Empirical and Theoretical Approaches to Language Acquisition:

A Generative Perspective

Edited by

Merle Weicker, Rabea Lemmer, Andrea Listanti and Angela Grimm

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–The Editors

CHAPTER 8

ON THE REDUCTION OF NON-STRIDENT VOICED FRICATIVE PLATEAU CLUSTERS IN CHILD GREEK[1]

IOANNA KAPPA

Abstract

This study investigates the reduction of a unique group of target plateau clusters/sequences ([vð, ɣð, vɣ]) formed by non-strident voiced fricatives of equal sonority in the speech of nine typically developing Greek children at the intermediate developmental phase. We aim to identify the underlying factors driving this reduction to C_1 or C_2. We demonstrate that sonority, positional faithfulness, and contiguity are irrelevant to preserving either C_1 or C_2 of the plateau clusters. Instead, the preservation is driven by the Place of Articulation (PoA), following a relative hierarchy ranking of POA features within the children's grammar. This hierarchy dictates which consonant, C1 or C2, is preserved. The data reveals two grammars, i.e., two different developmental paths: A dominant grammar prioritizes preserving the consonant with a marked PoA, either DORSAL or LABIAL, according to the dominance relation in the relevant PoA hierarchy ranking DORSAL > LABIAL > CORONAL. The latter conforms to the *Preservation of the Marked* (de Lacy 2006, 146), where the marked features are favored for preservation over the less marked ones. A second grammar prioritizes preserving segments with marked and unmarked PoA, conforming to the

[1] We would like to thank the reviewers for their insightful comments and suggestions. Any remaining errors are ours.
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hierarchy ranking DORSAL > CORONAL > LABIAL. This ranking accounts for preserving the marked DORSAL segment alongside the unmarked CORONAL one. In both grammars, the undominated DORSAL PoA is always preserved.

1. Introduction

This study investigates the reduction (simplification) affecting the target (adult-like) sonority plateau clusters[2] composed of non-strident voiced FRICATIVES in the phonological acquisition of Greek children. The study focuses on the cross-linguistically unusual clusters /vð/, /ɣð/, /vɣ/ and the derived [vʝ] and [ðʝ] ones. We aim to elucidate the exhibited reduction pattern(s) and identify the underlying factors driving the target cluster reduction to C_1 or C_2.

CLUSTERS AND CODAS IN STANDARD MODERN GREEK (henceforth Greek). It follows a brief description of the realized (surface) C_1C_2 clusters (Table 8-1) and codas in Greek.

Table 8-1. Attested surface clusters[3] in Standard Modern Greek

OBSTRUENT$_1$ SONORANT$_2$	STOP$_1$ NASAL$_2$	pn, kn, tm, (tn: internally)
	STOP$_1$ LIQUID$_2$	pl, pɾ, kl, kɾ, tɾ (tl: internally), bl, bɾ, gl, gɾ, dɾ
	FRICATIVE$_1$NASAL$_2$	xn, θn, ɣn, zm, (fn, vn, xm, θm: internally)
	FRICATIVE$_1$LIQUID$_2$	fl, fɾ, vl, vɾ, xl, xɾ, ɣl, ɣɾ, θl, θɾ, ðɾ (*ðl)
OBSTRUENT$_1$ OBSTRUENT$_2$	s$_1$ STOP$_2$	sp, st, sk
	STOP$_1$ s$_2$	ks, ps
	s$_1$ / z$_1$ FRICATIVE$_2$	sf, sx, sθ, (zv, zɣ)[4]
	FRICATIVE$_1$ STOP$_2$	ft, xt

[2] In this study, the term '*cluster*' refers to sequences of rising sonority under a braching onset, appendix-onset of falling (reversed) sonority, and plateau sonority sequences.
[3] Homorganic clusters are prohibited word-initially in the Greek phonological system, e.g., [*tl, *dl, *tn, *pm, *fm, *vm,*sn, *sl, *sɾ, *zn, *zl, *zɾ] etc. (Kappa 1995).
[4] The underlying clusters /sv/ and /sɣ/ undergo voicing assimilation and are realized as [zv] and [zɣ], respectively, implying that they are heterosyllabic.

	STOP$_1$ STOP$_2$	pt, kt[5]
	FRIC$_1$ FRIC$_2$	fx, xθ, vɣ, vð, ɣð (fç, θç, vʝ, ðʝ : derived)[6]
NASAL$_1$ NASAL$_2$		mn

The well-formed tautosyllabic clusters under a branching Onset in Greek adhere to the phonotactic *Sonority Sequencing Principle* (SSP) (Selkirk 1982, 1984; Clements 1990, *a.o.*). SSP stipulates that within a syllable, sonority reaches its maximum at the syllable nucleus and progressively diminishes towards both syllable edges. The segments are hierarchically ranked on a sonority scale according to their sonority, and their ordering governs rise and fall. Universally, within the group of consonantal segments, OBSTRUENTS possess the lowest degree of sonority compared to NASALS, exhibiting lower sonority than LIQUIDS. VOWELS represent the most sonorous segmental class. Within OBSTRUENTS, STOPS are the least sonorous, followed by FRICATIVES.

In this study, we adopt the language-specific sonority scale (1) that was set up according to Greek phonotactics, using the features [voice] and [continuant] as parameters for consonant classification (Kappa 1995). Under the latter scale, the stridents /s, z/, and the non-strident FRICATIVES are not grouped as plateau clusters, unlike in English (e.g., Clements 1990) and Russian (e.g., Kistanova 2021).

[5] The [STOP$_1$STOP$_2$] plateau clusters [pt] and [kt] belong to the earlier conservative, higher/ (archaic) formal style of Greek called *Katharevusa* ('puristic' language). The conservative/higher style was a "hybrid made up of lexical, morphological, and syntactic features from Ancient and Modern Greek" (Holton et al. 2012, xxiii), and it was associated with the written language, law, education, administration, church and prestige (Arvaniti 2007 and references therein). In Greek, there are still words with the fossilized voiceless plateau clusters /pt/, /kt/ of Katharevusa in use, e.g., [eliˈkoptero] 'helicopter', [anaˈptiras] 'lighter (for cigarettes)', [peˈriptero] 'kiosk', [oˈkto] 'eight', which are mostly realized dissimilated in the colloquial language, e.g., [oˈkto] ~ [oˈxto] 'eight' (Holton et al. 2012, xxiii); the latter dissimilation implies their heterosyllabic status. Non-alternating forms, e.g., [ˈptisi] 'flight' are lexically marked (Malikouti-Drachman 2001).

[6] The plateau clusters [fç, θç, vʝ, ðʝ] arise from the underlying sequences /fiV/, /θiV/, /viV/, /ðiV/, respectively, through a sequential process of glide formation of an unstressed /i/ followed by glide strengthening (e.g., Holton et al. 2012, *a.o.*).

(1) Sonority scale for Standard Modern Greek[7] (Kappa, 1995)

Stops	<	Fricatives$_{[-voi]}$	<	Fricatives$_{[+voi]}$	< s < z	<	Nasals	<	Liquids
/p, t, k	<	f, θ, x	<	v, ð, ɣ	< s < z	<	m, n	<	l, ɾ /
	voiceless < voiced						(< = less sonorous than)		

In Greek, rising sonority Obstruent$_1$ Sonorant clusters with the significant sonority distance between C$_1$ and C$_2$ are the most well-formed under a branching onset. The [Stop$_1$ s$_2$], [ps], [ks], clusters of smaller sonority rise also occur in Greek as tautosyllabic.

Word-initial and word-internal [Obstruent$_1$ Obstruent$_2$] clusters must agree in voicing; the following clusters are of non-rising sonority, demonstrating the following SSP violations therefore, they are considered as heterosyllabic:

(a) [s$_1$ Stop$_2$/Fricative$_2$] and [Fricative$_1$Stop$_2$] clusters have falling (reversed) sonority according to the sonority scale in (1), i.e., C$_1$ is more sonorous than C$_2$; therefore, C$_1$ cannot be prosodically licensed under a branching syllable onset. C$_1$ is attached as an *adjunct/appendix* to the left edge of the syllable node or a higher-level node, (e.g., Steriade 1982; Clements 1990; among many others). In Greek, a language-specific constraint dictates that only a [+continuant] segment (Sibilant or LAbial/ Dorsal Fricative) may be attached as an (extrasyllabic) appendix, which must be more sonorous than the onset head (Drachman 1990). For a comprehensive discussion of the "appendix," refer to Vaux and Wolfe (2009).

