Alternative Grammars in Acquisition: Markedness- vs. Faithfulness-oriented Learning

Anthi Revithiadou and Marina Tzakosta[*]
University of the Aegean and University of Leiden

1. Introduction

In pursuing the question of how children acquire language, many researchers have claimed that in initial grammars ($G_{initial}$), markedness constraints are more influential in shaping children's outputs.[1] Inventories of entirely unmarked structures are expected to be more easily processed in production and/or comprehension but of course lack the range of distinctions required for the expressiveness of adult language. Whether the child starts constructing grammar(s) from a set of unranked constraints (Tesar and Smolensky 1993, 1998; Boersma 1998) or from a ranking where markedness outranks faithfulness (Tesar and Smolensky 2000), its job is to figure out possible ways, known as *learning paths* (cf. Levelt and Van de Vijver to appear) that will gradually help it to acquire the final grammar (G_{final}). It is the linguist's job to explain how a child reaches its goal by addressing and ultimately providing an answer to the following three fundamental questions: (a) given that there exists variation in children's outputs, does this suggest more than one grammar is active at a given time interval and, if yes, is there a predominant grammar at each developmental stage? (b) what are the typological characteristics of intermediate grammars and (c) how are they interconnected to form developmental paths? In this paper, following the *multiple parallel grammar* model of L1 acquisition, proposed in Revithiadou and Tzakosta (to appear), we assume intermediate stages of acquisition to be associated with several co-existing grammars that give rise to extensive variation in children's speech. In fact, the general picture that the Greek child database provides is that children produce variable outputs for a given target form not only during the same recording session but, in general, throughout the acquisition process. The emphasis, however, is on the typological properties of these intermediate grammars and, especially, those that constitute linking paths between initial and more advanced developmental stages.[2]

More specifically, we claim that multiple grammars may be active at a certain stage without, however, being equally forceful. In the stage we examine, the quantitatively dominant grammar, called the *core* grammar, is oriented towards the faithful production of the stressed syllable. Next to the core grammar, several other parallel grammars can be in force and leave a quantitatively significant imprint on the children's production data. In the present paper, we examine a parallel grammar that drives children to produce the stressed nucleus with the initial consonant of the word as an onset. In short, we argue in favor of the existence of multiple intermediate grammars that lead to the production of variable outputs for a single input form. To illustrate with an example, a word like /karpúzi/ 'water-melon' in adult Greek is produced systematically by young learners of the language as [púzi] or [kúzi]. We argue that the former output is derived from the stressed syllable core grammar whereas the latter output results from a grammar in which the initial consonant plus stressed nucleus is preserved. Crucially, such outputs suggest that children opt to preserve segmental material of phonologically prominent (stressed or initial) positions in their outputs. On the basis of this observation and in line with Tzakosta's (in prep.) empirical findings, we maintain that positional faithfulness-oriented grammars play a crucial role in intermediate stages of L1 acquisition.

Interestingly, a smaller fraction of children's productions shows partial compliance with markedness principles, which suggests that the effects of markedness constraints fade away as acquisition progresses without, however, being completely annulled.[3] Certain markedness principles such as the sonority hierarchy and the markedness scales are found to maintain a limited influence on the featural composition of the produced stressed syllable or the preserved initial consonant of the target form. The lingering effects of the sonority

[1] Smith 1973, Demuth 1995, Levelt 1995, Goad 1997, Gnanadesikan to appear, among others.
[2] We depart from the traditional notion of *stage* as this has been defined by several researchers on L1 acquisition (Fikkert 1994; Demuth and Fee 1995). We assume this term to refer to a phase in language acquisition associated with a set of grammars that share specific typological characteristics. For extensive discussion of this issue see Tzakosta (in prep.).
[3] Cf. Pater 1998 for the issue of minimal violation of constraints.

hierarchy imply the existence of sub-grammars (i.e. constraint hierarchies) where, in contrast with the grammars of initial states, only a subset of markedness constraints dominates positional faithfulness: *markedness >> positional faithfulness >> markedness*. Such *hybrid co-grammars* are instances of the *Emergence of the Unmarked* (McCarthy and Prince 1994) and, besides providing empirical support for gradual markedness demotion, they are also assumed to form natural linking paths between the markedness grammars of initial stages and the positional faithfulness grammars of advanced ones.

The above assumptions are based on the study of naturalistic data drawn from the Greek child language database developed at the University of Leiden Center for Linguistics. In particular, we examine data from three boys and two girls with an age range of 1;07 to 3;06.

The remainder of this paper is organized as follows: section 2 presents a brief overview of the multiple parallel model of language acquisition. Section 3 focuses on the hybrid co-grammars that act as linking paths between different developmental states of language acquisition. Section 4 offers a general discussion of the typology of emerging grammars in various states of developmental history and concludes this paper.

