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Acquisition of Greek phonology: an overview

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THE QUEEN'S
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Acquisition of Greek phonology: an overview

Ineke Mennen & Areti Okalidou

1. Overview

Modern Greek (henceforth Greek) is the descendent of Ancient Greek. It is spoken by most inhabitants of Greece (approximately 11 million speakers) and is the official language of Greece. The linguistic situation in Greece has been characterized by diglossia from the middle of the 19th century until 1976. The two varieties of Greek diglossia are called *Katharevousa* and *Dhimotiki*. *Katharevousa* was created during the early 19th century and was the midpoint between Ancient and Modern Greek. It had many archaized forms of modern words and an archaic grammar. *Dhimotiki* was the variety spoken by Greeks in their daily lives and it became the official language in 1976 when *Katharevousa* was officially abolished. However, remnants of *Katharevousa* have remained in the Greek language, particularly in its written form.

2. Countries where Greek is spoken

Greek is mainly spoken in Greece and Cyprus (see also below). It is also spoken in some parts of Italy – Southern, east of Reggio; Salento (Colimera, Sternatía, Zollino) and Aspromonte (Bova, Condofuri, Palizzi, Roccoforte, Roghudi – where dialects of Greek (Salento, Aspromonte) are spoken. It is also spoken in Albania (Southern part), Egypt (Alexandria), Romania, Bulgaria (Sarakatsanika), southern Syria (Hamidyé), Lebanon (Tripoli), Turkey (Istanbul city), and in the Ukraine (around Marioupolis – also called Zdanov – and in the Zaporozye district). In addition, it is spoken in Greek immigrant communities in North America (about 1.1 million Americans are of Greek origin), Canada and Australia.

3. Components of Greek

3.1. Consonants

Greek has 31 consonants including allophones and affricates and is most closely related to Ancient Greek (see Table 1). The voiceless plosives [p, t, k] are unaspirated, the voiced plosives [b, d, g] are fully prevoiced and sometimes prenasalized [^mb, ⁿd, ^ŋg] in formal speech depending on personal speaking style and dialect (Arvaniti & Joseph, 2000; Botinis, Fourakis, & Prinou, 2000). The following allophones (bracketed in table 1) appear in Greek: [ç, ʝ, ç̣, ʝ̣] occur as palatal allophones of /k, g, x, ɣ/ before the front vowels /i/ and /e/, as in χέρι, κάγγελο, χιόνι and γιαγιά the Greek words for ‘hand’ [ˈçeri]; ‘fence’ [ˈkɛʝelo], ‘snow’ [ˈçoni], and ‘granny’ [jæˈja]

respectively; /k/ and /ŋ/ occur as palatal allophones of /l/ and n/ before a sequence of /i/ and another vowel *within* a single syllable, as in λιοντάρι and μπάνιο the Greek words for ‘lion’ [kʰoˈdɛri] and ‘bath’ [ˈbɛno]; /m, ŋ/ occur as allophones of the nasals /m, n/ which adopt the place of articulation of following fricatives, as in αμφιθέατρο and άγχος the Greek words for ‘amphitheatre’ [ɛmfithɛɛtro], and ‘stress’ [ˈɛŋ.xos]; and finally [ᵐb, ᵐd, ᵐg] sometimes occur as allophones of /b, d, g/, as in αμπέλι, πάντα or αγγούρι the Greek words for ‘vineyard’ [ɛᵐbɛli], ‘always’ [ˈpɛᵐdɛ], or ‘cucumber’ [ɛᵐguri]. The use of prenasalization appears to be in decline, however, as it was found that younger Athenian speakers produce them only rarely (Arvaniti & Joseph, 2000).

Table 1. Consonants produced in Greek

	Bilabial	Labio-dental	Dental	Alveolar	Post alv	Retroflex	Palatal	Velar	Uvular	Phar	Glottal
Plosive	p b (ᵐp) (ᵐb)		t d				(ç) (j)	k g (ᵑg)			
Nasal	m	(ŋ)	n				(ɲ)	(ŋ)			
Trill											
Tap or flap				r							
Fricative		f v	θ ð	s z			(ç) (j)	x ɣ			
Lateral fricative											
Affric				ts dz							
Approx											
Lateral approx				l			(ç)				

Black = articulations judged impossible

Based on the International Phonetic Alphabet.

