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ASYMMETRY IN THE SIMPLIFICATION OF REVERSED SONORITY CLUSTERS IN (A)TYPICAL PHONOLOGICAL DEVELOPMENT: EVIDENCE FROM GREEK**

This paper explores the asymmetry in the disordered (atypical) Greek L1 phonological productions of a child with Developmental Language Disorder (DLD) compared to the productions of two non-disordered (typical) children. The study focuses on the simplification patterns of reversed sonority consonantal clusters, namely [S/FRICATIVE+STOP] and [S+FRICATIVE]. The data show that, while the non-disordered children simplify reversed sonority clusters in the same way by deleting the more sonorous consonant, the child with DLD applies two different simplification patterns, resulting from constraints that disallow featural Markedness. We propose that the asymmetry attested in the reduction is due to the employment of two distinct grammars by the two groups of children. The typically developing children employ the cross-linguistically widely attested sonority-driven reduction. Meanwhile, the grammar of the child with DLD is not motivated by sonority, but rather by a general avoidance for Markedness, retaining the unmarked [-continuant] Manner of Articulation in [S/FRICATIVE+STOP] clusters, while favoring the consonant with unmarked Place of Articulation in [S+FRICATIVE] clusters, where the Manner of Articulation of both segments is marked, i.e. [+continuant].

Key words: typical/atypical phonological development, falling/reversed sonority clusters, cluster simplification, asymmetrical patterns, DLD, sonority, markedness, syllable structure, Modern Greek

1. INTRODUCTION

Disordered phonology is manifest through a considerable delay in reaching developmental milestones, as well as through idiosyncratic patterns

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(processes, lack of contrasts, etc.) that can deviate from the patterns attested in typical phonological development (e.g. Grunwell, 1985).

In this case study, we explore the phonological grammars that motivate the divergent and asymmetrical productions of a child with Developmental Language Disorder (DLD) who exhibits a prominent language delay, while not conforming to the patterns attested in children during the typical development of Standard Modern Greek L1 phonological system. At the age of 4;10, the child with DLD still produces only singleton onsets, which means that the child has yet to acquire more complex/marked structures such as branching onsets of rising-sonority, e.g. [pl], and clusters of reversed/falling sonority with extrasyllabic adjuncts, e.g. [st, sp, sk]. In the case of reversed sonority target clusters, which are the focus of this study, an asymmetry is attested in the production patterns, as the child with DLD does not simplify all reversed sonority clusters in a uniform way. These patterns are reviewed in comparison to the reduction pattern that is attested in two -younger- children with typical phonological development, who still have not completely acquired reversed sonority clusters, and whose realizations conform to the sonority reduction pattern, which is widely attested in the language acquisition phonological literature.

2. BACKGROUND

2.1. On Sonority and phonotactics

The Sonority Sequencing Principle (Sievers, 1881; Jespersen, 1904; Clements, 1990; Selkirk, 1984; Blevins, 1995, among others) is a phonotactic principle which states that sonority peaks at syllable nucleus, while it gradually falls towards both syllable edges. Sonority rise and fall is determined by the Sonority Scale (Selkirk, 1984), where segments are sorted hierarchically according to their sonority. The universal ranking of segments on a Sonority Scale is OBSTRUENTS < NASALS < LIQUIDS < VOWELS (< : less sonorous than), according to the natural classes classification. However, more fine-grained scales have been proposed, according to language-specific phonotactics (cf. Steriade (1982) for Latin and Attic Greek, among many others). Steriade (1982) also claims that a language-specific *Minimum Sonority Distance* (MSD) is required among the members of the cluster in order for the cluster to be tautosyllabic.

For Standard Modern Greek (SMG), Malikouti-Drachman (1984) has proposed the Sonority Scale in (1), arguing for Voicing as the determining feature, therefore she groups together the voiceless STOPS and the non-strident voiceless

FRICATIVES as the least sonorous segments, proposing that tautosyllabicity is governed by the language-specific MSD ≥4 between the members of a cluster. Clusters with an MSD less than 4, or with reversed sonority, are considered heterosyllabic.