2.   The system of multiple parallel grammars

Based on evidence from the Greek child speech, Revithiadou and Tzakosta (to appear) propose a non-linear model of language development according to which acquisition proceeds through a network of multiple parallel grammars. In each stage, there is a statistically predominant production pattern derived from the core grammar.[4] The core grammar is not necessarily different at each phase of language acquisition. It may be the same throughout phonological acquisition or it may change at each phase or even group of phases depending on the acquisition tactics of each child. The fact, however, that children produce variable outputs for a given input string suggests that alternative grammars also exert an effect. Such co-emerging grammars, known as *co-grammars*[5], are distinct constraint rankings that are enforced in parallel with each other and with the core grammar. Although they are not as quantitatively pervasive as the co-grammars, they still represent a substantial fragment of the production data which is too systematic to be considered accidental or error-driven. More importantly, it is also shown that the intermediate grammars of this specific stage are not typologically distant since they all share a ranking in which some positional faithfulness constraints are ranked over sonority and the markedness scales constraints. Let us have a close look at the Greek acquisition data that provide support for the proposed model of L1 acquisition.

In Greek, the vast majority of children's productions arise from a stressed-syllable faithfulness (ɔ́-faithfulness) grammar which favors templatic outputs[6] that preserve the segmental content of the stressed syllable in the target language. Monosyllabic truncations of the ɔ́-faithfulness pattern are given in (1).

(1) *monosyllabic truncations*
a	/ˈɣa.ta/	[ˈɣa]	'cat'	B2: 1;10
b	/ˈmi.ti/	[ˈmi]	'nose'	B2: 1;11.15
c	/kli.ˈði/	[ˈði]	'key'	D: 2;02
d	/sci.ˈla.ci/	[ˈla]	'dog-DIM'	F: 2;0.04
e	/ˈvle.po/	[ˈvle]	'see-1sg'	F: 2;05.09

It is evident from these data that children will realize the prosodic head of a target word, i.e. the stressed syllable, irrespective of whether its onset is structurally simple as in (1a-d) or complex as in (1e). Evidently, sonority considerations are inert in segmental selection. In (1a) and (1b), the voiced dorsal fricative /ɣ/ and the voiced labial sonorant /m/, respectively, are realized at the expense of the more unmarked voiceless coronal stop /t/ which occurs in the neighboring unstressed syllable.

The same holds for disyllabic truncations, as shown in (2). Polysyllabic words are truncated to disyllabic ones from the age of 1;10 (cf. B1) up to the age of 2;08.15 (cf. F). Regardless of the size of output words, the examples in (2) also show that children are faithful to the stressed syllable and its segmental content. It is the head of the prominent foot that the child produces faithfully, even if this means that a dorsal /k/ is produced

---

while the more unmarked coronal /t/ is not (2a), or that the voiced fricative /ɣ/ is favored over the voiceless stop /t/ (2e).

(2) *disyllabic truncations*
    a /por.to.ˈka.li/   [ˈka.li]   'orange'   B1: 1;10
    b /me.ˈɣa.lo/   [ˈɣa.lo]   'big'   B1: 1;11.09
    c /ka.ˈpe.lo/   [ˈpe.loː]   'hat'   M: 2;0.06
    d /cĕ.li.ˈðo.ni/   [ˈðo.ni]   'swallow'   F: 2;08.15
    e /tra.ɣˈu.ðja/   [ˈɣu.ja]   'song-pl'   D: 2;01.23

In order to account for the above facts, we must rely on the notion of prosodic headedness. It is well-established that phonological heads show the maximum complexity allowed by the grammar. If there is an asymmetry, the head will be more complex than the dependent. For instance, heads of feet are often heavier (i.e. bi-moraic) than their dependents. Similarly, certain phonemic contrasts are tolerated only in prosodic heads such as onsets or stressed syllables (cf. Dresher and Van der Hulst 1998). The saliency of prosodic heads has led researchers to propose head-specific faithfulness constraints such as HEADFAITH,[7] (Alderete 1995) stated in (3):

(3) HEADFAITH: Preserve the segmental and the featural composition of an input prosodic head in the output.

Ranked above the sonority and the markedness scales constraints, as shown in (4), HEADFAITH guarantees that the stressed syllable will be pronounced and, moreover, that its segmental content will be faithfully realized in the child's output. Consequently, all markedness constraints referring to voicing, manner and place of articulation are irrelevant to the selection of the optimal candidate. It should be pointed out that independent markedness constraints determine the monosyllabic and disyllabic template size of the outputs (cf. fn 6). The following tableaux spell-out the details of the competition that leads to the surfacing of the outputs listed in (1) and (2):

(4) HEADFAITH >> *VOI, *FRIC, {*DORS, *LAB >> *COR}

T1 /ˈɣa.ta/	HEADFAITH	*VOI	*FRIC	*DORS	*LAB	*COR
a [ˈta]	*!					*
☞ b [ˈɣa]		*	*	*		
c [ˈka]	*!			*		