Acknowledgement is made to the International Phonetic Association (c/o Department of Linguistics, University of Victoria, Victoria, British Columbia, Canada).

Nicolaidis (1994; 2003) has documented the maximum point of contact for repeated productions of lingual consonants by Greek adults using EPG. The following frames (figure 1) were selected as representative ones from the above compilation of EPG studies.

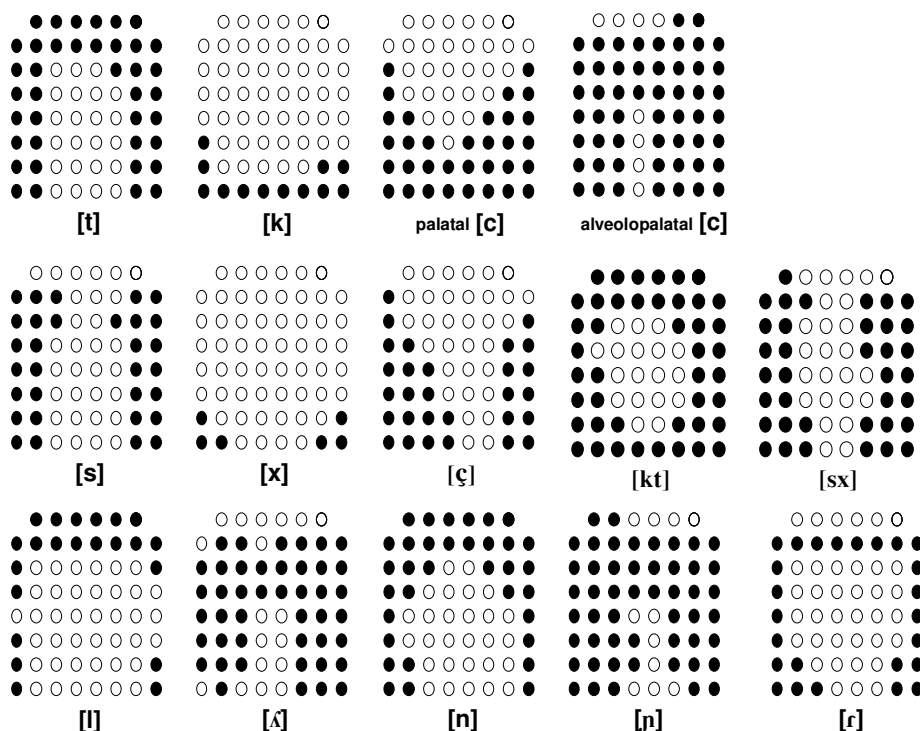
3.2. Vowels and diphthongs

Greek has five vowels /i, ε, ɐ, o, u/ (Jongman, Fourakis, & Sereno, 1989). Unstressed /i/ and /u/ may be devoiced or elided in casual speech (Dauer, 1980). Furthermore, vowel sequences can sometimes be pronounced as a short diphthong (Arvaniti, 1999a). Examples of such short diphthongs are κλαίει, σκιουράκι and φράουλα the Greek word for ‘cries’ (second person singular) [ˈklɛi], ‘little squirrel’ [skjuˈrɛki], and ‘strawberry’ [ˈfɾɛulɛ].

Table 2. Vowels produced in Greek

	Front	Central	Back
Close	i		u
Close-mid			o
Open-mid	ε		
Open		ɐ	

Figure 1. Collated maximum point of contact frames for production of lingual consonants by Greek adults.



3.3. Phonotactic restrictions

3.3.1. Syllables

The syllable structure of Greek can be described in the formula $C_{(0-3)}VC_{(0-1)}$. Greek, however, has a tendency to have open syllables (Holton et al., 1998), and most words tend to be bi-syllabic or multi-syllabic (Setatos, 1974). The vowel /i/ is realized differently depending on its position in the syllable. When /i/ is followed by another vowel *within* the same syllable, the /i/ is pronounced as a voiced (after voiced consonants) or voiceless (after voiceless consonants) palatal fricative, so that the underlying /i/ in κλειδιά the Greek word for ‘keys’ /kli.ˈði̯ə/ becomes [kli.ˈðj̥ə] and the underlying /i/ in αφτιά the Greek word for ‘ears’ /ə.ˈfti̯ə/ becomes [ə.ˈft̪̥ə] (e.g., Charalambopoulos, Alvanoudi, Didaskalou, Lambropoulou, & Poulli, 2003). Finally, the /i/ in /m/+i/+vowel sequences forming one syllable is pronounced as /ɲ/, as in μυαλό the Greek word for ‘mind’ [mɲə.ˈlo] (e.g., Arvaniti, 1999a).