(b) In clusters consisting of either two non-strident Fricatives ([Fricative$_1$Fricative$_2$]), i.e., the voiceless /fθ/, /xθ/ and the voiced /vð/, /ɣð/, /vɣ/, as well [vj], [ðj] or [Stop$_1$Stop$_2$], i.e., /pt/ and /kt/. In the latter clusters, C$_1$ and C$_2$ exhibit equivalent sonority, forming plateau clusters with a sonority distance of *zero.* The voiceless [Fricative$_1$Fricative$_2$] plateau clusters of higher (archaic) style, such as /fθ/ and /xθ/, are dissimilated to [Fricative$_1$Stop$_2$] [ft] and [xt], respectively, e.g., [fθiˈno] → [ftiˈno] 'cheap', [ˈxθes] → [ˈxtes]

[7] The sonority scale in (1) includes the consonantal phonemes of Greek. The voiced Stops [b, d, g] are not included as they are considered to be the phonetic realizations of the underlying sequences [Nasal Stop$_{voiceless}$], /Np/, /Nt/, /Nk/, respectively (e.g., Newton 1972; Malikouti and Drachman 1992; Pagoni 1993; Kappa 1995; Arvaniti 1999; *a.o.*). [b, d, g] are often variably realized as prenasalized voiced Stops or as [Nasal Stop$_{voiceless}$] (Arvaniti and Joseph 2000, *a.o.*), e.g., 'vineyard' may be realized as [a*b*eli]~ [a*^{m}b*eli] ~ [a*mp*eli].

'yesterday'. Similarly, the [$\text{S}\small{\text{TOP}}_1\text{S}\small{\text{TOP}}_2$] plateau clusters /pt/ and /kt/ are dissimilated to [ft] and [xt], respectively, e.g., [pteˈɾo] → [fteˈɾo] 'wing', [ˈktipos] → [ˈxtipos] 'beat'. In the non-strident voiced plateau [$\text{FRICATIVE}_1\text{FRICATIVE}_2$] clusters under investigation, C_1 does not satisfy the above in (a) language-specific condition due to the equal sonority between C_1 and C_2. Moreover, the latter clusters cannot be realized as dissimilated ones due to the restriction against [voiced FRICATIVE_1voiced STOP_2] clusters in the Greek phonological system.

Plateau clusters are attested in other languages too, e.g., in Georgian occur the voiceless [$\text{FRICATIVE}_1\text{FRICATIVE}_2$], e.g., [ʃx], [$\text{STOP}_1\text{STOP}_2$], e.g., [bg], [$\text{NASAL}_1\text{NASAL}_2$], e.g., [mn] (Crouch 2022, 44 and references therein), in Hebrew [$\text{STOP}_1\text{STOP}_2$], e.g., [kt], [pk], [gd] (e.g., Bloch 2011), in Russian [$\text{FRICATIVE}_1\text{FRICATIVE}_2$], e.g., [sf], [$\text{STOP}_1\text{STOP}_2$], e.g., [bd], [$\text{NASAL}_1$ NASAL_2], e.g., [mn] (Kistanova 2021, 2), to name a few. Baroni (2014) provides a typology of phonotactics for all types of plateau clusters attested in 39 languages belonging to different language families.

Finally, in (native) Greek, only /s/ and /n/ are allowed in the word-final coda position. LIQUIDS /l, ɾ/ are permitted in word-internal coda position, e.g., [ˈpoɾ.ta] 'door'. NASAL /n/ in the word-internal coda is assimilated to the place of articulation of the following consonant, e.g., [ˈan.θɾo.pos] 'human being', [ˈaŋ.xos] 'stress' [eɱ.ˈvo.lio] 'vaccine'. OBSTRUENTS may be assigned to internal-coda position in the case of a four consonant internal sequence, e.g., [af.ˈstɾi.a] 'Austria' or at morphological boundaries, e.g., [ek+stɾa.ˈti.a] 'campaign', [ef+stɾo.ˈfi.a] 'intelligence' (Kappa 1995).

Regarding the syllabification of sC and sC_1C_2 sequences in word-internal positions, the Greek phonotactics literature lacks a consensus. Specifically, there is no explicit agreement on whether [s] is syllabified as an appendix to the following onset or as a word-internal coda[8], e.g., [ˈa.stɾo] or [ˈas.tɾo] 'star', respectively (see Malikouti-Drachman 2001 for an overview). We argue that [s] in sC and sC_1C_2 clusters in Greek, FRIC_1 in [$\text{FRICATIVE}_1\text{STOP}_2$] and [$\text{FRICATIVE}_1\text{FRICATIVE}_2$] clusters and STOP_1 in [$\text{STOP}_1\text{STOP}_2$] clusters are word-initially appendices and word-internally either appendices or heterosyllabic coda-onset sequences as

[8] Our ongoing research has experimentally shown that both adult and children informants accept either of the two word-internal syllabifications. Similarly, in [$\text{FRIC}_1\text{STOP}_2$], e.g., [a.ˈfto] vs. [af.ˈto] 'this', and in non-strident voiced plateau [$\text{FRIC}_1\text{FRIC}_2$], e.g., [a.ˈvɣo] vs. [av.ˈɣo] 'egg' (Gatsou, Iliopoulou and Kappa in prep.).

Goad (2016) claims for the initial sC clusters as well as for the internal ones following Kaye (1992) (see also fn. 8).

The study is structured as follows: Section 2 presents the research methodology of data collection. In section 3, we briefly present the common traits in the grammars of all children participating in this study regarding the segments that are realized as single onsets vs. the non-realized ones and the common simplification patterns, both for CVC syllable structure and for the C_1C_2 clusters of rising and of reversed sonority. Section 4 focuses on the data presentation regarding the reduction of target plateau clusters containing non-strident voiced FRICATIVES. In section 5 follows the data analysis, and we conclude in section 6.

2. Research methodology – Data collection

We examine naturalistic data from nine typically developing monolingual Greek children acquiring Greek as their first language (L1) (age range 2;04.20–2;09.25, years;months.days, four boys (B) and five girls (G)). This study falls under the author's active research project, "Variation, input frequency and norms in the phonological development of Greek as a first language." The Research Ethics Committee of the University of Crete has approved the ethical aspects of the project's research protocol (approval no. 26/21.2.2022), and all participating children's parents/legal guardians have provided written informed consent. The developmental data were collected weekly, in sessions of 20–30 minutes for each child, and the children's speech was recorded at a sampling rate of 44.1 kHz. using a high-tech recorder and a professional microphone. The data were obtained from children's spontaneous conversational speech, naming familiar objects and describing specially chosen or designed pictures containing words with all prosodic structures, segments, and cluster types in stressed/unstressed syllables, word-initially/-internally. A trained linguist broadly transcribed the recorded audio speech samples utilizing the International Phonetic Alphabet (IPA), and the author or a doctoral student in Phonology revised the transcriptions.

3. Common traits in the children's grammar

All children participating in this study are in the intermediate developmental phase [9], i.e., segments with marked features, e.g., [+cont(inuant)] and CVC# syllabic structures have started to occur in their system, see below (I) and (II), respectively. These children exhibit the following common traits (I-V) in their typically developing grammar:

I. The STOPS [p, t, k, b, d, g] and the NASALS [m, n] are realized faithfully in the children's productions. The RHOTIC [ɾ] is not realized; therefore, it is either deleted or, most commonly, it is substituted by the LATERAL [l], e.g., the target word [neˈɾo] 'water' may be realized either as [neˈo] or, more frequently, as [neˈlo]. FRICATIVES, i.e., segments with a marked *Manner of Articulation* (MoA), such as the voiceless [f, θ, x, s] and the voiced [v, ð, ɣ, z], occur as single onsets in the children's outputs [10] in stressed/unstressed syllables in word-initial/-internal position.