(1) STOPS, non-strident voiceless FRICATIVES < voiced FRICATIVES < S < Z < NASALS < LIQUIDS

/p, t, k/, /f, θ, x/ < /v, ð, γ / < /s/ < /z/ < /m, n/ < /l, ɾ/

less sonorous → more sonorous

rising sonority

(< : less sonorous than)

Given the Sonority Scale in (1) and the language-specific MSD ≥4 for SMG, the well-formed complex clusters of rising sonority are maximally restricted to two consonants. Specifically, only [OBSTRUENT+NASAL/LIQUID] clusters are allowed to be licensed as tautosyllabic under a branching onset in SMG, namely: [voiceless STOP/voiceless FRICATIVE+ NASAL/LIQUID], e.g. *pn, pl, pɾ,* etc., *fn, fl, fɾ, θn, θl, θɾ,* etc., [voiced FRICATIVE+(CORONAL) NASAL], i.e. *vn*, *γn* (the homorganic *ðn* is not realized), [voiced FRICATIVE+LIQUID], i.e. *vl, vɾ, γl, γɾ, ðɾ* (the homorganic *ðl* is not permitted in native SMG). The attested clusters [S$_1$+OBSTRUENT$_2$], i.e. [sp, st, sk, sf, sθ, sx], for example in the word [ˈ**sk**a.la] 'ladder', violate the *Sonority Sequencing Principle* in SMG, as sonority is not rising from the first to the second consonant, but it is reversed; namely, the sonority falls from the first more sonorous consonant (C$_1$), i.e. [S], to the second less sonorous (C$_2$), i.e. [OBSTRUENT]. Due to the latter sonority violation, a [S$_1$+OBSTRUENT$_2$] cluster does not constitute a well-formed tautosyllabic cluster and is not allowed to be prosodically licensed under a branching syllable onset, thus [S] lies outside the syllable, therefore it is called *extrasyllabic*, or *extraprosodic*. In order for [s] to be phonetically realized, it must be incorporated into a higher prosodic constituent, as an *adjunct/ appendix* to the left of a simple onset (e.g. Steriade (1982), among many others; cf. Vaux and Wolfe (2009) for a detailed overview of extrasyllabicity and the appendix in the phonological theory). In addition, it has been argued that extraprosodic segments are mainly (although not limited to) apical CORONALS cross-linguistically (see contributions in Paradis and Prunet (1991) for a relevant discussion). For SMG, it has been proposed that, in reversed/falling sonority clusters, C$_1$ is structurally represented as an *appendix* (e.g. Malikouti-Drachman, 1984; Kappa, 1995).

It has to be noted that, in SMG, clusters of [non-strident, voiceless FRICATIVE$_1$+voiceless OBSTRUENT$_2$], i.e. [ft, xt], e.g. [**ft**e'ɾo] 'wing', which are of equal sonority, according to the proposed Sonority Scale in (1), thus violating the *Sonority Sequencing Principle,* are also attested. In order to account for the latter clusters, Kappa (1995) argues for a language specific *scale of consonantal strength* in (2) (the reverse of the Sonority Scale), where STOPS and voiceless FRICATIVES are not grouped together, thus justifying the status of the voiceless FRICATIVE as an adjunct and of the stronger (or less sonorous) STOP as a HEAD-ONSET in [FRICATIVE_1+STOP_2] clusters, such as [ft] and [xt].

(2) STOPS > voiceless FRICATIVES > voiced FRICATIVES > s > z > NASALS > LIQUIDS

stronger ◄――――――――――――――――――― *weaker*

(Note : > stronger than).

The Sonority Sequencing Principle is irrelevant in SMG codas, owing to the fact that the (native) SMG phonological grammar only accepts singletons in coda position. Moreover, the segments accepted as a coda are restricted to the CORONALS [s] and [n] word-finally, and the Coronal sonorant consonants [n], [l], [ɾ] word-medially (e.g. Malikouti-Drachman, 1984, among others). This implies that, in falling sonority [S_1/FRICATIVE+OBSTRUENT_2] word medial clusters, C_1 cannot be licensed either under onset (which is due to reversed sonority, since C_1 is more sonorous than C_2) or under the preceding coda, even in cases when the preceding syllable is open, which is due to SMG phonotactics, regarding the segments allowed in word-medial codas. Thus, in SMG, C_1 in falling sonority clusters is parsed as an appendix at the left periphery of the syllable, either in a word-initial or in a word-medial syllable.

2.2 Extrasyllabicity in developing grammars

Patterns of phonological processes towards unmarked structures seem to be of a certain type in the progress of phonological development, whether it is disordered, or not (e.g. Chin and Dinnsen, 1992; Ingram, 1989a; 1989b, among others). It is widely accepted that syllable appendices are considered to be marked structures, compared to CV syllables with a singleton consonant under onset that are acquired first. Moreover, [S+OBSTRUENT] clusters seem to exhibit peculiarities regarding their order of acquisition (cf. Gierut (1999), who provides evidence that [S+OBSTRUENT] clusters are treated as unmarked structures in the acquisition of English).