3.3.2. Consonants and consonant clusters

Any consonant can occur in syllable-initial position. Consonants in syllable-final word-final position are restricted to /s/ and /n/, except in loan-words (Setatos, 1974) or in remnant words from Katharevousa (Holton et al., 1998) where other final consonants (or clusters) can occur. As a result, many Greek words end in a vowel. Consonants that occur in syllable-final word-within position are mainly /r/, /l/ and /n/

(PAL, 1995). For example, the final /n/ of proclitics (such as articles, weak forms of pronouns, negative particles) is elided before all consonants (except plosives or vowels), so that ‘the skirt’ (feminine accusative) /tin 'fustə/ becomes [ti 'fustə]. Word-initial voiceless plosives become voiced after a proclitic that ends in /n/, and the /n/ may assimilate for place of articulation to the following plosive, so that ‘the father’ (masculine accusative) /ton pə'tɛrɑ/ becomes tom pə'tɛrɑ/. Word-final /s/ becomes voiced when it is followed by a word-initial voiced consonant (as long as the two words are in the same intonational phrase), so that ‘the dog barks’ /o 'skilos γə'vyizi/ becomes [o 'skiloz γə'vyizi]. The reader is referred to Arvaniti (1999a) for an overview.

Setatos (1974) recognizes as many as 65 clusters in syllable-initial and word-initial position. Clusters can appear in word-initial and word-medial position, but are not allowed in word-final position (except in borrowings from Katharevousa and some loanwords). Table 3 contains the most common Greek clusters in syllable-initial position. Homorganic sequences are not permissible in Greek (Malikouti-Drachman, 1984), and there is a tendency to convert a sequence of two voiceless fricatives or stops into a fricative plus stop sequence (Newton, 1972; Holton et al., 1998). In /s/-clusters, the /s/ assimilates to the following consonant and becomes voiced before a voiced consonant, as in σβήνω the Greek word for ‘erase’ /'zvino/. There are also many hetero-syllabic clusters in Greek which can consist of up to four consonant phonemes (Setatos, 1974), such as in εκστρατεία the Greek word for ‘crusade’ [ɛkstrə'tiə].

Table 3. Consonant clusters in syllable-initial position in the word

Syllable-initial		Example	Example	Syll.-initial	Example	Example
/p, b, k, f, v, θ, x, γ/	+ /l/	‘book’	[vi'vlio]	/z/ + /m, γ/	‘curly’	[zɣu'rɛ]
/p, b, t, d, k, g, f, v, θ, ð, x, γ/	+ /r/	‘train’	[t'reno]	/tm/	‘depart- ment’	[t'mimɛ]
/p, k, m, x, γ/	+ /n/	‘opinion’	[ɣ'nomi]	/skn/	‘midge’	[s'knipɛ]
/p, k, f, x/	+ /t/	‘money’	[le'ftɛ]	/sc/	‘dog’	[s'cilos]
/p, k/	+ /s/	‘fish’, ‘wood’	[psɛ'ri], [ksilo]	/pç/	‘duck’	[pɛpçɛ]
/s/ + /p, t, k, f, x/		‘house’	[s'piti]	/bj/	‘buttons’	[ku'bɟɛ]
/s/ + /p, k/ + /l/		‘hard’	[skli'ros]	/tç/, /fç/	‘eyes’	[mɛtçɛ]
/s/ + /p, t, f/ + /r/		‘eraser’	[ksistrɛ]	/ðj/	‘apron’	[po'ðɟɛ]

3.4. Tones

Greek does not use tones to differentiate meaning.