II. The word-final coda [s] is sporadically realized, driven by morphological development (Kappa 2002b), in each child's grammar. This is due the acquisition of inflection, as /s/ is the inflectional marker for nominative singulars, e.g., of masculine nouns. Therefore, e.g., the word [ˈponos] 'pain- M.NOM.SG' is realized in an adult-like manner, with a final coda.

III. The word-internal Coda is yet to be acquired, e.g., the target words [ˈvol.ta] 'walk' and [ˈpoɾ.ta] 'door' are realized as [ˈvo.ta] and [ˈpo.ta], respectively, namely, the (target) initial [CVC.] syllables are realized by all children as [CV.] ones (ratio 100%) without a word-internal coda.

IV. In the children's productions, target branching onsets with tautosyllabic well-formed [$\text{OBSTRUENT}_1\text{SONORANT}_2$] clusters of rising sonority have started to be sporadically realized. The cross-linguistic

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[9] The beginning of the *intermediate phase* of acquisition is after the age of 1;06 (Ingram 1989) or after the age of 2 years (Macken 1992), and it is characterized by the emergence of phonological contrasts, marked sounds, and marked syllabic structures (branching onsets, codas) (Jakobson 1968).

[10] The younger children #01B and #05B may realize the target voiced CORONAL FRICATIVE /ð/ variably, either as a FRICATIVE or, most frequently, with the corresponding STOP, namely the target segment /ð/ may be realized as [ð] ~ [d]. The latter variation implies that the segment /ð/ is not fully acquired yet, e.g., the target [vðoˈmaða] 'week' is realized by both children as [voˈmada], see (6a).

pattern[11] of reduction to the less sonorous (OBSTRUENT$_1$) (2) is dominant in the children's grammar.

(2)		Target	Children	Child	Age	Gloss
	a.	[kaˈɾekla]	[kaˈleka]	#01B	2;05.00	'chair'
	b.	[ˈbluza]	[ˈbuza]	#38B	2;05.26	'blouse'
				#05Btw	2;06.12	
	c.	[ˈtɾeno]	[ˈteno]	#32G	2;08.14	'train'
	d.	[ˈpɾasino]	[ˈpasino]	#20Gtw	2;09.12	'green'
	e.	[oˈbɾela]	[oˈbela]	#21Gtw	2;09.18	'umbrella'
	f.	[ˈxroma]	[ˈxoma]	#28B	2;05.28	'colour'
	g.	[xloˈɾini]	[xoˈlini]	#01B	2;07.15	'bleach'
	h.	[fliˈʣani]	[fiˈʣani]	#36Gtw	2;09.25	'cup'
	i.	[viˈvlio]	[viˈvio]	#37Gtw	2;09.25	'book'

V. When the target word contains a non-rising sonority cluster of [OBSTRUENT$_1$OBSTRUENT$_2$], reduction occurs in the children's productions (ratio 100%). The children employ different patterns for reducing [OBSTRUENT$_1$OBSTRUENT$_2$] clusters; see below ~~in (a, b)~~ and section 4.

TARGET: Falling (reversed) sonority [FRICATIVE$_1$/s$_1$ STOP$_2$] clusters are realized, i.e., [ft], [xt], [st], [sp], [sk], where C_1 is more sonorous than C_2, according to the proposed language-specific sonority scale for Greek in (1). The voiceless [FRIC$_1$/s$_1$ STOP$_2$] clusters are reduced, by all children under study, to the less sonorous C_2 (STOP$_2$) in stressed/unstressed word-initial/-internal positions (3) conforming to the widely attested cross-linguistic pattern[12]. The children's grammar does not allow any marked structures with extrasyllabicity yet; therefore, the

[11] Reduction to the less sonorous OBSTRUENT$_1$ is attested in many languages, for instance in Dutch (e.g., Jongstra 2003; Fikkert 2004; *a.o.*), English (e.g., Gnanadesikan 1997; *a.o.*), European French (Demuth and McCullough 2009), European Portuguese (Freitas 2003), German (Grijzenhout and Joppen 1998), Greek (Kappa 2002a; Tzakosta 2003; Ploumidi 2020; *a.o.*), Hebrew (e.g., Ben-David 2006; Bloch 2011, *a.o.*), Polish (Łukaszewicz 2007), Spanish (e.g., Barlow 2003).

[12] For instance, in Dutch, (e.g., Fikkert 1994; Jongstra 2003; Gerrits and Zumach 2006; *a.o.*), English (e.g., Gnanadesikan 1996; Barlow 1997; among many others), European Portuguese (e.g., Freitas 2003), German (e.g., Goad and Rose 2004; Yavaş, Fox-Boyer, and Schaefer 2018), Hebrew (e.g., Ben-David 2006; Bloch 2011), Norwegian (e.g., Kristoffersen and Simonsen 2006; Strömbergsson et al. 2022), Polish (e.g., Łukaszewicz 2007; Yavaş and Marecka 2014), Swedish (e.g., Strömbergsson et al. 2022).

more sonorous [voiceless FRICATIVE$_1$/s$_1$] extrasyllabic consonants, are not prosodically licensed as *adjuncts/ appendixes,* and they are not realized (e.g., Barlow 2001; Goad and Rose 2004 and references therein, *a.o.*). The reduction to the STOP in (3) is also attested in other studies on the acquisition of Greek.[13]

(3) Reduction of target [FRICATIVE$_1$/s$_1$STOP$_2$] to [STOP$_2$]

	Target	Children	Child	Age	Gloss
a.	[aˈfto]	[aˈto]	#38B	2;04.27	‘this’
b.	[oˈxto]	[oˈto]	#32G	2;06.02	‘eight’
c.	[ˈstoma]	[ˈtoma]	#01B	2;06.10	‘mouth’
d.	[ˈasto]	[ˈato]	#36Gtw	2;07.21	‘leave it!’
e.	[ˈskala]	[ˈkala]	#21Gtw	2;09.18	‘ladder’
f.	[ˈspiti]	[ˈpiti]	#28B	2;07.05	‘house’

According to the sonority scale in (1), the target clusters [s$_1$/z$_1$ FRICATIVE$_2$], i.e., [sf], [sx], [sθ], [zv], [zɣ], are of falling sonority too. The latter clusters[14] are reduced by all children similarly to the less sonorous C$_2$, see Table 8-2 and the relevant examples in (4).

Table 8-2. Reduction of falling sonority [FRICATIVE$_1$OBSTRUENT$_2$] clusters

	[FRIC$_1$/s$_1$+STOP$_2$]⟶[STOP$_2$]					[s$_1$/z$_1$+FRIC$_2$]⟶[FRIC$_2$]			
TARGET	ft	xt	st	sp	sk	sf	sx	zv	zɣ
Children's Output	t			p	k	f	x	v	ɣ

(4) Reduction of target [s$_1$/z$_1$FRICATIVE$_2$] to [FRICATIVE$_2$]

	Target	Children	Child	Age	Gloss
a.	[ˈsfeɾa]	[ˈfela]	#37Gtw	2;09.05	‘sphere’
b.	[poˈðosfeɾo]	[poˈðofelo]	#36Gtw	2;09.12	‘soccer’
c.	[ˈsxaɾa]	[ˈxala]	#05Btw	2;08.03	‘grill’
d.	[ˈzvuɾa]	[ˈvula]	#21Gtw	2;08.25	‘spinning top’

[13] In Greek, e.g., Kappa 2002a, Tzakosta 2003, Coutsougera 2007, Syrika 2010, Paracheraki 2016, Yavaş and Babatsouli 2016, among others.