In the studies on developing (disordered, or non-disordered) phonological grammars, [s] in [S+OBSTRUENT] clusters has been represented either as a *single unit* with the STOP following it, which means that it is represented as a complex segment, structurally analogous to an affricate (e.g. Barlow & Dinnsen, 1998; Gierut, 1999), or as an extrasyllabic/extraprosodic *adjunct*/*appendix* to the left edge of the syllable (e.g. Fikkert, 1994; Barlow, 2001; Goad & Rose, 2004, among many others).

Studies on the (typical) acquisition of SMG clusters (e.g. Kappa, 2002; Tzakosta, 2007; Tzakosta, 2009; Tzakosta & Vis, 2009 a; b; c; Sanoudaki, 2010) have shown that, in the realizations of children, the target[1] clusters of [S+OBSTRUENT] go through a deletion of the segment [s]. Tzakosta (2007) also shows that, while word-initial [OBSTRUENT+LIQUID] clusters are realized earlier at the intermediate acquisition stage, the [S/FRICATIVE+OBSTRUENT] clusters are still simplified. Sanoudaki (2007, 2010) shows that word-initial [S+OBSTRUENT] clusters are acquired before or after the [OBSTRUENT+LIQUID] clusters according to each child's grammar, while [OBSTRUENT+OBSTRUENT] clusters, i.e. [ft], [xt], are systematically acquired later than the [OBSTRUENT+LIQUID] clusters.

Nevertheless, children are expected to realize at least 75% of [S+STOP] clusters faithfully, regardless their word-initial/medial position, between the ages of 3;06 and 4;06 (PAL [Panhellenic Association of Logopaedics], 2000).

3. PRESENT STUDY

Our aim in this pilot study was to investigate the asymmetrical patterns that can be observed in typical versus disordered child Greek, specifically the asymmetry in the simplification of target *reversed (or falling) sonority clusters* [S/FRICATIVE+OBSTRUENT]: [st, sp, sk, sθ, sf, sx, ft, xt] (cf. §2.1). We investigated the production of the above target clusters in word-initial and word-internal position, both in stressed and in unstressed syllables.

In our study, the following research question arises: what drives this observed (a)symmetry in the simplification patterns of reversed sonority clusters in typical and atypical grammars, i.e. what are the relevant constraints/constraint rankings that differentiate the typical grammar from the atypical one? The analysis

[1] It should be noted that, throughout the study, the term *target(s)* refers to adult-like realization(s) to which the children are exposed in their ambient language (L1).

is couched in the framework of Optimality theory (Prince & Smolensky, 1993/2004), see §4.

3.1 Methodology

For the present study, we examined data of target [S/FRICATIVE+OBSTRUENT] clusters in SMG. The clusters were found word-initially or word-internally, both in stressed and in unstressed syllables. We studied their simplification patterns in typical and in disordered child speech.

(i) We studied the realizations of two typically developing children (girls), who were raised in Crete, acquiring SMG as their first language (L1). Both children were in the *intermediate phase of phonological acquisition* at the time of data collection. The relevant naturalistic, developmental productions and the data from picture-naming tasks were produced at ages from 2;06 to 3 years old.

(ii) We studied the realizations of a child with DLD. The child was raised in Crete, has acquired SMG as L1 and was diagnosed with DLD by the local public Center for Diagnosis, Differential Diagnosis and Support and consequently referred to a speech-language pathologist for intervention. It is stated that the child does not have any co-occurring emotional or cognitive disorders, mental or neurological damage, and is not deaf/hard of hearing at the time of data collection. The cross-sectional data for this child are drawn from Giannakaki (2020), who elicited them through a picture-naming task, when the child was 4;10 years old.

3.2 Data

3.2.1 Typically developing children

Both typically developing children exhibit the widely attested *sonority-based* reduction (see relevant data in Table 1), which is common in developing phonologies (for SMG, cf. Kappa, 2002; Tzakosta, 2007; Tzakosta, 2009). This means a reduction to the less sonorous cluster member, according to the language-specific Sonority Scale. In SMG, in the case of a consonantal cluster of a SIBILANT or FRICATIVE (C_1) followed by a STOP (C_2), and in the case of a SIBILANT (C_1) followed by a FRICATIVE (C_2), C_2 is always the less sonorous, or stronger, member, according to the scale in (2) proposed by Kappa (1995) for SMG (cf. §2.1).