3.5. Stress and intonation

Greek is a syllable-timed language (Dauer, 1980; Arvaniti, 1994) and its rhythmic characteristics are very similar to those reported for Italian (Arvaniti, 1994). Main stress falls on one of the last three syllables of a word, and stress placement is mostly determined by morphology. Secondary stress only occurs when words with stress on

the antepenult (or penult) are followed by one (or two) enclitic(s) and the additional stress is placed on the penultimate syllable of the word+enclitic group. An enclitic is an unstressed word that is incapable of standing on its own and is phonologically joined at the end of a preceding word to form a single unit. An example of a word with stress on the antepenult is *δάχτυλο* the Greek word for *finger* ['ðɛxtilo], which when an enclitic such as *my* [mu] is added receives additional stress, as in *my finger* [ɪðɛxti'lomu]. There are several minimal pairs where stress is the only difference between words, for example in *κύμα* and *κιμά* the Greek words for 'wave' ['kimə] and 'minced meat' (accusative case) [ki'mɐ], or *πόδια* and *ποδιά* 'legs' ['poðjɐ] and 'apron' [po'ðjɐ] (Arvaniti, 1999a).

Greek has 5 pitch accents:

- ◆ L*+H (rise from low from the accented syllable to high after the accented syllable; frequently used in nuclear position in calls, imperatives, negative declaratives and wh-questions),
- ◆ L+H* (rise from low to the accented syllable, which is high; often used to signal narrow focus),
- ◆ H* (high level from the accented syllable; often used as the nucleus in broad focus declaratives),
- ◆ H*+L (a fall from high pitch in the accented syllable, indicating a more nonchalant attitude on the part of the speaker than H*) and
- ◆ L* (low level from the accented syllable; it appears as the nuclear accent before a continuation rise, in yes-no questions, and in suspicious calls).

The most common of these is the L*+H pitch accent. The pitch accents can be combined with three types of phrase accents and three types of boundary tones to form intonation contours (Arvaniti & Baltazani, 2005). The same authors have developed a transcription system for Greek intonation called GRTToBI (Greek Tones and Break Indices), which can be found on the internet (see Appendix A). For further readings on Greek intonation see Botinis (1989), Mennen & den Os (1993), and Mennen (1999, 2004).

3.6. Writing system

Greek is written in the Greek alphabet, which developed in classical times (ca. 9th century B.C.). The Greek alphabet has 24 letters as well as an accent mark to indicate stressed vowels in bi-syllabic or multi-syllabic words and to disambiguate meaning among homorganic monosyllabic words (Holton et al., 1998). Greek spelling is fairly transparent, as in Greek orthography most letters consistently represent the same sound. However, the same sound can be represented by different letters or pairs of letters. For example, there are 5 different spellings for the sound [i], 2 different spellings for the sound [o], and 2 different spellings for the sound [s]. This should make spelling more difficult than reading.

4. Varieties of Greek

There is consensus (Kontos, 1997; Newton, 1972) that northern dialects are distinguished from southern dialects of Greek, with the exception of the two major cities (Athens and Thessaloniki), which hardly differ from one another with respect to their phonological features (Newton, 1972). In particular, northern varieties tend to drop unstressed high vowels /i/ and /u/, and to raise the unstressed mid vowels /ɔ/, /ɛ/ to high vowels /i/, /u/ respectively. In southern varieties there is a strong tendency for fronting before the front vowels /i/ and /ɛ/ or before a glide, so that /k/, /x/, /ɣ/ are produced as /c/, /ʃ/ /z/ or sometimes they are produced further forward to become /tʃ/, /s/, /z/ in some dialects.

4.1. Cypriot-Greek dialect

Cypriot-Greek (CYG) is a southeastern dialect of Greek and it is spoken on the island of Cyprus. Cypriot-Greek is considered a closer variety to ancient Greek and therefore bears several phonological, lexical and syntactic differences as compared to Greek (Petinou & Terzi, 2002). The phonological phenomena of the CYG dialect are similar to the ones described above for the south-eastern dialect. Note that as in Greek, velar plosives, velar fricatives as well as the glide [l] have palatalized variants when preceding a front high vowel. In sum, the special phonetic characteristics of CYG include:

- ◆ All sonorants and voiceless obstruents can geminate in word-initial and word-medial positions (Arvaniti, 1999b; Charalambopoulos, 1982; Tserdanelis & Arvaniti, 2001).
- ◆ Consistently prenasalized voiced plosives (Arvaniti, 1999b)
- ◆ Both aspirated and unaspirated plosives (Arvaniti, 1999b)
- ◆ Post-alveolar sibilants: voiced /z/ and unvoiced /ʃ/ (Newton, 1972)
- ◆ Palato-alveolar affricates: voiced /dʒ/ and unvoiced /tʃ/ (Newton, 1972)
- ◆ Five vowels is /i, ε, ϐ, ɔ, u/. The back mid vowel /ɔ/ is more open than the Greek one, and the /u/ is slightly more peripheral (Arvaniti, 1999b).