[14] None of the children's vocabularies included any target words containing the cluster [sθ], either word-initially or word-internally.

e.	[zɣuˈɾa]	[ɣuˈla]	#20Gtw	2;09.03	‘curly-PL’

TARGET: The belonging to the formal high variety of Greek *Katharevousa,* marked voiceless plateau clusters of equal sonority [$\text{S}\small{\text{TOP}}_1$$\text{S}\small{\text{TOP}}_2$] /kt, pt/, and non-strident voiceless [$\text{F}\small{\text{RICATIVE}}_1$$\text{F}\small{\text{RICATIVE}}_2$] /fθ, xθ/ are neutralized in (adult) Greek, and they are realized dissimilated as the falling sonority clusters [xt, ft] and [ft, xt], respectively, namely as the ‘*unmarked* type of obstruent clusters’ (Morelli 1999, ii). The dissimilation applies in (adult) Greek due to the action of the phonotactic constraint OCP (‘*Obligatory Contour Principle*’) that prohibits the occurrence of adjacent identical feature specifications (e.g., Itô and Mester 1986; McCarthy 1986; Yip 1988; *a.o.*), in this case, the feature [±con(tinuant)], therefore, a cluster of segments with the same Manner of Articulation (MoA) is prohibited. The children’s input closely resembles to the target word, i.e., the adult’s surface form to which they are exposed (e.g., Smolensky 1996a, b; Tesar and Smolensky 1998; Gnanadesikan 2004; *a.o.*), i.e., the children have as input(s) the relevant adult words with the dissimilated clusters of falling sonority [ft] and [xt]. The latter are reduced by the children to the less sonorous $\text{S}\small{\text{TOP}}_2$ (5).

(5)	$\text{F}\small{\text{RIC}}_1$$\text{S}\small{\text{TOP}}_2$	Children	Gloss
a.	[fteˈɾo]	[teˈlo]	‘wing’
b.	[ˈxtima]	[ˈtima]	‘farm’
c.	[ftiˈno]	[tiˈno]	‘cheap’
d.	[ˈxtes]	[ˈtes]	‘yesterday’

4. Reduction of non-strident voiced [$\text{F}\small{\text{RIC}}_1$$\text{F}\small{\text{RIC}}_2$] plateau clusters: data description

In the Greek language, children are exposed to the frequent occurrence of plateau clusters composed of two non-strident voiced FRICATIVES in adult speech, e.g., [(e)vðoˈmaða] ‘week’, [ˈmi*ɣð*ala] ‘almonds’, [ˈ*vɣ*azo] ‘take out’, [aˈ*vɣ*o ‘egg’, [ˈ*ɣð*inome/ˈ*ɣð*ino] ‘undress’/’undress (sb)’, [ˈvʝazome] ‘I am in a hurry’, [moˈlivʝa] ‘pencils’, [ðʝaˈvazo] ‘read’, [peˈðʝa] ‘children’, among others.

This study focuses on the reduction of the target plateau clusters/sequences of non-strident voiced [$\text{F}\small{\text{RICATIVE}}_1$$\text{F}\small{\text{RICATIVE}}_2$], i.e., of [vð], [ɣð], [vɣ] and [vʝ], [ðʝ]. Both cluster members are marked both for MoA and for voicing, namely as [+continuant] for MoA (violating the OCP against the adjacent identical feature specification [+cont]) and as [+voice] for the supralaryngeal feature, differing only in their PLACE OF ARTICULATION (PoA). Based on our adult experimental data on the syllabification of the aforementioned [FRICATIVE$_1$FRICATIVE$_2$] clusters, we suggest that in the relevant target-words the children are exposed to, FRICATIVE$_1$ is attached word-internally as an appendix to the syllable node.

The children's grammar cannot tolerate complex clusters/sequences like the voiced fricative plateau clusters, either in stressed or in unstressed syllables, both word-initially, i.e., in *a perceptually prominent* position (Smith 2002), and word-internally, hence reduction occurs (ratio 100%). The target clusters are reduced by the children either to C_1, preserving the appendix or to C_2, preserving the head onset segment (data in (6-10).

In the following data (6, 7), the target plateau cluster consists of a voiced LABIAL FRICATIVE (C_1) and a non-strident voiced CORONAL FRICATIVE (C_2). The plateau cluster is reduced predominantly to C_1; 7/9 children realize the LABIAL segment (6), word-initially/-internally in stressed and unstressed syllabic positions. 2/9 children (#32G and #38B) realize the CORONAL C_2 in all stressed/ unstressed prosodic positions (7). (B: boy, G: girl, tw: twin).

(6) [$C_{1\text{-LAB}}$ $C_{2\text{-COR}}$] ⇢ $C_{1\text{-LABIAL}}$

Word initially

	Target	Children	Child	Age	Gloss
a.	[vðoˈmaða]	[voˈmada]	#05Btw	2;05.20	'week-
			#01B	2;06.02	F.NOM.SG'
		[voˈmaða]	#28B	2;06.24	
			#21Gtw	2;08.25	
b.	[ˈvðela]	[ˈvela]	#05Btw	2;06.15	'leech-
			#36Gtw	2;07.14	F.NOM.SG'
			#37Gtw	2;07.14	

Word internally

	Target	Children	Child	Age	Gloss
c.	[ɾaˈvði]	[laˈvi]	#028B	2;07.05	'wand-
			#01B	2;07.15	N.NOM.SG'
			#37Gtw	2;07.21	
			#05Btw	2;07.23	
			#20Gtw	2;08.25	
d.	[ɾaˈvðaca]	[laˈvaca]	#21Gtw	2;08.25	'wand-
			#36Gtw	2;09.12	DIM.NOM.PL'

(7) [C1-LAB C2-COR] ⇢ C2-CORONAL

Word initially

	Target	Children	Child	Age	Gloss
a.	[ˈvðela]	[ˈðela]	#38B	2;07.21	'leech-F.NOM.SG'
b.	[ˈvðeles]	[ˈðeles]	#32G	2;07.13	'leech-PL

Word internally

	Target	Children	Child	Age	Gloss
c.	[ɾaˈvði]	[laˈði]	#38B	2;06.10	'wand-
			#32G	2;08.15	NOM.SG
d.	[ɾaˈvðaca]	[laˈðaca]	#38B	2;08.10	'wand-
			#32G	2;09.21	DIM.NOM.PL'

In (8), the target plateau cluster consists of a voiced DORSAL FRICATIVE (C_1) and a voiced CORONAL FRICATIVE (C_2). As a result of the cluster reduction, 9/9 children preserve the DORSAL C_1 in stressed/unstressed syllables, both word-initially and -internally.

(8) [C1-DOR C2-COR] ⇢ C1-DORSAL

Word initially

	Target	Children	Child	Age	Gloss
a.	[ˈɣðino]	[ˈʝino][15]	#01B	2;05.16	'undress(sb)-PRS.1SG'
b.	[ɣðiˈtos]	[ʝiˈtos]	#05Btw	2;05.18	'undressed-M.NOM.SG'
c.	[ɣðiˈti]	[ʝiˈti]	#32G	2;08.15	'undressed-
			#20Gtw	2;09.18	F.NOM.SG'
			#21Gtw	2;09.18	
			#36Gtw	2;09.22	
			#37Gtw	2;09.22	

Word internally

	Target	Children	Child	Age	Gloss
d.	[ˈmiɣðala]	[ˈmiɣala]	#28B	2;05	'almond-
			#01B	2;05.24	N.NOM.PL'
			#38B	2;05.26	
			#05Btw	2;06.04	
			#21Gtw	2;07.23	

[15] The palatalized [ʝ] is an allophone of the DORSAL FRICATIVE /ɣ/ that occurs before the front vowels [i, e]. All participating children in this study faithfully realized the palatalized DORSAL.

In (9), the target plateau cluster consists of a voiced LABIAL FRICATIVE (C_1) and a voiced DORSAL FRICATIVE (C_2). All children (9/9) realize the DORSAL_2 in stressed/unstressed syllables, both word-initially/-internally.