For example, word-initially, the target word [ˈ**sx**a.ɾa] ‘grill’ is realized as [ˈ**x**a.ɾa], and the target [**sf**u.ˈga.ɾi] ‘sponge’ is realized as [**f**u.ˈga.ɾi] (1a). In these examples, a word-initial [S+ FRICATIVE] cluster is reduced to the less sonorous

FRICATIVE segment, both in a stressed syllable, e.g. [ˈ**sx**a.ɾa], and in an unstressed syllable, e.g. [**sf**u.ˈga.ɾi].

Examples of target [S/FRICATIVE+STOP] clusters (1b) are indicative of a reduction to the less sonorous STOP member, both in stressed and in unstressed syllables. For example, word-initially, the target [ˈ**sk**a.la] 'ladder' is realized as [ˈ**k**a.la] and word-medially the target [le.ˈ**ft**a] 'money' is realized as [le.ˈ**t**a].

The reduction pattern is present in about half relevant realizations (target words containing a [S/FRICATIVE+OBSTRUENT] cluster word-initially/medially, in stressed and unstressed syllables). The reduction ratio is 54.25%, whereas the clusters are realized faithfully in a ratio of 45.75%.

Table 1. Examples of realizations from typically developing children

1a) ***typical***				1b) ***typical***			
Target	Child's output	/Age	Gloss	Target	Child's output	/ Age	Gloss
s + FRIC → FRICATIVE				s/FRIC+STOP → STOP			
'**sx**aɾa	'**x**aɾa	/ 2;08.19	'grill'	'**st**oma	'**t**oma	/ 2;08.21	'mouth'
sxo'lio	**x**o'lio	/ 2;08.14	'school'	**st**a'fili	**t**a'fili	/ 2;08.28	'grape'
pa**sx**a'litsa	pa**x**a'litsa	/ 2;08.07	'ladybug'	a'**st**eɾja	a'**t**eja	/ 3;00.04	'stars'
'**sf**iga	'**f**iga	/ 2;09.12	'wasp'	'**sk**ala	'**k**ala	/ 2;08.14	'ladder'
sfu'gaɾi	**f**u'gali	/ 2;08.21	'sponge'	bi'**sk**oto	bi'**k**oto	/ 2;08.07	'biscuit'
				'**sp**iti	'**p**iti	/ 2;08.14	'house'
				spa'θi	**p**a'θi	/ 2;08.14	'sword'
				'la**sp**i	'la**p**i	/ 2;09.12	'mud'
				'**xt**ena	'**t**ena	/ 2;11.11	'comb'
				xta'poði	**t**a'poði	/ 2;09.12	'octopus'
				'ni**xt**a	'ni**t**a	/ 2;11.18	'night'
				fte'ɾa	**t**e'la	/ 2;11.11	'wings'
				le'**ft**a	le'**t**a	/ 2;05.20	'money'

3.2.2. DLD case study

The child with disordered phonology seems to have acquired all phonemes and allophones of the target language (however, affricates are not faithfully realized consistently). The child's productions in the dataset contain simple onsets to a great extent (97%), which implies that almost all clusters are reduced to a singleton, irrespective of well-formedness, stress, and position in the word. In other words, complex onsets, as well as syllable initial clusters with reversed sonority are yet to be acquired at this stage in this child's grammar (e.g. [ˈ**pl**i.o] 'boat' is realized as [ˈ**p**i.o]).

In this case study, two different reduction patterns are exhibited in the [S/FRICATIVE + OBSTRUENT] consonantal clusters under study (see relevant data in Table 2):

(i) in [S+FRICATIVE] targets (2a), namely in target words containing the clusters [sx] and [sf], there is a reduction to the more sonorous segment [s]. For instance, the target [**sx**o.ˈli.o] 'school', with the target cluster in a word-initial unstressed position, is realized as [**s**o.ˈli.o]. Moreover, the target [mo.ˈ**sx**a. ɾi] 'calf', with the target cluster at a word-medial stressed position, is realized as [mo.ˈ**s**a.ɾi].

(ii) in [S+STOP] or [FRICATIVE+STOP] targets (2b), namely [st, sp, sk] and [ft, xt], we observe a reduction to the less sonorous STOP segment, a pattern that is also observed in the typical realizations. For example, in the target [**st**a.ˈfi.li] 'grape' the [st] cluster at the word-initial unstressed position is realized as [**t**a.ˈfi.li], with the deletion of the SIBILANT. Similarly, the target [a.ˈ**sp**i.ða] 'shield', is realized as [a.ˈ**p**i.ʝa].