5. Typical acquisition of Greek

Appendix B contains a summary of studies of the acquisition of Greek.

5.1. Acquired sounds

5.1.1. Consonants

Table 4 contains age of acquisition data for Greek from studies by Magoula (2000), PAL (1995), Papadopoulou (2000), and Thomadaki and Magoula (1998), all of which used the criterion of 75% (Papadopoulou 2000 also used the 90% criterion) correct production in word-initial, -medial, and -final positions. It should be noted that voicing distinctions are acquired by 2;6-3;0 years old (Magoula, 2000; Okalidou, Petinou, Theodorou, & Karasimou, 2002). Interestingly, palatal allophones /k/, /ɲ/ attain proper use (that is, as allophonic variations at certain contexts) only after the alveolar

consonants /l/ and /n/ are acquired even though /k/ and /ŋ/ appear earlier in children's phonetic repertoire (Magoula, 2000). Also note, that for some consonants the reported ages of acquisition differ between the different studies, most notably for the phonemes of /n/, /d/, /l/, /ts/, /v/, /k/ and /ŋ/. This may be due to the differences in sample size and/or sample task.

Table 4. Age of acquisition for Greek consonants

Consonant	Magoula (2000)	Thomadaki & Magoula (1998)	PAL (1995)	Papadopoulou (2000)	Papadopoulou (2000)
Criterion	75% criterion	75% criterion	75% criterion	75% criterion	90% criterion
p	1;9-2;2	-	2;6-3;0	3;7-4;0	3;7-4;0
b	2;1-2;2	-	2;6-3;0	3;7-4;0	3;7-4;0
m	1;6-1;8	-	2;6-3;0	3;7-4;0	3;7-4;0
n	1;6-1;8	-	3;0-3;6	3;7-4;0	3;7-4;0
^ŋ g	-	-	-	* (4;6)	* (4;6)
j	NA	NA	NA	NA	NA
t	1;5-2;0	-	2;6-3;0	3;7-4;0	3;7-4;0
d	1;6-2;2	-	3;0-3;6	3;7-4;0	3;7-4;0
k	-	-	2;6-3;0	3;7-4;0	3;7-4;0
g	-	-	2;6-3;0	3;7-4;0	3;7-4;0
x	-	-	3;0-3;6	3;7-4;0	3;7-4;0
f	-	-	3;6-4;0	3;7-4;0	3;7-4;0
l	1;6-1;11	-	3;6-4;0	3;7-4;0	3;7-4;0
ʒ	NA	NA	NA	NA	NA
ʃ	NA	NA	NA	NA	NA
ts	-	-	4;6-5;0	3;7-4;0	4;1-4;6
dz	-	-	4;6-5;0	4;1-4;6	* (4;6)
s	-	-	3;6-4;0	3;7-4;0	* (4;6)
z	-	-	3;6-4;0	3;7-4;0	* (4;6)
r	-	-	5;6-6;0	* (4;6)	* (4;6)
v	2;1-2;6	-	3;0-3;6	3;7-4;0	3;7-4;0
ð	-	-	4;0-4;6	3;7-4;0	4;1-4;6
θ	-	-	4;0-4;6	3;7-4;0	* (4;6)
c	-	-	2;6-3;0	3;7-4;0	* (4;6)
ʝ	-	-	2;6-3;0	4;1-4;6	* (4;6)
ç	-	-	3;0-3;6	4;1-4;6	4;1-4;6
ʝ	-	-	3;0-3;6	3;7-4;0	3;7-4;0
ʎ	-	2;6	4;0-4;6	4;1-4;6	4;1-4;6
ŋ	-	2;6	2;6-3;0	3;7-4;0	3;7-4;0