T2 /cĕ.li.ˈðo.ni/	HEADFAITH	*VOI	*FRIC	*DORS	*LAB	*COR
☞ a [ˈðo.ni]		*	*			*
b [ˈdo.ni]	*!	*				*
c [ˈto.ni]	*!					*

The grammar in (4) qualifies as the *core grammar* because, besides being cross-linguistically well-attested, it is quantitatively prevalent in the speech of all children of our study during all states of intermediate development.[8]

However, the Greek L1 learners also make use of several parallel grammars, which are not as prevalent as the core grammar. In such cases, production focuses on the faithful preservation of the word-initial consonant, which is realized as the onset of the stressed nucleus of the target form. The monosyllabic and di-/trisyllabic truncations in (5) and (6), respectively, are telling in this respect. In the examples in (5), faithfulness to the initial segment is pursued at all costs. In (5a), for instance, the dorsal fricative /ɣ/ is retained even though it is more marked than the voiceless /k/ which occurs in the stressed syllable. Similarly, in (5b) the labial /p/ wins out over the dorsal /k/ in the stressed syllable and the coronal /t/ in the peninitial one, whereas in (5c-d) the labial /b/ supersedes the coronal sonorant /r/ which occurs in the head syllable.

---

[7] The constraint comprises both HEAD-MAX which requires input segments of a prosodic head to be preserved in the output, and HEAD-IDENT[F] which requires correspondent segments contained in a prosodic head to be identical for F. Thus, HEADFAITH is violated when, for instance, an input prosodic head such as /ɣa/ surfaces as [ˈka] or [ˈa].
[8] In a model of partially ordered constraints, this quantitative effect is derived by assuming that more total orders conspire towards the same output.

(5) *monosyllabic truncations*

  a /ɣli.ˈko/   [ˈɣo]   'sweet'   D: 2;01.09
  b /por.to.ˈka.li/   [ˈpa]   'orange'   B2: 1;11.28
  c /boró/   [bó]   'can-1sg'   B(1): 2;05.07
  d /borí/   [bí]   'can-3sg'   D: 2;08.16

The same picture emerges from the di- and trisyllabic truncations in (6). We observe that consonants that are more marked with respect to the manner and/or place of articulation than the onset of the stressed syllable in the adult form, are also retained in children's outputs. More specifically, in (6a), dorsals and labials are realized at the expense of the relatively unmarked coronals. Moreover, in (6b), fricatives are preferred over stops regardless of voicing values. The same holds for the trisyllabic forms in (6c) and (6d). Here, however, the initial syllable is often preserved at the expense of the non-initial unmarked one. In (6c), for instance, the leftmost syllable with the dorsal or labial onset is pronounced instead of the unmarked (coronal) second one. Finally, in (6d), fricatives win out over stops.

(6) *di-/trisyllabic truncations*

  a /kra.ˈta.o/   [ˈka.o]   'hold-1sg'   F: 1;11.15
    /pi.e.ˈro.tos/   [ˈpo.toθ]   'clown'   D: 2;03.28
  b /fri.ɣa.ˈnu.la/   [ˈfu.la]   'cracker-DIM'   D: 2;03.07
    /ɣu.ru.ˈna.ci/   [ˈɣa.ci]   'pig-DIM'   D: 2;03.14
  c /ka.ra.ˈme.les/   [kaː.ˈme.lec̚]   'sweet-pl'   B1: 2;05.07
    /me.li.ˈti.ni/   [me.ˈti.ni]   'Melitini'   D: 2;04.05
    /pe.ta.ˈlu.ða/   [pe.ˈlu.ða]   'butterfly'   F: 2;07.17
  d /ɣu.ru.ˈna.ca/   [ɣu.ˈna.ca]   'pigs-DIM.pl'   B1: 2;09.12
    /fo.to.ɣra.ˈfi.es/   [fa.ˈfi.eθ]   'photograph-pl'   D: 2;04.05

The word initial position has been claimed to be special in many ways, e.g. as being salient in perception and, by extension, in language processing (cf. Smith 2002 and references cited therein). Production data from Greek child speech add to the bulk of empirical evidence in support of this observation. Special positional faithfulness constraints have been proposed in order to deal with the increasing evidence that neutralization of featural contrasts primarily affects perceptually non-salient positions (Beckman 1998 *et seq.*). The fact that in children's speech faithful productions target prosodically salient positions and, in particular, word initial consonants suggests that the following positional faithfulness constraint needs to be added to the repertoire of analytical tools:

(7) #C-FAITH:[9] Preserve the input initial consonant and its features in the output.

The grammar responsible for the truncations in (5) and (6) takes the form of the constraint ranking in (8).[10] Tableaux 3 and 4 illustrate the effects of the hierarchy that top-ranks #C-FAITH. It is important to emphasize that this secondary grammar exists in parallel with the core grammar in (4).