(9) [$C_{1\text{-LAB}}$ $C_{2\text{-DOR}}$]⇢ $C_{2\text{-DORSAL}}$

Word initially

	Target	Children	Child	Age	Gloss
a.	[ˈvɣazi]	[ˈɣazi]	#32G	2;06.25	‘take out-
			#36Gtw	2;07.14	PRS.3SG’
			#37Gtw	2;08.28	
b.	[ˈvɣazo]	[ˈɣazo]	#28B	2;05	‘take out-
			#21Gtw	2;09	PRS.1SG’
c.	[ˈvɟeno][16]	[ˈɟeno]	#28B	2;05	‘come out-
			#01B	2;05.16	PRS.1SG’
			#05Btw	2;05.25	
			#32G	2;08	
			#21Gtw	2;07.23	

Word internally

	Target	Children	Child	Age	Gloss
d.	[ˈevɣale]	[ˈiɣale]	#01B	2;04.25	‘take out-
		[ˈeɣale]	#38B	2;06.10	PST.3SG’
			#28B	2;06.24	
e.	[ˈevɣala]	[ˈeɣala]	#20Gtw	2;07.15	‘take out-PST.1SG’
f.	[aˈvɣo]	[aˈɣo]	#05Btw	2;06.15	‘egg-
			#21Gtw	2;07.23	N.NOM.SG’
g.	[aˈvɣa]	[aˈɣa]	#01B	2;05.16	‘egg-
			#37Gtw	2;09.07	N.NOM.PL’
h.	[avɣuˈlaci]	[aɣuˈlaci]	#36Gtw	2;08.28	‘egg-
			#32G	2;09	DIM.NOM.SG’

In the following data in (10), the target words ending in [-ðɟa], [-vɟa] are the plural forms (nominative) of the neuter nouns, whose stem ends in /–i/ and have a *zero* (∅) inflectional suffix in nom. Singular, e.g., /luˈluði-∅/, therefore, the stem /luˈluði-/surfaces as the word [luˈluði] ‘flower’ (e.g., Ralli 2005, 241, fn. 261). The latter neuter nouns exhibit */i/ ~ Glide* alternation when a vowel initial inflectional suffix, indicating

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[16] Target [ˈ*vɟ*eno] PRS.1SG: [ɟ] is the palatalized allophone of /ɣ/, cf. [ˈ*v*ɣo]-FUT.1SG.

number and case, is attached to the stem, resulting in glide formation,[17] e.g., in the plural. The glide is strengthened, and it is realized as a voiced palatal FRICATIVE if a voiced consonant precedes,[18] e.g., the nominative plural form with the inflectional suffix /-a/, /luˈluði-a$_{Infl}$/, is realized as [luˈluðʝa] 'flowers'. Regarding the glide formation, as in the target words in (10), Topintzi and Baltazani (2014) argue that the glide formation occurs due to paradigmatic faithfulness, namely due to a constraint demanding "the words in a paradigm to have an identical number of syllables" (ibid. 180) in singular and plural, i.e., three syllables in both forms: [lu.ˈlu.ði]SG and [lu.ˈlu.ðʝa]PL.

In a plural (target) form, as in /luˈluði-a$_{Infl}$/NOM.PL, a vowel hiatus /i-a/ occurs. The hiatus could be resolved by the deletion of the stem final /i/, while the vowel /a/ would be preserved, on the one hand as the most sonorous vowel in the vowel hierarchy of Greek[19] (Malikouti-Drachman and Drachman 1992), on the other hand driven by morphology, as /a/ is an inflectional suffix designating the nominative plural. However, we argue that the deletion of /i/ does not occur due to a language-specific constraint that requires 'EDGE INTEGRITY' (Kang 2004). Namely, the right edge segment of a morphological unit, e.g., a stem, like /i-/ in /luˈluði-/, must be preserved and appear at the corresponding edge. Consequently, the edge stem segment /i/ is preserved due to the glide formation, simultaneously resolving the hiatus. The subsequent glide strengthening in the prevocalic position results in a palatal fricative [ʝ] if the preceding consonant is a voiced one, hence the realization of [ðʝ] in (10a-e) and [vʝ] in (10f, g).

In the data in (10), all children uniformly preserve the stem edge segment, which surfaces as the (strengthened glide) palatal FRICATIVE C_2 in the target words to which the children are exposed. The reduction to the palatalized (DORSAL) C_2 is consistent with the children's DORSAL output segments above in (8) and in (9), where the CORONAL C_1 [ð] and the LABIAL C_1 [v], respectively, are not preferred for realization.

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[17] The glide formation occurs in GEN. SG and throughout the declension of plural forms because the stem-final syllabic /i/ is followed by the respective vowel initial inflectional suffixes (Holton et al. 2012, 75).

[18] In Greek, the obstruent clusters agree in voicing; therefore, if the preceding consonant is a voiceless one, then the strengthened glide is realized as a voiceless palatal FRICATIVE [ç], e.g., /kaɾfi-a/ ⇢ [kaɾˈfça] 'nail' NOM.PL, /vaθi-a/⇢ [vaˈθça] 'deep' ADJ.NEU.NOM.PL. The children of this study realize the latter plural forms as [kaˈça] and [vaˈça], respectively.

[19] Vowel hierarchy of Greek (>: more sonorous than): /a > o > u > i > e/ (Malikouti-Drachman and Drachman 1992).

(10)	Target	Children	Child[20]	Age	Gloss
a.	[kliˈðʝa]	[ciˈʝa]	#01B	2;05.16	‘key-N.NOM.PL’
b.	[luˈluðʝa]	[luˈluʝa]	#05Btw #38B #36Gtw #37Gtw #32G	2;05.18 2;06.17 2;08.20 2;08.20 2;09	‘flower-N.NOM.PL’
c.	[aˈxlaðʝa]	[aˈxaʝa]	#05B #20Gtw #36Gtw	2;06.28 2;07.02 2;07.25	‘pear-N.NOM.PL’
d.	[ˈfɾiðʝa]	[ˈciʝa]	#28B	2;06.24	‘eyebrow-N.NOM.PL’
e.	[peˈxniðʝa]	[piˈçiʝa] [peˈçiʝa]	#05Btw #36Gtw #37Gtw #32G	2;07 2;07.25 2;08.20 2;08.25	‘toy-N.NOM.PL’
f.	[kaˈɾavʝa]	[kaˈaʝa] [kaˈlaʝa]	#01B #38B #21Gtw	2;04.25 2;06.10 2;06.25	‘ship-N.NOM.PL’
g.	[moˈlivʝa]	[moˈliʝa]	#20Gtw #38B #05Btw #36Gtw #32G #37Gtw	2;06.25 2;06.28 2;07.25 2;08.20 2;08.26 2;09	‘pencil-N.NOM.PL’

The following Table 8-3 illustrates the observed reductions in children’s productions of target non-strident voiced [FRICATIVE$_1$FRICATIVE$_2$] clusters (data in 6-10), where either C_1 or C_2, is realized (✓) as an output by each child.

[20] The children #20Gtw and #21Gtw are twins, as well as #36Gtw and #37Gtw.

Table 8-3. Reduction of (word-initial/-internal) target non-strident voiced [FRICATIVE$_1$FRICATIVE$_2$] plateau clusters

TARGET	[C_{Lab} C_{Dor}] [vɣ]		[C_{Lab} $C_{\text{pal Dor}}$] [vj]		[C_{Lab} C_{Cor}] [vð]		[C_{Dor} C_{Cor}] [ɣð]		[C_{Cor} $C_{\text{pal Dor}}$] [ðj]	
Output / Child	[v] C_1 LAB	[ɣ] **C_2** **DOR**	[v] C_1 LAB	[j] **C_2** **pal DOR**	[v] **C_1** **LAB**	[ð] **C_2** **COR**	[ɣ] **C_1** **DOR**	[ð] C_2 COR	[ð] C_1 COR	[j] **C_2** **pal DOR**
#01B		✓		✓	✓		✓			✓
#05Btw		✓		✓	✓		✓			✓
#20Gtw		✓		✓	✓		✓			✓
#21Gtw		✓		✓	✓		✓			✓
#28B		✓		✓	✓		✓			✓
#32G		✓		✓		✓	✓			✓
#36Gtw		✓		✓	✓		✓			✓
#37Gtw		✓		✓	✓		✓			✓
#38B		✓		✓		✓	✓			✓

5. Data analysis

In the following analysis, we aim to determine which factors play a role in the children's grammar and drive the reduction of the target plateau clusters to either C_1 or C_2. The formal analysis is couched in the *Correspondence Theory* approach (McCarthy and Prince 1995) to the Optimality Theory framework (Prince and Smolensky 1993/2004).