* = Sound was not acquired at age in brackets

- = Sound was not tested

NA = Not applicable, i.e. sound does not occur in Greek

5.1.2. Consonant clusters

Table 5 contains age of acquisition data for consonant cluster acquisition from studies by PAL (1995) and Papadopoulou (2000). Both studies used the criterion of 75% correct production regardless of position in the word. Due to the high number of clusters in Greek, both studies only tested a restricted number of them. The most active period of cluster acquisition was between 3;6 and 4;6, when most of the two element clusters with /s/, the clusters consisting of plosive/fricative + /l/, most of the nasal clusters, and clusters with /r/ were acquired. Interestingly, PAL observed that children often acquire two-element clusters with /r/ before they have acquired /r/ as a singleton. This finding was corroborated by Papadopoulou (2000). Cluster acquisition was not complete by the age of 6;0 when most 3-element clusters and clusters with palatal fricatives have not been acquired yet. Tzakosta (2001) – not represented in the table – reported a longitudinal case study on the development of consonant clusters in a 2;1-2;9 year old boy. At age 2;9, the acquired clusters consisted of less marked consonant elements in both word-initial and word-medial positions. Three element consonant clusters were reduced to two element consonant clusters. Some easy consonant clusters were /ft/, /vɣ/, /fç/, /vl/, /ðj/, /xt/, /ɣm/. In case of multisyllabic words containing more than one cluster, the child first begun to retain the one which occurred word-medially unless the word-initial cluster had fewer consonants. Also, clusters were retained more easily in stressed than unstressed syllables.

Table 5. Age of acquisition for Greek consonant clusters

Consonant cluster	PAL (2000)	Papadopoulou (2000)	Consonant cluster	PAL (1995)	Papadopoulou (2000)
sp	3;6-4;0	-	fr	-	4;1-4;6
st	4;0-4;6	-	vr	4;6-5;0	4;1-4;6
sk	4;0-4;6	-	ɣr	5;0-5;6	* (4;6)
sc	4;0-4;6	3;7-4;0	θr	5;6-6;0	* (4;6)
sf	4;6-5;0	4;1-4;6	ðr	5;6-6;0	* (4;6)
sx	* (6;0)	4;1-4;6	pç	3;6-4;0	-
pl	3;6-4;0	3;7-4;0	bj	* (6;0)	-
kl	3;6-4;0	3;7-4;0	tç	* (6;0)	-
fl	4;0-4;6	3;7-4;0	ðj	4;0-4;6	-
vl	3;6-4;0	3;7-4;0	zm	4;0-4;6	-
yl	5;0-5;6	4;1-4;6	zy	4;6-5;0	-
ft	4;6-5;0	3;7-4;0	pn	3;6-4;0	-
st	-	3;7-4;0	kn	3;6-4;0	-
xt	4;0-4;6	3;7-4;0	mn	4;0-4;6	-
ps	4;0-4;6	4;1-4;6	xn	4;6-5;0	4;1-4;6
ks	4;0-4;6	4;1-4;6	vɣ	3;6-4;0	3;7-4;0
pr	-	4;1-4;6	spr	-	* (4;6)
br	-	4;1-4;6	str	5;0-5;6	* (4;6)
tr	4;0-4;6	* (4;6)	sfr	-	* (4;6)
dr	4;6-5;0	* (4;6)	xtr	5;6-6;0	-

kr	4;0-4;6	4;1-4;6	ftç	*(6;0)	-
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* = Sound was not acquired at age in brackets

- = Sound was not tested

5.1.3. Vowels

Papadopoulou (2000) found that by the age of 4;0, 90% of children had acquired all five Greek vowels.

5.2. Percent correct

To date there are no studies of percentage of consonants, consonant clusters or vowels produced correctly.

5.3. Phonological processes

Magoula (2000) reported the following processes between 1;6 and 2;0 years of age: reduplication, consonant harmony, final consonant deletion and cluster reduction. PAL (1995) reports the following processes. Between 2;6 and 3;0 years of age cluster reduction, consonant deletion, final consonant deletion, consonant harmony, metathesis/migration, fronting, backing and stopping were common. Between 3;0 and 3;6 consonant deletion, fronting, and backing were declining and between 3;6 and 4;0 consonant harmony, and stopping were declining and some clusters were appearing (except /r/ clusters). Between 4;0 and 5;0 syllable reduction, metathesis/migration, and final consonant deletion were declining, and /r/ clusters were appearing. Between 5;0 and 5;6 three-element clusters were appearing. Between 5;6 and 6;0 all 3-element clusters except /ftç/ were acquired in syllable initial word initial position.

With respect to the process of consonant harmony, partly different findings were obtained by another study (Papadopoulou, 2000) which found that it was still present in 83% of children between 3;7 and 4;0, and in 63% of children between 4;1 and 4;6.