(8) #C-FAITH >> HEADFAITH >> *VOI, *FRIC, {*DORS, *LAB >> *COR}

T3 /por.to.ˈka.li/	#C-FAITH	HEADFAITH	*VOI	*FRIC	*DORS	*LAB	*COR
☞ a [ˈpa]		*				*	
b [ˈka]	*!				*		
c [ˈta]	* !	*					*

T4 /kar.ˈtu.la/	#C-FAITH	HEADFAITH	*VOI	*FRIC	*DORS	*LAB	*COR
☞ a [ˈku.la]		*			*		
b [ˈtu.la]	*!		*			*	

Since it is highly ranked, #C-FAITH does not allow the markedness scales nor the sonority constraints to exercise any influence on the shape of outputs. The preservation of the stressed nucleus reveals the relatively high rank HEADFAITH occupies.

---

[9] The constraint comprises both #C-MAX and #C-IDENT[F].

[10] When the template size increases, the optimal outputs satisfy both positional faithfulness constraints.

The following table, adapted from Revithiadou and Tzakosta (to appear), provides a general picture of the distribution of the faithfulness grammars that are active during this stage of language development. Note that cell *1a* in Table 1 represents only the part of the core grammar that refers to stressed initial syllables. This is because the core grammar numbers several thousands of words, a fact that makes it impossible to provide a global overview of the distribution of the core grammar and the parallel co-grammars. Still the high percentage of outputs that faithfully preserve the segmental content of the prosodic head of the word, especially in monosyllables, suggests that the responsible grammar should be more central in the system than the co-emerging alternative grammars. In addition, it should also be noted that the core grammar in cell *1b* forces the production of trochaic forms by preserving the stressed syllable together with an unstressed one in di-/trisyllabic formations . On the other hand, the grammar in cell *2b* endorses the preservation of the initial unstressed plus the stressed syllable, yielding iambic outputs. The percentages of the remaining production patterns in cells *3* and *4* are high enough to impose distinct parallel co-grammars in the children's productions. It is important to notice that the sum of the preferred grammars, namely the core grammar and the grammars that require maintenance of material in word-initial position, demonstrate the major tendency in Greek child speech of this stage, namely the preservation of segmental material of phonologically prominent positions.

Faithfulness grammars/produced words	monosyllabic words	di-/trisyllabic words[11]
1 a initial stressed syllable	79.3% (300)	
b initial stressed syllable + unstressed syllable (trochee)		26 % (37)
2 a initial unstressed syllable	15.1 % (57)	
b initial unstressed syllable + stressed nucleus (iamb)		45.1 % (64)
3 initial consonant + stressed nucleus	3.7 % (14)	28.9 % (41)
4 initial consonant + unstressed nucleus	1.9 % (7)	0 % (0)
Total	**100% (378)**	**100 % (142)**

Table 1: Faithfulness grammars in intermediate stages of L1 acquisition

Although the effects of markedness constraints diminish as acquisition progresses, traces of sonority effects can still be found in advanced states of L1 acquisition. This issue is addressed in detail in the following section.

3.   Hybrid co-grammars

As we discussed in the previous section, Greek children employ more than one grammar at the same time during the course of acquisition. We have shown that in the network of multiple parallel grammars, positional faithfulness constraints are high ranked. This suggests that as language maturation proceeds, the effects of markedness principles such as the sonority hierarchy and the markedness scales fade away. Our data do illustrate, however, that these principles do not vanish completely, since partially 'unmarked' outputs are also produced in children's speech. This is an instance of minimal constraint violation, as proposed by Pater (1998). More specifically, we argue that there are parallel sub-grammatical systems, called *hybrid co-grammars*, where certain markedness constraints occupy a rank which allows them to exercise a *partial* influence on positional faithfulness. We argue that such markedness-driven constraint hierarchies in fact constitute linking paths between advanced and initial states of acquisition. Furthermore, we show that Greek children become gradually faithful to their target grammars by demoting clusters of markedness constraints thus providing empirical support for Tesar and Smolensky's (2000) gradual markedness constraint demotion. We claim that these linking paths are instances of the *Emergence of the Unmarked* (McCarthy and Prince 1994). We start by exploring markedness effects on the stressed syllable faithfulness grammar (section 3.1) and then move on to their impact on the initial consonant faithfulness grammar (section 3.2).