Reduction is frequent in the relevant data from the child with DLD. A 77% ratio of reduction and a 23% ratio of faithful realizations is observed.

Table 2. Examples of realizations from the child with DLD

2a) **DLD** / Age 4;10				2b) **DLD** / Age 4;10		
S + FRIC →	[s]	Gloss		S / FRIC + STOP →	STOP	Gloss
'**sç**imata	'simata	'shapes'		**st**a'fili	ta'**f**ili	'grape'
ce'ɾas**ç**a	ce'ɾasa	'cherries'		a'**st**eɾi	a'**t**eɾi	'star'
sxo'lio	so'lio	'school'		'**sk**ala	'**k**ala	'ladder'
mo'**sx**aɾi	mo'saɾi	'calf'		**sk**a'mni	**k**a'ni	'stool'
pas**x**a'litsa	pasa'lisa	'ladybug'		ða'**sk**ala	ða'**k**ala	'teacher' FEM
sfi'ɾi	si'ʝi	'hammer'		'mas**k**a	'ma**k**a	'mask'
po'ðo**sf**eɾo	po'ʝoseɾo	'soccer'		**sp**a'θi	**p**a'si	'sword'
				a'**sp**iða	a'**p**iʝa	'shield'
				'**xt**ena	'**t**ena	'comb'
				ni**xt**e'ɾiða	ni**t**e'ʝiʝa	'bat'
				'na**ft**is	'na**t**is	'sailor'

3.3. On the simplification patterns

As shown in the examples discussed in §3.2, both the two typically developing toddlers and the child with DLD seem to have yet to complete the development of the extraprosodic structure, thus they cannot realize an appendix either word initially or word medially. Concerning word-medial appendices, it should be noted again that, in SMG, a word-medial onset segment, that cannot be realized as an appendix at this stage, is unable to be accommodated at the preceding coda, due to the language phonotactics (cf. §2.1).

The cluster simplification observed in the data can be grouped in the following two patterns:

(i) When the *Manner of Articulation* of C_1 and C_2 differs, namely when C_1 is a [+continuant] s/voiceless FRICATIVE and C_2 is a [-continuant] STOP, both typically developing children (1b), as well as the child with DLD (2b) reduce the cluster to the least sonorous member, i.e. the STOP (C_2); e.g. the targets [**st**a.'fi.li] 'grape' and ['**sk**a.la] 'ladder' are realized by all children as [**t**a.'fi.li] and ['**k**a.la], respectively.

(ii) On the contrary, when the *Manner of Articulation* of C_1 and C_2 is identical, namely when C_1 is a [+continuant] [s] followed by a [+continuant] voiceless FRICATIVE (C_2), e.g. [sf, sx], then an asymmetry in the reduction patterns is observed (for a comparison, see Table 3). Specifically, the typically developing children in our study still reduce the cluster to the least sonorous member (1a), namely to the voiceless FRICATIVE (C_2); e.g. the target [**sx**o.'li.o] 'school' is realized as [**x**o.'li.o], whilst the child with DLD reduces the [S+ FRICATIVE] cluster to the more sonorous segment (2a), i.e. to [s]; e.g. the target [**sx**o.'li.o] is realized as [**s**o.'li.o].

Table 3. Comparison of simplification patterns

TARGET	SIMPLIFICATION PATTERN(S)	Child with DLD	Typically developing children
Appendix	No appendix word initially/-internally	✓	✓
Different MoA [s / FRIC+STOP], [st, sp, sk, ft, xt]	Reduction to the less sonorous (STOP)	✓	✓
Identical MoA [S+FRICATIVE], [sx, sf]	Reduction to the less sonorous segment (FRICATIVE)		✓
	Reduction to the more sonorous segment [s]	✓	

4. ANALYSIS

The data in §3.2 indicate that, in both grammars (typical and atypical), the attested simplification is driven by a preference for *unmarkedness*.

We propose that the prosodic structure in both grammars is not fully developed yet, therefore the extraprosodic/extrasyllabic segments cannot be licensed as adjuncts, hence simplification occurs. Furthermore, despite the older age of the child with DLD, the atypical grammar still retains the demand for phonological unmarkedness, i.e. realization of unmarked syllabic structures such as CV syllables, which is observed in the grammar of much younger children. This demand prompts simplification and, in competition with the constraints for faithful target-like productions, it results in the preservation of the less marked segment. More specifically:

The grammar of typically developing children uniformly simplifies all [S/FRICATIVE+OBSTRUENT] clusters, whether they are [S+FRICATIVE] (e.g. [sf] is reduced to [f] in table (1a)) or [S/FRICATIVE+STOP] (i.e. [sp] is reduced to [p] and [ft] is reduced to [t] in table (1b)), to the unmarked less sonorous segment, which is the segment with the higher consonantal strength, according to the relevant language-specific strength scale (Kappa, 1995) (cf. §2.1).