5.4. Intelligibility

To date there is no study of intelligibility of Greek-speaking children.

5.5. Phonetic inventory

Table 6 shows the phonetic inventory of Greek children from the ages of 1;5 to 2;6 (Magoula, 2000) and 3;7 to 4;6 (Papadopoulou, 2000), presenting sounds which were produced by at least 75% of the children in the sample. The highlighted sounds represent the newly acquired sounds at each age level. In general, it appears that the first sounds produced by Greek children are plosives, nasals and glides at bilabial and alveolar places of articulation. Then, velar plosives, their palatal allophones and labiodental fricatives are produced which subsequently are followed by dental fricatives and the liquid /r/. By the age of 4;6 the majority of sounds have emerged, with the exception of [j].

Table 6. Phonetic inventory of Greek children (Magoula, 2000; Papadopoulou, 2000)

Ages 1;5-1;8	Ages 1;9-2;0	Ages 2;1-2;2	Ages 2;3-2;6	Ages 3;7-4;0	Ages 4;1-4;6
p, d, t m, n, l, j	p, d, t m, n, l, j b, k, c, v	p, d, t m, n, l, j b, k, c, v f	p, d, t m, n, l, j b, k, c, v f, ð, ɹ	p, d, t m, n, l b, k, c, v f, ð, ɹ, g θ, s, z, ç, x, ɣ, ɲ, ʎ, ts	p, d, t m, n, l b, k, c, v f, ð, ɹ, g θ, s, z, ç, x, ɣ, ɲ, ʎ, ts dz

Key. The highlighted sounds represent the newly acquired sounds at each age level.

5.6. Common mismatches

During 1;6-2;0 years of age Magoula (2000) indicates that /j/ acts as a “default”, substituting a variety of other consonants. Later on, during 3;7-4;6 years of age, Papadopoulou (2000) reports on some other common mismatches. Greek children frequently substituted /r/ with [l]. This particular mismatch is also frequently observed in Italian, Hindi, Igbo, Portuguese, Quiche and Spanish speaking children (Bortoloni & Leonard, 1991). Another common mismatch was the substitution of /j/ by [g]. The affricates /ts/ and /dz/ were mainly substituted by the alveolar fricatives /s/ and /z/ respectively. Substitutions of fricatives were common, /s/ was mostly substituted by [ʃ], /z/ mostly by [ʒ], by /s/ and /ð/ by [z]. Finally, the lateral approximant /ʎ/ was mostly substituted by [j].

5.7. Syllable structure

A few studies have investigated the development of syllable structure in Greek (e.g., Kappa 2002; Tzakosta, 2005). Kappa (2002) reported a case study of a girl aging from 1;7;-3;0 years old. Her first word productions attempted to preserve a minimum prosodic form of words and were usually bisyllabic (CVCV) but often also trisyllabic with reduplicated syllables. She used exclusively open syllables (CV) with simple consonant onsets and avoided onsetless syllables (V) either by inserting an initial consonant (CVCV) or by deleting the onsetless syllable. For words containing clusters she simplified her output by retaining the less sonorous element. Syllable reductions in multi-syllabic words were made by preserving the trochaic two-syllable pattern (first syllable stressed and a final unstressed syllable). However, Tzakosta (2005) provided evidence that despite the multisyllabic nature of Greek, children aged from 1;7-3;6 years old also produce monosyllabic truncations with 0.4%-16.8% occurrence.

5.8. Prosody

To date there is no study of Greek children’s prosody.

5.9. Phonological awareness

Longitudinal studies by Porpodas and colleagues provided evidence for the significance of syllable and phoneme awareness in Greek literacy acquisition (e.g., Porpodas, 1993). Generally, it is affirmed that, in contrast with English, a substantial

degree of phonological awareness is gained as early as 7 years and accounts posit the orthographic transparency of the Greek language (e.g., Nikolopoulos & Goulandris, 2000). Aidinis and Nunes (2001) have shown that syllable awareness precedes phoneme awareness with performance in both tasks varying as a function of word length, stress and position for ages 5;2-5;11, 6;1-6;11 and 7;1-7;11. Indicatively, syllable awareness at initial position was 73% for 5 year olds, 92% for 6 year olds and 100% for 7 year olds. Consonants yielded better results than vowels. Nikolopoulos, Goulandris, & Snowling (2003) demonstrated that performance for 7 year olds (grade 2) decays for more cognitively elaborate tasks such as phoneme counting (87%), phoneme substitution (80%) consonant segmentation (65%) and spoonerisms (48%).²