3.1 Sonority effects on the stressed syllable faithfulness core grammar

The sonority hierarchy and the markedness scales have often been found to exercise a partial influence on children's outputs cross-linguistically (cf. Kehoe 1995, 2000, for English). Minimal markedness effects are found with respect to both positional faithfulness grammars discussed in section 2. Influence of markedness is

---

[11] The statistics for di-/trisyllabic truncated forms come from two children only, namely F and D, whose data cover an extended part of the age range under investigation.

evidenced in child Greek in production data such as the ones in (5) and (6). More specifically, the segmental composition of the targeted stressed syllable is often changed in favor of the unmarked feature values. For instance, in (5a-c) fricatives are realized as stops, suggesting that the marked [+continuant] value of the fricative changes to the less marked [-continuant]. In (5c), a coronal stop is selected over the labial fricative. It is evident that such outputs arise from a ranking where *FRIC dominates HEADFAITH. Moreover, in (5d-e) the voicing value of the onset of the stressed syllable is altered towards the unmarked value, i.e. [-voice], which suggests that *VOI occupies occupies a high rank in the hierarchy.

(5) *monosyllabic truncations*

a	/ˈva.lo/	[ˈba]	'put on-1sg'	B (2): 1;10
b	/kra.ˈsi/	[ˈti]	'wine'	D: 2;03.14
c	/le.ˈfta/	[ˈta]	'money'	F: 2;01.11
d	/ˈble/	[ˈple]	'blue'	B2: 1;11.14
e	/ˈva.tra.xos/	[ˈfax]	'frog'	F: 2;05.09

Similar shifts to the unmarked value are exhibited by disyllabic truncations, as shown in (6). The combined effects of *VOI and *FRIC can be seen in the form *pe.ða.ca* (6c) where the voiced fricative surfaces as a voiceless stop, [ˈta.ca].

(6) *disyllabic truncations*

a	/e.kli.ˈsu.la/	[ˈtu.la]	'church-DIM'	Me: 1;07.05
	/ka.ˈre.kla/	[ˈte.ca]	'chair'	F: 1;11.21
	/ka.la.ˈθa.ci/	[ˈta.ci]	'basket-DIM'	Me: 2;03.01
b	/ka.ra.ˈme.la/	[ˈpe.la]	'sweet'	F: 1;11.28
	/tre.ˈna.ci/	[ˈta.ci]	'train-DIM'	B2: 1;11.28
c	/pe.ˈða.ca/	[ˈta.ca]	'children-DIM.pl'	M: 2;02.24

The rankings in (7) formalize the described system of affairs. The selection of the optimal candidates is illustrated in tableaux 5 and 6, respectively. In all these rankings, only a subset of markedness constraints outranks HEADFAITH, thus giving rise to partially unmarked outputs.

(7) *sonority effects on the σ́-faithfulness core grammar*
    a   *FRIC >> HEADFAITH >> *VOI, {*DORS, *LAB >> *COR}: (5a-c), (6a)
    b   *VOI >> HEADFAITH >> *FRIC, {*DORS, *LAB >> *COR}: (5d-e), (6b)
    c   *VOI, *FRIC >> HEADFAITH >> {*DORS, *LAB >> *COR}: (6c)

T5 /ˈva.lo/	*FRIC	HEADFAITH	*VOI	*DORS	*LAB	*COR
a [ˈva]	*!		*		*	
☞ b [ˈba]		*	*		*	

T6 /pe.ˈða.ca/	*VOI	*FRIC	HEADFAITH	*DORS	*LAB	*COR
a [ˈda.ca]	*!		*			*
b [ˈθa.ca]		*!	*			*
☞ c [ˈta.ca]			*			*

A fundamental premise of Optimality Theory (Prince and Smolensky 1993) is that different constraint rankings correspond to different grammars. Consequently, the rankings in (7) represent several parallel co-grammars in Greek child speech. As mentioned in section 2, the co-grammars are distinct constraint rankings that are enforced in parallel with each other and with the core grammar. Crucially, depending on which markedness constraint is top-ranked, different markedness outputs emerge. The co-grammars in (7), in particular, reflect the minimal effects of markedness on the faithfulness-based core grammar and, in a sense, are relics of earlier stages of acquisition where markedness constraints dominated. This point becomes clear if we take into consideration the following examples:

(8) *markedness core grammar: cor > dors, lab*

a	/ka.ˈse.ta/	[ˈte.ta]	'tape'	D: 2;1
b	/pi.ˈsto.li/	[te.ˈto.li]	'pistol'	D: 2;1
c	/pe.ˈða.ca/	[ˈta.ta]	'child-DIM.pl'	D: 2;2

The examples in (8) are produced by D during initial stages of acquisition and reflect the effects of a markedness grammar. Outputs with voiceless coronals are favored over faithfulness productions of the adult forms. We infer, therefore, that at this developmental state sonority and markedness scales must outrank faithfulness to the prosodic head: *VOI, *FRIC, {*DORS, *LAB >> *COR} >> HEADFAITH.