In the target plateau clusters (6-10), SONORITY plays no role in cluster reduction in the children's outputs due to the equal sonority of C_1 and C_2; therefore, the reduction should be explained in sonority-independent terms. On the contrary, SONORITY plays a role in the reduction of [OBSTRUENT$_1$ SONORANT$_2$], [s$_1$STOP$_2$/FRICATIVE$_2$], and [FRICATIVE$_1$STOP$_2$] clusters where reduction to the less sonorous segment occurs.

POSITIONAL FAITHFULNESS (Beckman 1998) is also irrelevant to preserving C_1. Namely, positional faithfulness to a word-initial position or a stressed syllable is not involved in the reduction pattern, as shown in the following examples (6a, c) with preservation of C_1 **vs.** (9b) with preservation of C_2. Specifically, in the first case, the LABIAL C_1 is preserved word-initially (6a) or in an internal stressed syllable (6c). However, the LABIAL C_1 is reduced in a word-initial stressed syllable (9b).

		Target	Children	Gloss
(6)	a.	[v$_1$ð$_2$oˈmaða]	[v$_1$oˈmaða]	'week-NOM.SG'
(6)	c.	[ɾaˈv$_1$ð$_2$i]	[laˈv$_1$i]	'wand-NOM.SG'
			vs.	
(9)	b.	[ˈv$_1$ɣ$_2$azo]	[ˈɣ$_2$azo]	'take out-PRS.1SG'

CONTIGUITY, namely the preservation of the C_2 which precedes the syllable nucleus[21], also seems to be irrelevant to our Greek child data; namely, C_2 [ð] is reduced both, in (6), e.g., (6c) and (8), e.g., (8d).

		Target	Children	Gloss
(6)	c.	[ɾaˈv$_1$ð$_2$i]	[laˈv$_1$i]	'wand-NOM.SG'
(8)	d.	[ˈmiɣ$_1$ð$_2$ala]	[ˈmiɣ$_1$ala]	'almond-NOM.PL'

CONTIGUITY is the main factor that drives the reduction of plateau clusters [STOP$_1$STOP$_2$] in child Hebrew (Bloch 2011), where the preservation of STOP$_2$ is preferred (11a, b). However, variation may occur in a child's system, preserving the LABIAL STOP$_1$ in (11c) vs (11b).

(11) Reduction of [STOP$_1$STOP$_2$] plateau clusters in child Hebrew (data drawn from Bloch 2011, 50)

	Target	Children	Child	Age	Gloss
a.	[k$_1$t$_2$aˈna]	[t$_2$aˈna]	RM	1;10.13	'small-FEM.SG'
b.	[p$_1$k$_2$ak]	[k$_2$ak]	SR	1;07.17	'cork'
			vs.		
c.	[p$_1$k$_2$ak]	[p$_1$ak]	SR	1;05.29	'cork'

The Greek children under study exhibit a PoA-driven unified reduction strategy, regardless of the (un)stressed word-initial/-internal position of the target plateau cluster. Specifically, all children (9/9) favor

[21] Van der Pas (2004) provides evidence from child Dutch that, in the reduction of the target [OBSTRUENT$_1$SONORANT$_2$] clusters, the less sonorous [OBSTRUENT$_1$] is not preserved in the system of some children. However, the reduction is CONTIGUITY driven, i.e., it is realized the consonant adjacent to the vocalic nucleus, thus preservation of C_2 (SONORANT) occurs, especially in stressed syllable positions.

the preservation of the DORSAL member of a plateau cluster; therefore, the DORSAL consonant is preserved over the LABIAL one (12) and over the CORONAL one (13).

(12) DORSAL > LABIAL 9/9 children
(13) DORSAL > CORONAL 9/9 children

Most children (7/9: GROUP A) favor the preservation of the LABIAL member of a cluster over the CORONAL one (14).

(14) LABIAL > CORONAL 7/9 children (GROUP A)

Only two children (2/9: GROUP B) favor the preservation of the CORONAL segment over the LABIAL one (15).

(15) CORONAL > LABIAL 2/9 children (GROUP B)

Relative hierarchy ranking of POA features: GROUP A vs. GROUP B
GROUP A: In simplifying plateau clusters, 7/9 children favor the preservation of the segment with a marked PoA. Specifically, in the reduction of clusters [$C_{1\text{-LAB}}C_{2\text{-COR}}$] (6) and [$C_{1\text{-DOR}}C_{2\text{-COR}}$] (8), the C_1 segment with a LABIAL (6) or a DORSAL POA (8) is preserved instead of the C_2 segment with the unmarked CORONAL one. The reduction of the CORONAL segment (C_2), e.g., in (6c) and (8d), conforms to the *Preservation of the Marked* (PoM), namely 'the marked elements can be specifically targeted for preservation than the less marked ones' (de Lacy 2006, 146). In the reduction of target clusters [$C_{1\text{-LAB}}C_{2\text{-DOR}}$] in (9), the DORSAL segment (C_2) is preserved over the LABIAL one (C_1) (9b).

(6)	c.	[ɾaˈv$_1$ð$_2$i]	[laˈv$_1$i]	LABIAL > CORONAL
(8)	d.	[ˈmiɣ$_1$ð$_2$ala]	[ˈmiɣ$_1$ala]	DORSAL > CORONAL
(9)	b.	[ˈv$_1$ɣ$_2$azo]	[ˈɣ$_2$azo]	DORSAL > LABIAL

The dominance relations among the PoA features in (12, 13, 14), namely DOR > LAB, DOR > COR and LAB > COR, imply the *relative hierarchy ranking of PLACE features* (16) in the phonological grammars of children in GROUP A, which accounts for the preservation of C_1 (6, 8) and C_2 (9) and results in a unified account of the children's outputs.

(16) POA RANKING: DORSAL > LABIAL > CORONAL (7/9 children)

In the literature on phonological development, there is evidence that segments with LABIAL and/or DORSAL PoA are preferred to CORONAL ones, for instance, in onset selection in truncation (e.g., Fikkert 1994; Pater 1997), in the reduction of target rising sonority clusters [OBSTRUENT$_1$SONORANT$_2$] (e.g., Pater and Barlow 2003) or in the reduction of target plateau clusters [STOP$_{LAB/DOR}$ STOP$_{COR}$] in Hebrew (Bloch 2011).

In the phonological literature, there is a disagreement regarding the universal dominance ranking between the DORSAL POA and the LABIAL one, and this implies that their ranking is not universally fixed (e.g., Pater 1997; de Lacy 2006; *a.o.*). Jun (1995) proposes the ranking DORSAL > LABIAL > CORONAL as a universal one for the PoA preservation. Our data from Group A conform to the latter ranking (see above in 16). Conversely, Gnanadesikan (2004, 105, fn. 30 citing 1997), in her case study on the acquisition of English, suggests that 'place features may be scalar' and that the dominance ranking of LABIAL over DORSAL may be universal, thus LABIAL > DORSAL > CORONAL. The latter ranking is confirmed in a case study for consonant harmony in child Greek (Kappa 2001). In another study on the acquisition of Greek, relying on a corpus of longitudinal data from nine children (Tzakosta 2007), the statistical analysis shows that the majority of PLACE harmony triggers are the unmarked CORONAL ones followed by the marked LABIAL ones, thus resulting in the ranking CORONAL > LABIAL > DORSAL. Tzakosta (ibid.) attributes the dominance of CORONAL POA to its unmarked status[22] and to the high-frequency rate of coronal segments in Greek. De Lacy (2006) argues that a universally fixed PoA ranking cannot capture the preservation of both marked and unmarked features in the same grammar.

GROUP B: 2/9 children (#32G and #38B) favor the preservation of the DORSAL consonant like the children in GROUP A. Specifically, in the reduction of the target clusters [$C_{1\text{-}DOR}$ $C_{2\text{-}COR}$] in (8), C_1 with the marked DORSAL POA is preferred to be preserved over C_2 with the unmarked CORONAL POA, e.g., (8d). In the target clusters [$C_{1\text{-}LAB}$ $C_{2\text{-}DOR}$] in (9), C_2 with the DORSAL PoA is preserved over the LABIAL C_1, e.g., (9a, d).