6. Speech assessment for Greek children

To date the only available test for speech assessment is the *Assessment of Phonetic and Phonological Development* (PAL, 1995), which is an adaptation of Grunwell's (1985) *Phonological Assessment of Child Speech* (PACS). However, SLTs in Greece also use informal/home made single word tests and conversational speech sampling during assessment. No studies have so far documented professional practices on speech assessment. Also, there are no additional speech sampling tools that have been developed for use with Greek children. However, some standardized tests contain sections for speech (PAL, 2005; Paraskevopoulos Kalatzi-Azizi, & Giannitsas, 1999). Moreover, development of a computerized speech therapy tool, *Optical-Logo-Therapy*, is in progress by the Institute of Language and Speech Processing (ILSP) (Hatzis, Green, & Howard, 1997).

7. Speech intervention for Greek children

No studies have so far investigated the speech intervention practices in Greece. However, some commonly used intervention approaches are:

- ◆ Traditional articulation therapy (Van Riper & Erickson, 1996)
- ◆ Minimal pair therapy (Weiner, 1981)
- ◆ Core vocabulary (Bradford & Dodd, 1997)

8. References

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Appendix A. Resources about Greek especially useful for SLTs

1. Books

- ◆ Botinis, A. (1989). *Stress and prosodic structure in Greek*. Lund: Lund University Press.
- ◆ Holton, D. Mackridge, P. & Philippaki-Warbuton, I. (1997). *Greek: A comprehensive grammar of the modern language*. London: Routledge.
- ◆ Joseph, B. & Philippaki-Warbuton, I. (1986). *Modern Greek*. London: Croom Helm.

2. Journals

- ◆ *Glossologia*. www.leaderbooks.com/. Glossologia focuses on synchronic and diachronic studies of the Greek language (on any research domain: phonetics-phonology, morphology, syntax, semantics, pragmatics etc.).
- ◆ Epikoinonia (language, speech, voice). www.logopedists.gr. Epikoinonia is a clinical journal where professionals publish current information, ideas and research updates from international literature.

3. Professional association

The most established professional association of speech-language pathologists within Greece is the Panhellenic Association of Logopaedics. There is also a smaller organization of Special Educators-Logotherapists educated in Germany and an organization by graduates of the technological institutions of Greece.

4. Useful Greek Websites

GRTToBI (Greek Tones and Break Indices) <http://ling.ucsd.edu/~arvaniti/grtobi.html> for an overview of Greek intonation and how to transcribe it.

Πανελλήνιος Σύλλογος Λογοπεδικών (ΠΣΛ) <http://logopedists.gr> for an overview of speech pathology information

Pedagogical Institute of the Ministry of Education and Religious Affairs of Greece <http://pi-school.gr> for an overview of research and educational programs of the Institute of Education, Ministry of National Education and Religion.

Appendix B. Summary of studies of typical Greek speech acquisition

Authors	Year	Country	No. of children	Age of children	Information	Sample type	Data collection
Kappa	2003	Cretan	1	1;7-3;0	Development of syllables	Connected speech (spontaneous)	Longitudinal
Magoula	2000	Athenian Greek	4	1;6-2;6	Age of acquisition of consonants	Connected speech (spontaneous + single word)	Longitudinal
Okalidou Petinou, Theodorou, & Karasimou	2002	Standard Greek (northern and southern) and Cypriot Greek	12	2;0-4;0	Development of voicing	Elicited nonsense words	Cross-sectional
PAL	1995	Athenian Greek	300	2;6-6;0	Age of acquisition of consonants, clusters; phonological process analysis	Single word	Cross-sectional
Papadopoulou	2000	Katerini (northern Greece) Greek	34	3;7-4;6	Age of acquisition of consonants, vowels, clusters; phonological process analysis; error forms	Single word	Cross-sectional
Tzakosta	2005	Athenian Greek	11	1;7-3;0	Segmental selection in monosyllabic truncation forms	Connected speech (spontaneous)	Cross-sectional & Longitudinal
Tzakosta	2001	Cretan Greek	1	2;1-2;9	Consonant clusters	Connected speech (spontaneous)	Longitudinal