We can now see that the co-grammars in (7), all of which show remnants of markedness dominance, represent *linking paths* that connect the markedness grammar of early acquisition with the faithfulness grammar of advanced language development. In other words, we claim that the markedness and faithfulness grammars are not isolated from each other but rather are linked by what we call *hybrid co-grammars*. This, in turn, entails that the learner does not follow a single path of linearly ordered grammars. On the contrary, the child enters into a network of manifold grammatical systems, which are interconnected by linking paths (see figure 1, section 4). Crucially, the existence of hybrid co-grammars provides empirical evidence in favor of constraint demotion. Children become gradually faithful to their target grammars by demoting clusters of markedness constraints. Furthermore, hybrid co-grammars represent a small fraction of children's production data, a fact that is expected under the present hypothesis. Linking paths represent transitional stages of development and cannot be more forceful numerically than core grammars. Actually, just 28% of the total number of di-/trisyllabic truncations (e.g. the examples in (6)) is the by-product of a hybrid grammar.

Finally, it should also be mentioned that the rankings in (7) constitute only some of the possible hybrid co-grammars. Constraint permutation provides all possible linking paths that progressively assist the acquisition of the final state of the adult grammar. The rising number of possible co-grammars is not considered problematic for the theory nor for language acquisition per se, since multiple grammars facilitate language learning and provide alternatives towards the child's primary goal, namely the acquisition of the target grammar. The Greek acquisition facts reveal that children actually employ several alternative grammars in order to achieve this goal. In the following section, we present evidence for the emergence of a parallel positional faithfulness grammar, which, as will be shown, leaves a lesser statistical imprint on the production data than the hybrid grammar presented here.

3.2 Sonority effects on initial consonant faithfulness

Sonority and markedness effects are not only evident in the stressed-syllable core grammar but also in the initial consonant faithfulness grammar. The data in (9) and (10), respectively, illustrate that faithfulness constraints are trapped between markedness constraints, the latter determining the segmental quality of the produced form. Specifically, in cases of cluster reduction, as in (9), it is the less marked member of the cluster with respect to manner of articulation that is selected. In cases of segmental selection in truncated forms, as in (10), on the other hand, the initial segment of the target form is retained in the children's outputs provided it is unmarked. Otherwise, it is replaced by a less marked segment. Again, this substitution basically refers to the manner rather than to the place of articulation. These cases are also instances of the *Emergence of the Unmarked* (McCarthy and Prince 1994) since markedness constraints impose a minimal effect on the segmental content of the produced forms but faithfulness constraints are still influential enough to demand certain properties of the input to be reflected on the output.

(9) *stop > fricative*

a	/ˈsci.lo/	[ˈci.o]	'dog-ACC.sg'	Me: 1;07.14
b	/ˈste.la/	[ˈteː]	'Stella'	Me: 1;08.31
c	/sku.ˈpi.ðja/	[ˈci.ja]	'trash'	Me: 2;0.26
d	/pla.ste.ˈli.ni/	[pa.te.ˈli]	'plaster'	F: 2;06.24

(10) [*-voice*] > [*+voice*], *stop > fric*

a	/ɣa.lo.ˈpu.la/	[ka.ˈpu.la]	'turkey'	F: 2;01.18
b	/ti.ˈle.fo.no/	[ˈte.fo]	'phone'	D: 2;04.13
c	/ˈθa.la.sa/	[ˈta.la]	'sea'	D: 2;07.27

The selection of the optimal output is illustrated in tableaux 7 and 8. In T7, *FRIC is crucially ranked above #C-FAITH. This ranking accounts for the fact that #C-FAITH is partially satisfied since the coronality of the input segment is faithfully produced. From the rank it occupies, the pecific markedness constraint can only exercise control on the manner of articulation of the output productions. In T8, on the other hand, both *FRIC and *VOI are ranked higher than #C-FAITH and together are responsible for depriving the initial consonant of the winning output from the [+voice] and [+continuant] features that its input correspondent has.

(15) *sonority effects on #C-faithfulness grammars*
    a   *FRIC >> #C-FAITH >> HEADFAITH >> {*DORS, *LAB >> *COR}
    b   *FRIC, *VOI >> #C-FAITH >> HEADFAITH >> {*DORS, *LAB >> *COR}

T7 /'sci.lo/	*FRIC	#C-FAITH	HEADFAITH	*DORS	*LAB	*COR
☞ a ['ci.o]	*!	*		*		*
b ['si.o]			*			*

T8 /ɣa.lo.'pu.la/	*FRIC	*VOI	#C-FAITH	HEADFAITH	*DORS	*LAB	*COR
☞ a [ka.'pu.la]					*		
b [xa.'pu.la]	*!				*		
c [ga.'pu.la]		*!			*		

Table 2 exhibits the rate of sonority effects of hybrid grammars on the positional faithfulness grammars. Markedness effects are more robust on the σ́-faithfulness core grammar than on the #C-faithfulness grammar. This may be due to the numerical prevalence of the former. Table 2 demonstrates that out of 684 monosyllabic truncations 200 cases exhibit sonority effects. The rest of the cases represent the core grammar, free from any sonority effects. For disyllabic and trisyllabic forms, on the other hand, only in 47 out of 167 reported cases sonority exercises influence on the core grammar. The rest of the percentage refers once again to the core grammar. The percentages for the #C-faithfulness grammar are to be explained accordingly.