However, in the case study data of disordered phonological development, an asymmetry is manifest. We propose that, in the DLD child's grammar, the reduction of [S/FRICATIVE+OBSTRUENT] clusters is driven by a general avoidance of segmental markedness, that dictates the preservation of a segment which is unmarked for PoA, or has an unmarked [-continuant] MoA feature. Thus, two different selection patterns emerge. Specifically:

(i) Clusters where the *Manner of Articulation* (MoA) differs in continuance, i.e. [S+STOP] clusters, e.g. [sp, sk], are reduced to the segment with the unmarked MoA, that is the [-continuant] STOP, as seen in the examples in table (2b). This reduction pattern parallels the simplification to the less sonorous STOP pattern that is attested in the typically developing children.

(ii) Clusters of *relative similarity*, which have the same, marked for continuance, *Manner of Articulation,* namely the [+continuant] feature, and differ in PoA, such as the [s+FRICATIVE] clusters, e.g. [sf, sx], are reduced to the segment with the unmarked *Place of Articulation* (PoA), namely to the CORONAL [s][2], as seen in the examples in table (2a).

We claim that, in the grammar of the child with DLD, the reduction of reversed/falling sonority clusters is driven by the preservation of a segment bearing a maximum of one marked distinctive feature, either for MoA, i.e. [+continuant] or for PoA. Specifically:

a. The child realizes either a segment with a marked PoA (LABIAL or DORSAL) and an unmarked [-continuant] MoA (see above (i)); i.e. the clusters [sp] ([s+LABIAL STOP]) and [sk] ([s+DORSAL STOP]) are reduced to the segment with the unmarked MoA, therefore [p] and [k] are realized, respectively,

or

b. the child realizes a segment with a marked, [+continuant], MoA, and an unmarked CORONAL PoA (see above (ii)), i.e. both [s+LABIAL FRICATIVE] and [s+DORSAL FRICATIVE] clusters are reduced to the unmarked CORONAL [s].

On the contrary, in the grammar of the -younger- typically developing children the reduction is driven by a requirement for unmarkedness in sonority, not for unmarkedness in the PoA or in the MoA feature. Therefore, a less sonorous segment is selected and realized. The realized less sonorous segment(s) may bear both a marked MoA and a marked PoA, i.e. both [s+LABIAL FRICATIVE] and [s+DORSAL FRICATIVE] clusters are reduced to the less sonorous FRICATIVE with the marked PoA, LABIAL and DORSAL, respectively; e.g. [sf] is reduced to [f] and [sx] is reduced to [x].

For our formal analysis, we adopt the theoretical framework of Optimality Theory (OT) (Prince & Smolensky, 1993/2004), with Faithfulness constraints as defined in Correspondence Theory (McCarthy & Prince, 1995). In the framework of OT, the children must acquire the relative ranking of universal constraints that is relevant to their language (L1), as the phonological development proceeds. It is

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[2] Regarding the unmarkedness of CORONAL PoA, it has been argued in the phonological literature that coronal consonants are underspecified for PoA, therefore they are universally less marked than the labial and the dorsal ones (e.g. Rice and Avery, 1993; Rice, 1994, among others).

cross-linguistically observed that, in the earlier stages of phonological acquisition, children's realizations are characterized by unmarkedness; e.g., no branching (complex) onsets and no codas, no adjuncts, among others. Namely, the children realize only the unmarked CV syllables. According to OT, unmarkedness in children's realizations is attributed to the different ranking of the same constraints in the children's and in target (adult) grammars. In the children's grammars, Markedness constraints (against marked features, marked structures) are predominant and outrank Faithfulness constraints (M≫F) (cf. Demuth, 1995; Gnanadesikan, 1996; Smolensky, 1996; among many others), while in target (adult) grammars the reverse constraint ranking (F≫M) applies.

In the present study, in the grammar of all children, Markedness constraints are still ranked higher than Faithfulness constraints, resulting in the realization of unmarked structures.

The relevant constraints in this study are described below in (3) and (4).

