. Arabic consonants - Palestinian colloquial (see Shahin 2000)
(Interdental ð ð̙ instead of ð ð̙ and additional postalveolar tʃ also occur, in a subset of dialects.)

bilabial	labiodental	interdental	alveolar	postalveolar	palatal	velar	uvular	pharyngeal	glottal
			t t̙			k	q		ʔ
b b̙			d d̙						
			r						
				dʒ					
f		θ	s s̙	ʃ			χ	ħ	h
			z				ʁ	ʕ	
m m̙			n						
			l l̙						
w					j				

Together, Tables 1-4 show that the cleft palate children's stops include segment innovations that are phoneme-specific replacements, e.g., [b̥] for /b/, [p̪] for /f/, [d̥] and [c] for /d/, [ʡ] and [ƙ] for /k/ (emphatic consonants ignored). However, [q] merged /t̙ k q/ for Hanin, /t̙ q/ for Odai, /d k q/ for Mohammad; [ʔ] merged /b t d k ʔ/ for Odai, /b t̙ ʔ/ for Mohammad. The abundant neutralization resulting from the backed (uvular and pharyngeal) and glottal replacements seems to indicate that the children's productions were insensitive to the phonemics of the language. This is consistent with the conclusion of previous studies that the characteristics of cleft speech stem from the nature of the organic condition and are largely universal.

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