Sonority effects/ produced words	monosyllabic truncations	di-/trisyllabic truncations[12]
1 on the σ́-faithfulness grammar	29.2% (200/684)	28.1% (47/167)
2 on the #C-faithfulness grammar	5.4% (37/684)	13.7% (23/167)

Table 2: Sonority effects on positional faithfulness grammars

5.   Summary and conclusions

In this paper, we focused on intermediate phases of L1 phonological acquisition and maintained that they are associated with faithfulness grammars as opposed to initial states, which are primarily connected with markedness grammars. The first goal of this paper was to illustrate that L1 learning of Greek does not proceed in a linear, stage-like fashion where each stage is associated with a single grammar. On the contrary, we argued in favor of a non-linear network of multiple co-emerging grammars which share a common typological characteristic, namely high-ranking of positional faithfulness. To be more specific, we showed that there exists a core grammar which, first, demands the preservation and faithful segmental realization of the stressed syllable and, second, is more dominant than the others throughout the stage under investigation. Furthermore, we claimed that this core grammar is accompanied by a set of co-emerging faithfulness grammars which constitute alternative developmental paths that children may follow during the process of acquiring their native language. Naturally, such faithfulness-oriented grammars generate variable output forms that are different instantiations of positional faithfulness. The general picture that the Greek child database provides is that children produce variable outputs for a given target form not only during the same recording session but, in general, throughout the acquisition process. In line with this, the data we are concerned with here confirm that variation is systematic enough to motivate distinct rankings, which may differ from the ranking of the core grammar only minimally.

The Greek acquisition data further demonstrate that, as phonological acquisition proceeds and children display gradual faithfulness to the input, markedness exercises some degree of influence on the output forms. These marginal markedness grammars are instances of the *Emergence of the Unmarked* and, moreover, act as linking paths between grammars of initial and more advanced stages of acquisition. The existence of hybrid co-grammars conforms to the claim that children become gradually faithful to their target grammars by demoting markedness constraints. With hybrid co-grammars, the *whys* and the *hows* of phonological acquisition stop being an unsolved puzzle since they provide the appropriate ground to explain why markedness effects are widely found in child data cross-linguistically. The proposed constellation of grammars is depicted in figure 1.

---

[12] The statistics for di-/trisyllabic truncated forms come from two children only, namely F and D, whose data, nevertheless, cover an extended part of the age range under investigation.
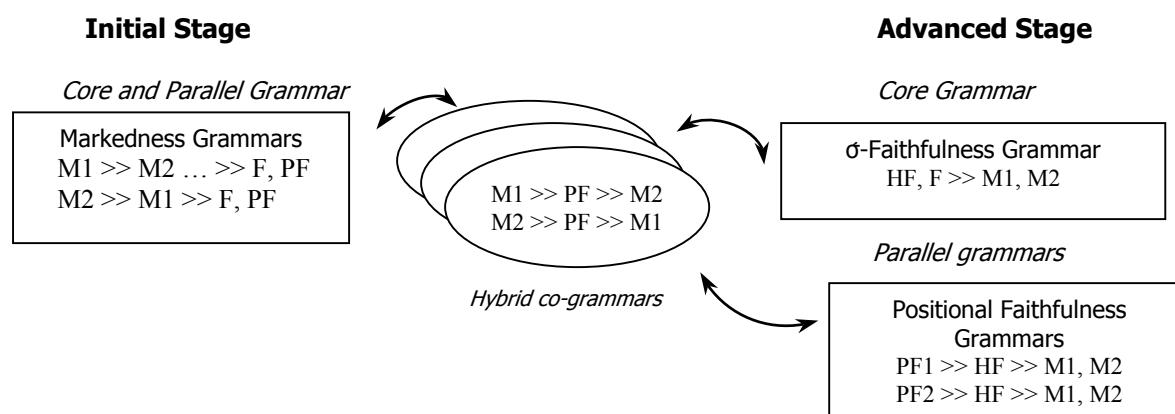
Figure 1: The network of multiple parallel grammars

To conclude, in this study we presented a general model of how the order of acquisition is structured. We are confident that future research will show that the proposed model of multiple parallel grammars is not an accidental compilation of typologically diverse grammars but rather a coherent and dynamic system that safely leads the learner to the acquisition of the target language.

References

Alderete, J. (1995) 'Head dependence in stress-epenthesis interaction', in: B. Hermans & M. van Oostendorp (eds.) *The Derivational Residue in Phonology*, Amsterdam: John Benjamins, 29–50.