(3) Faithfulness constraints

MAX-IO (McCarthy & Prince, 1995) This constraint demands a corresponding Output segment for every segment in the Input (No-deletion)

(4) Markedness constraints

a) Markedness constraint against adjuncts/appendices

*APPENDIX$_{[LEFT]}$ (Goad & Rose, 2004) One violation for every consonant attached to the left periphery of the syllable

b) Markedness constraints, that derive from the Sonority Scale for SMG in (2), (cf. §2.1):

*STOP	One violation for every STOP in the Output
*FRICATIVE	One violation for every FRICATIVE in the Output
*[s]	One violation for every [s] in the Output

Ranking Hierarchy of the above markedness constraints in (4b) for SMG:

*S ≫ * FRICATIVE ≫ * STOP

The above (partial) ranking hierarchy is the language-specific version of the *universal Margin Hierarchy* proposed by Prince & Smolensky (2004:160), cf. also Baertsch (2002). The above markedness hierarchy generates the *Margin Harmony* scale M/*s* ≺ M/*FRICATIVE* ≺ M/*STOP*, which states that it is less harmonic to parse a (strident) [s] as a margin segment, than to parse a FRICATIVE, and it is less harmonic to parse a FRICATIVE as a margin, than to parse a STOP.

c) Markedness constraints for MoA (Prince & Smolensky, 1993/2004):

*[+continuant] One violation for every [+continuant] segment in the Output

d) Markedness constraints for PoA (Prince & Smolensky, 1993/2004):

*DORSAL One violation for every DORSAL Place of Articulation in the Output
*LABIAL One violation for every LABIAL Place of Articulation in the Output
*CORONAL One violation for every CORONAL Place of Articulation in the Output

The above Markedness constraints for PoA in (4d) are hierarchically ranked as follows:

*DORSAL, *LABIAL ≫ *CORONAL (Smolensky, 1993).

In general, simplification in all children (both in children with typical phonological development and in the child with DLD) is driven by adherence to the undominated Markedness constraint against the realization of an appendix at the left edge of the syllable, which is ranked higher than MAX-IO, which forbids segmental deletion, thus

$$*\text{APPEND}_{[\text{LEFT}]} \gg \text{MAX-IO}$$

The constraint ranking in (5) results in the grammar (G1) of typically developing children, where reduction to the less sonorous emerges (cf. Table 4 and Table 5).

(5) CONSTRAINT RANKING in GRAMMAR-1 (G1)

$$*\text{APPEND}_{[\text{LEFT}]} \gg \text{MAX-IO} \gg *\text{s} \gg *\ \text{FRICATIVE} \gg *\ \text{STOP} \gg *[\text{continuant}] \gg *\text{DORSAL}, *\text{LABIAL} \gg *\text{CORONAL}$$

The constraint ranking in the grammar G1 (5) of typically developing children results in the realization of syllables where consonant clusters are reduced to the less sonorous consonant, according to the sonority hierarchy (scale) in (2).
While we propose the ranking in (5), only the ranking in (5a) with the constraints that are relevant for our analysis is presented in Table 4 and Table 5, for economy of space.

(5a) *APPEND[LEFT] ≫ MAX-IO ≫*[S] ≫* FRICATIVE ≫*STOP

As seen in *Table 4*, the target-like candidate (a), starting with a [s+Stop] cluster, is outranked by the undominated *APPEND[LEFT] constraint, due to the presence of the extrasyllabic adjunct [s]. Simplified candidates (b) and (c) both satisfy the undominated *APPEND[LEFT] constraint and violate the MAX-IO constraint, but (b) is outranked by a fatal violation of the *[s] constraint, which is satisfied by candidate (c). Therefore, (c) is selected as the optimal Output and the STOP is realized as the syllable onset.

Table 4. Grammar 1 - Reduction to the less sonorous

[ˈ**sk**ala]	*APPEND[LEFT]	MAX-IO	*[s]	* FRICATIVE	*STOP
a. ˈ**sk**a.la	*!	✓	*	*	*
b. ˈ**s**a.la	✓	*	*!	*	✓
☛c. ˈ**k**a.la	✓	*	✓	✓	*

Similarly, in *Table 5*, the target-like candidate (a), starting with a [S+FRICATIVE] cluster, is outranked as a result of violating the undominated *APPEND[LEFT] constraint, due to the adjunct [s]. Like in Table 4, simplified candidates (b) and (c) both satisfy the undominated *APPEND[LEFT] constraint and violate the MAX-IO constraint, but (b) is outranked by a fatal violation of the *[s] constraint, which is again satisfied by candidate (c). Subsequently, the less sonorous voiceless FRICATIVE is realized under the first syllable onset in the Output.