		[$C_{1\text{-}DOR}$ $C_{2\text{-}COR}$]	⇢	[$C_{1\text{-}DOR}$]			
(8)	d.	[ˈmiɣ$_1$ð$_2$ala]	⇢	[ˈmiɣ$_1$ala]	#38B	2;05.26	'almond-
					#32G	2;08.02	N.NOM.PL'

[22] Regarding the unmarked status of CORONALS, see contributions in Paradis and Prunet (1991).

[C$_{1\text{-LAB}}$ C$_{2\text{-DOR}}$] ⇢ [C$_{2\text{-DOR}}$]

(9) a. [ˈv$_1$ɣ$_2$azi] ⇢ [ˈɣ$_2$azi] #32G 2;06.25 ‘take out-PRS.3SG’

(9) d. [ˈev$_1$ɣ$_2$ale] ⇢ [ˈeɣ$_2$ale] #38B 2;06.10 ‘take out-PST.3SG’

The difference between the two groups of children lies in the reduction of the plateau cluster [C$_{1\text{-LAB}}$C$_{2\text{-COR}}$] by GROUP B, see the relevant data in (7), where the realization of the C$_2$ with the unmarked CORONAL POA is preferred over the marked LABIAL C$_1$, i.e., COR > LAB (15), word-initially/-internally, e.g., in (7b) and (7c), respectively. The latter reduction of LABIAL does not conform to the *Preservation of the Marked*.

[C$_{1\text{-LAB}}$ C$_{2\text{-COR}}$] ⇢ [C$_{2\text{-COR}}$]

(7) b. [ˈv$_1$ð$_2$eles] ⇢ [ˈð$_2$eles] #32G 2;07.13 ‘leech-NOM.PL’

(7) c. [ɾaˈv$_1$ð$_2$i] ⇢ [laˈð$_2$i] #38B 2;06.10 ‘wand-NOM.SG’

Additional evidence for the dominance ranking of CORONAL > LABIAL (15) in the children’s system is offered by data from consonant harmony in the speech of child #38B at an earlier age (2;02.10), e.g., in the target word [kaˈɾavi] ‘ship’ the LABIAL [v] undergoes CORONAL harmony, and it is realized as [d] in the child’s output [ˈda**d**i]. The dominance of CORONAL over LABIAL in consonant harmony is also evidenced in Tzakosta (2007).

The dominance relations among the PoA features in (12, 13, 15), namely DOR > LAB, DOR > COR, and COR > LAB, imply the *relative hierarchy ranking of PLACE features* (17) in the phonological grammars of the children in GROUP B which accounts for the preservation of C$_1$ (8) and C$_2$ (7, 9).

(17) POA RANKING: DORSAL > CORONAL > LABIAL (2/9 children)

Comparing the PoA hierarchy rankings in the system of children in Group A (ranking in 16) vs. children in Group B (ranking in 17), we argue that a fixed PoA ranking cannot offer a unified account for the preserved segments in the productions of all children. The ranking in (16) accounts for the preservation of segments with a marked PoA only (DORSAL, LABIAL), while the ranking in (17) accounts for the preservation of segments with marked and unmarked PoA, DORSAL, and CORONAL, respectively. Rankings (16) and (17) show different developmental paths regarding the preservation of unmarked CORONAL compared to the preservation of the marked LABIAL. In both PoA rankings, the marked DORSAL PoA dominates; therefore, the DORSAL segment is always preserved.

At the onset of phonological development, the innate markedness constraints predominate, favoring unmarked segments/structures and opposing the realization of marked segments/structures, e.g., complex onsets, continuant OBSTRUENTS, among others. Thus, markedness constraints outrank faithfulness constraints (M >> F) (e.g., Gnanadesikan 2004, Tesar and Smolensky 1998, 2002, among others), which require that the output forms resemble the input forms (e.g., Demuth 1995, among many others). As the phonological development progresses, the constraints are gradually reranked, and the faithfulness constraints are promoted over the markedness ones, resulting in the production of more marked outputs that are faithful to the input (e.g., Tesar and Smolensky ibid.). The reranking of markedness and faithfulness constraints is a gradual process that varies from child to child. The main faithfulness (18) and markedness (19) constraints, which operate on output structures and are relevant for the segment preservation/ reduction in the data (6-10), are listed below.

(18) FAITHFULNESS CONSTRAINT (McCarthy and Prince 1995)

MAX-DOR(SAL)	No-deletion of an input DORSAL
MAX-LAB(IAL)	No-deletion of an input LABIAL
MAX-COR(ONAL)	No-deletion of an input CORONAL
IDENT[cont]	If there is a [+continuant] segment in the Input, its Output correspondent must also be [+continuant].

(19) MARKEDNESS CONSTRAINTS (Prince and Smolensky 1993/2004)

*APP(ENDIX)	No extrasyllabic appendix
OCP[+cont]	Constraint against the adjacent identical feature specification [+continuant] for MoA
*DOR(SAL)	One violation for every DORSAL PoA in the Output
*LAB(IAL)	One violation for every LABIAL PoA in the Output

*COR(ONAL)	One violation for every CORONAL PoA in the Output
*[+cont(inuant)]	One violation for every [+cont] segment in the Output

At this intermediate developmental phase, which is signaled by the re-ranking of (some) markedness constraints over faithfulness ones, all children produce more faithful outputs (see below the constraint rankings in 20 and 21). FRICATIVES marked for MoA as [+cont] are produced faithfully, and this is attributed to the dominance of the faithfulness constraint IDENT[+cont], which is promoted and outranks the markedness constraint *[+cont] in the children's grammar[23] which do not yet allow extrasyllabic appendices satisfying the constraint *APPENDIX, or a sequence of FRICATIVES satisfying (OCP[+cont]), hence the undominated, equally ranked markedness constraints *APPENDIX, OCP[+cont]. The constraint OCP[+cont] remains undominated for a longer time and prohibits the realisation of a plateau clusters with voiced fricatives, therefore the plateau clusters are simplified. The faithfulness constraints MAX for PoA (no deletion) are higher ranked, dominating the respective Markedness constraints for PoA, resulting in the preservation of the segment with the relevant PoA.

(20) CONSTRAINT RANKING GROUP A (7/9 children)
*APPENDIX, OCP[+cont] >> MAX-DOR >> MAX-LAB >> MAX-COR >> *DOR >> * LAB >> *COR >> IDENT[+cont] >> *[+cont]

(21) CONSTRAINT RANKING GROUP B (2/9 children)
APPENDIX, OCP[+cont] >> MAX-DOR >> MAX-COR >> MAX-LAB >> * DOR >> * LAB >> *COR >> IDENT[+cont] >> *[+cont]

In both constraint rankings (20, 21), the satisfaction or violation of the lower-ranked markedness constraints for PoA plays no role in selecting the optimal output candidate (see Tableaux 8-4 – 8-7 below). Due to the lack of space in the following Tableaux (8-4 – 8-7), the

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[23] In the initial stage of acquisition, the markedness constraint *[+cont] is higher ranked, i.e., *[+cont]>>IDENT[+cont], therefore all input/target [+cont] FRICATIVES (marked for MoA) are realized as [-cont.) STOPS (unmarked for MoA) (Kappa 2002a).

rankings include only the constraints that are crucial for our analysis; therefore the lower ranked constraints IDENT[+cont] >> *[+cont] are not included. In all Tableaux, OCP[+cont] is violated by the output candidate (8-4a – 8-7a), while all realized fricatives output candidates satisfy IDENT[+cont] and violate the lowest ranked constraint *[+cont].

In Tableaux 8-4–8-7 below, all target-like candidates with a plateau cluster in (8-4a–8-7a) violate the undominated *APPENDIX and OCP[+cont] constrains, therefore they are excluded as optimal outputs.

In both Tableaux 8-4 and 8-5 below, the grammars of all children prefer the preservation of an output candidate that satisfies the higher-ranked faithfulness constraint MAX-DOR; therefore, it is selected as the optimal output the segment [ɣ] with the marked DORSAL PoA, i.e., the candidate (c), in both Tableaux 8-4 and 8-5. Both outputs, the CORONAL [ð] in Tableau 8-4b and the LABIAL [v] in Tableau 8-5b, violate the higher-ranked MAX-DOR constraint; therefore, both [ð] and [v] fail to be selected as the optimal outputs.