Anttila, A. (1997). *Variation in Finnish Phonology and Morphology*. Doctoral dissertation, Stanford University, California.

Beckman, J.N. (1998) *Positional Faithfulness*. Doctoral dissertation, University of Massachusetts, Amherst.

Boersma, P. (1998) *Functional Phonology. Formalizing the Interactions between Articulatory and Perceptual Drives*. Doctoral dissertation. Amsterdam: IFOTT/LOT 11.

Demuth, K. (1995) 'Markedness and the development of prosodic structure', in: J. Beckman (ed.) *Proceedings of NELS 25*. University of Massachusetts, Amherst: GLSA, 13–25.

Demuth, K. and J. Fee (1995) *Minimal Words in Early Phonological Development*. Ms. Brown University, Providence, Rhode Island, and Dalhousie University, Halifax, Nova Scotia.

Dresher, B.E. & H. van der Hulst (1998) 'Head-dependent asymmetries in phonology: Complexity and visibility'. *Phonology* 15, 317–352.

Fikkert, P. (1994) *On the Acquisition of Prosodic Structure*. Doctoral Dissertation, HIL/Leiden University. The Hague: Holland Academic Graphics.

Gnanadesikan, A. (to appear) 'Markedness and faithfulness constraints in child phonology', to appear in: R. Kager, J. Pater and W. Zonneveld (eds.) *Constraints on Phonological Acquisition*. Cambridge: CUP.

Goad, H. (1997) 'Consonant harmony in child language', in: S.J. Hannahs and M. Young-Scholten (eds.) *Focus on Phonological Acquisition*. Amsterdam: John Benjamins, 113–42.

Itô, J. and A. Mester (1995) 'Japanese phonology', in J.A. Goldsmith (ed.) *The Handbook of Phonological Theory*. Oxford: Blackwell, 817–838.

Kehoe, M. (1995) *An Investigation of Rhythmic Processes in English-Speaking Children's Word Productions*. Doctoral dissertation, University of Washington.

Kehoe, M. (2000) 'Truncation without shape constraints: The latter stages of prosodic acquisition. *Language Acquisition* 8, 23–67.

Levelt, C.C. (1995) 'Unfaithful kids: Place of articulation patterns in early child language'. Paper presented at the Dept. of Cognitive Sciences, John Hopkins University, Baltimore.

Levelt, C.C. and R. van de Vijver (to appear) 'Syllable types in cross-linguistic and developmental grammars', to appear in: R. Kager, J. Pater and W. Zonneveld (eds.) *Constraints on Phonological Acquisition*. Cambridge: CUP.

McCarthy, J.J. and A. Prince (1994) 'The Emergence of the Unmarked: Optimality in Prosodic Morphology', in: M. Gonzàlez (ed.) *Proceedings of the NELS* 24. University of Massachusetts, Amherst: GLSA, 333–379.

Orgun, C.O. (1996) *Sign-based Morphology and Phonology with Special Attention to Optimality Theory*. Doctoral dissertation, University of California, Berkeley. ROA-171.

Pater, J. (1998) 'Minimal violation and phonological development'. *Language Acquisition* 6, 201–253.

Prince, A. & P. Smolensky (1993) 'Optimality Theory: Constraint interaction in generative grammar'. Report no. RuCCS-TR-2. New Brunswick: Rutgers University Center for Cognitive Science.

Revithiadou, A. and M. Tzakosta (to appear) 'Markedness hierarchies vs. positional faithfulness and the role of multiple grammars in the acquisition of Greek', to appear in: *Proceedings of GALA 2003*, 4-6 September 2003, Utrecht University, Utrecht.

Smith, J. (2002) *Phonological Augmentation in Prominent Positions*. Doctoral dissertation, University of Massachusetts, Amherst.

Smith, N.V. (1973) *The Acquisition of Phonology: A Case Study*. Cambridge: CUP.

Tesar, B. and P. Smolensky (1993) 'The learnability of Optimality Theory: An algorithm and some basic complexity results'. Cognitive Science Department, University of Colorado, Boulder. ROA-2.

Tesar, B. and P. Smolensky (1998) 'Learnability in Optimality Theory'. *Linguistic Inquiry* 29, 229–268.

Tesar, B. and P. Smolensky (2000) *Learnability in Optimality Theory*. Cambridge: The MIT Press.

Tzakosta, M. (1999) 'The acquisition of prosodic structure in Modern Greek'. Summary of MA thesis, University of Crete, Rethymno.

Tzakosta, M. (2001) 'The realization of consonant clusters in child language'. *Proceedings* of the *21st Annual Meeting of Greek Linguistics*. Thessaloniki: AUTH, 736–746.

Tzakosta, M. (in prep.) *Acquiring Stress in an Unknown World: Acquisition of Stress in Greek and its Implications for Universal Grammar*. Doctoral Dissertation, Leiden University/ULCL.