Table 5. Grammar 1 - Reduction to the less sonorous

['**sx**aɾa]	*APPEND[LEFT]	MAX-IO	*[s]	* FRICATIVE	*STOP
a. '**sx**aɾa	*!	✓	*	**	✓
b. '**s**aɾa	✓	*	*!	*	✓
☛c. '**x**aɾa	✓	*	✓	*	✓

In parallel to G1, the simplification in the grammar of the child with DLD (G2) is prompted by the Markedness constraint *APPENDIX[LEFT], which is undominated, and dominates MAX-IO.

The constraint interaction in (6) results in Grammar 2 (G2), illustrated in Table 6 and Table 7.

(6) CONSTRAINT RANKING in GRAMMAR-2 (G2)

$$*\text{APPENDIX}_{[\text{LEFT}]} \gg \text{MAX-IO} \gg *[+\text{continuant}] \gg *\text{DORSAL}, *\text{LABIAL} \gg *\text{CORONAL} \gg *\text{s} \gg *\ \text{FRICATIVE} \gg *\ \text{STOP}$$

For purposes of space economy and clarity, in Table 6 and Table 7, we are limited in the constraints and ranking in (6a)

$$\text{(6a)}\ *\text{APPENDIX}_{[\text{LEFT}]} \gg \text{MAX-IO} \gg *[\text{continuant}] \gg *\text{DORSAL}, *\text{LABIAL} \gg *\text{CORONAL}$$

In *Table 6*, candidate (a), which is target-like, is outranked due to the violation of the undominated $*\text{APPEND}_{[\text{LEFT}]}$ constraint, like in Table 4 and Table 5. While the simplified candidates (b) and (c) both violate MAX-IO, candidate (b) fatally violates *[continuant], as it contains two [+continuant] segments. Candidate (c) violates the markedness constraint *[continuant] minimally (only once), therefore it is selected as the optimal Output. The Markedness constraints for PoA do not play any pivotal role in the selection of the optimal candidate.

Table 6. Grammar 2 - Reduction to the unmarked MoA [-continuant]

[**sp**a'θi]	$*\text{APPEND}_{[\text{LEFT}]}$	MAX-IO	*[+continuant]	*DORSAL	*LABIAL	*CORONAL
a. **sp**a.'θi	*!	✓	**		*	**
b. **s**a.'θi	✓	*	**!		✓	**
☛c. **p**a.'θi	✓	*	*		*	*

Likewise, in *Table 7*, the faithful to the Input candidate (a), is outranked after violating $*\text{APPEND}_{[\text{LEFT}]}$, like in all the above tables. The simplified candidates (b) and (c) both violate MAX-IO, due to the deletion of one of the consonants of the [S+FRICATIVE] cluster. *[continuant] is also violated by candidates (b) and (c), which both start with a [+continuant] segment. Finally, candidate (c) is selected as optimal, as it does not violate the lower ranked *DORSAL constraint for PoA, which is violated by candidate (b), that starts with a DORSAL [x].

Table 7. Grammar 2 - Reduction to the unmarked CORONAL PoA

[**sx**oˈlio]	*APPEND[LEFT]	MAX-IO	*[continuant]	*DORSAL	*LABIAL	*CORONAL
a. **sx**o.ˈli.o	*!	✓	**	*		**
b. **x**o.ˈli.o	✓	*	*	*!		*
☛c. **s**o.ˈli.o	✓	*	*	✓		**

5. CONCLUSION

The analysis presented in this paper indicates that, while a demand for unmarkedness restricts the realizations and drives the processes in the course of phonological development, whether disordered or not, the constraint ranking, i.e. the relevant constraints that play a crucial role in the children's grammar, can differ between children with typical and children with disordered development.

In our study, the child with DLD has yet to acquire extrasyllabicity at the age of 4;10, exhibiting a delay in the development of prosodic structure. In addition to this delay, the grammar employed by this child differs from the sonority-driven grammar utilized by typically developing children, as we claim that simplification strategies in this child with DLD result from constraints that disallow featural markedness. The asymmetrical simplifications of reversed sonority clusters observed in the data of this case study originate from the demands of the divergent grammar.

These findings point towards the conclusion that phonological development in DLD can be both delayed and deviant, in comparison to the developmental milestones and the grammars put in use by typical children acquiring the same language.

As the present study investigates the phonology of a sole child with DLD, while data and analyses on the phonology of DLD in SMG are scarce, rigorous research on large participant samples is needed in order to understand whether this divergence is prevalent, and draw conclusions on whether acquisition in DLD in SMG is delayed, deviant, or both.

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