Tableau 8-4. [C$_{1\text{-DOR}}$ C$_{2\text{-COR}}$] ⇢ C$_{1\text{-DORSAL}}$ GROUP A and B (data in 8)

ɣ$_1$ð$_2$	*APP, OCP[+cont]	MAX-DOR	MAX-LAB	MAX-COR	*DOR	*COR
a) ɣ$_1$ð$_2$	*,* !	✓		✓	*	*
b) ð$_2$	✓, ✓	*!		✓	✓	*
☛c) ɣ$_1$	✓, ✓	✓		*	*	✓

Tableau 8-5. [C$_{1\text{-LAB}}$ C$_{2\text{-DOR}}$] ⇢ C$_{1\text{-DORSAL}}$ GROUP A and B (data in 9)

v$_1$ɣ$_2$	*APP, OCP[+cont]	MAX-DOR	MAX-LAB	MAX-COR	*DOR	*LAB
a) v$_1$ɣ$_2$	*, *!	✓	✓		*	*
b) v$_1$	✓, ✓	*!	✓		✓	*
☛c) ɣ$_2$	✓, ✓	✓	*		*	✓

The rankings in Tableau 8-6 (GROUP A) and in Tableau 8-7 (GROUP B) below show the difference in the grammars of children in GROUP A vs. the children in GROUP B, due to the different dominance relations between the marked LABIAL and the unmarked CORONAL PoA, which results in the preservation of a segment with the marked LABIAL PoA (GROUP A) vs. the preservation of the segment with the unmarked CORONAL PoA (GROUP B).

In Tableau 8-6 (Group A), the dominance ranking of MAX-LAB >> MAX-COR results in selecting the marked LABIAL output candidate (8-6c) below, which satisfies the higher-ranked MAX-LAB constraint. The latter constraint is violated by the CORONAL candidate in (8-6b) below; therefore, the CORONAL [ð] fails to be selected as the optimal output.

Tableau 8-6. [C$_{1\text{-LAB}}$ C$_{2\text{-COR}}$] ⇢ C$_{1\text{-LABIAL}}$ GROUP A (data in 6)

v$_1$ð$_2$	*APP, OCP[+cont]	MAX-LAB	MAX-COR	*LAB	*COR
a) v$_1$ð$_2$	*, *!	✓	✓	*	*
b) ð$_2$	✓, ✓	*!	✓	✓	*
☛c) v$_1$	✓, ✓	✓	*	*	✓

In Tableau 8-7 (Group B), the dominance ranking of MAX-COR >> MAX-LAB results in the selection of the unmarked CORONAL output candidate [ð] in 8-7b below, which satisfies the higher-ranked MAX-COR constraint. The latter constraint is violated by the LABIAL candidate in 8-7c below; therefore, the LABIAL [v] fails to be selected as the optimal output.

Tableau 8-7. [C$_{1\text{-LAB}}$ C$_{2\text{-COR}}$] ⇢ C$_{1\text{-LABIAL}}$ GROUP B (data in 7)

v$_1$ð$_2$	*APP, OCP[+cont]	MAX-COR	MAX-LAB	*LAB	*COR
a) v$_1$ð$_2$	*, *!	✓	✓	*	*
☛ b) ð$_2$	✓, ✓	✓	*	✓	*
c) v$_1$	✓, ✓	*!	✓	*	✓

pp.192-193 In this paragraph there is a shadow which should be removed, if possible.

At this developmental phase (see above) the action of OCP[+cont] is not evident in the reduction of plateau clusters due to the action of the undominated *APPENDIX, which forbids appendices.

As the phonological development progresses, i.e., at a later developmental phase, the *APPENDIX markedness constraint is demoted, and complex clusters of falling sonority, e.g., [sC, ft, xt], start being realized in the speech of older children (see Tableau 8-8), as the children's data reveal. For example, the child #21Gtw (age 3;01) has begun to produce [s$_1$+STOP$_2$] and [x$_1$+STOP$_2$] falling sonority clusters, e.g., the target words [ˈ$s_1k_2$ala] 'ladder' and [$x_1t_2$es] 'yesterday', respectively, with an appendix at the left edge, are realized faithfully, due to the demotion of the markedness constraint *APPENDIX (Tableau 8-8c). The undominated OCP[+cont] constraint is satisfied in the output candidate (c) because the cluster members have different MoA features. Consequently, the output candidate (c) is selected as the optimal one because it also satisfies both the higher-ranked constraints MAX-DOR and MAX-COR, contrary to the output candidates (a) and (b).

Tableau 8-8

ˈ$s_1k_2$ala	OCP[+cont]	MAX-DOR	MAX-COR	*DOR	*COR	*APP
a) ˈ$s_1$ala	✓	*!	✓	✓	*	✓
b) ˈ$k_2$ala	✓	✓	*!	*	✓	✓
☛c) ˈ$s_1k_2$ala	✓	✓	✓	*	*	*

However, at this later developmental phase, the OCP[+cont] constraint remains undominated in the grammar of older children, preventing the realization of target plateau clusters. The action of OCP[+cont] is evident, for instance, in the grammar of child #21G (age 3;01), see Tableau 8-9a, where the target-like output candidate [ˈ$v_1ɣ_2$ale] 'take out-IMP' violates OCP[+cont]. Therefore, it is not selected as the optimal one. The evaluation of output candidates in Tableau 8-9 mirrors that of Tableau 8-5 (data in (9)).

Tableau 8-9

ˈ$v_1ɣ_2$ale	OCP[+cont]	MAX-DOR	MAX-LAB	*DOR	*LAB	*APP
a) ˈ$v_1ɣ_2$ale	*!	✓	✓	*	*	*
b) ˈ $v_1$ale	✓	*!	✓	✓	*	✓
☛c) ˈ$ɣ_2$ale	✓	✓	*	*	✓	✓

6. Conclusions

Our Greek data provides evidence that the children's grammar at this developmental phase cannot tolerate complex clusters C_1C_2 with rising sonority under a branching onset and falling sonority clusters with an appendix, e.g., [sC, xt, ft]. The grammars also cannot tolerate word-initial/-internal sequences consisting of marked voiced fricatives. Both following constraints are still undominated in the grammar of all children under study: OCP[+cont] and *APPENDIX; therefore, the target plateau clusters containing the voiced fricatives [vð, ɣð, vɣ] and [ðʝ], [vʝ], are reduced either to C_1 (target appendix) or C_2 (target head onset). Sonority, positional faithfulness, and contiguity are irrelevant to preserving C_1 or C_2. The latter selection is *PoA-driven*, preserving either the target C_1 or the target C_2, and obeys a relative hierarchy ranking of POA features that accounts for preserving C_1 or C_2. The data show that there is no grammar, i.e., no constraint ranking, that uniformly accounts for the segment preservations in the productions of all children under study. The data provide evidence that there is a dominant grammar (7/9 children) that demands the preservation of the consonant with a marked PoA, DORSAL, or LABIAL one, according to the dominance relation of the marked PoA features in the relevant PoA hierarchy ranking DORSAL > LABIAL > CORONAL. This dominant grammar conforms to the 'Preservation of the Marked' (de Lacy 2006). The grammars of 2/9 children demand the preservation of segments with marked and unmarked PoA; the hierarchy ranking DORSAL > CORONAL > LABIAL accounts for the preservation of the marked DORSAL and the unmarked CORONAL in these children's productions. In both grammars, i.e., PoA rankings, the undominated PoA is the marked DORSAL; therefore, the DORSAL segment of a target plateau cluster is always preserved.

The grammars as mentioned above provide evidence that they do not conform to a fixed PoA hierarchy ranking, thus they support the argument of de Lacy (2006) that a universally fixed PoA ranking cannot capture the preservation of both marked and unmarked features in the same grammar, as the grammar of Group B also shows.

We argue that the aforementioned grammars demonstrate different developmental paths regarding the simplification patterns of plateau clusters/sequences in the children's productions.

Ethics and consent

The ethical aspects of the research/fieldwork protocol have been approved by the Research Ethics Committee of the University of Crete (protocol approval no. 26/21.2.2022), and all participating children's parents/legal guardians have provided written informed consent.

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