STRESSED VS. FINAL SYLLABLE IN EARLY SPEECH: WHICH ONE IS STRONGER?

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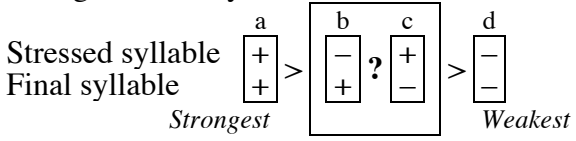
1. Introduction

Research on language acquisition identifies two strong positions within a word – final syllable and stressed syllable (Echols and Newport 1992, Gerken 1994). This observation is based primarily on target–production (i.e. adult–child) correspondence, where target unstressed non-final syllables are often truncated while stressed and final syllables are preserved in children's productions (e.g. Arabic *bərtəqálə* → *qálə* 'orange', Hebrew *télefon* → *téfon* 'phone', Russian *sabáka* → *bʲáka* 'dog').

The notion of 'strength' in phonology refers to the power to resist alternation (usually weakening/lenition), where this power can be gained from acoustic prominence, position within the word/syllable, and/or segmental content (Escure 1977, Carvalho *et al.* 2008, Bat-El 2014 among others). In child phonology, resistance to alternation is actually faithfulness to the target. Since the final and the stressed syllables resist truncation more often than other syllables, they are the two strong positions in the word.

The truncation data provide a partial strength hierarchy in child phonology, where final stressed syllables (1a) are the strongest ones, and unstressed non-final syllables (1d) are the weakest ones. In between are the unstressed final syllables (1b) and the stressed non-final syllables (1c), whose relative ranking on the strength hierarchy has not yet been established.

(1) Strength hierarchy



In this paper we replace the question mark between (1b) and (1c) with a 'bigger than' sign, arguing that the *final syllable is stronger than the stressed one*. The supporting data are drawn from children acquiring Hebrew and Arabic, two languages with different stress patterns (mostly final vs. mostly penultimate respectively). We show that children make significantly more errors, and are thus less faithful to the target in stressed (non-final) syllables than in final (unstressed) ones. The errors we address here are syllable truncation, consonant deletion, and segmental substitutions (harmony and context-free substitution).

Our finding that the final syllable is the strongest position in child phonology leads to the notion of edges in children and adult phonology (Dinnsen and Farris-Timble 2008). For children, as noted above, the right edge is stronger than the left one, but for adults it is the other way around (Beckman 1998, Steriade 2001). This difference can be exemplified with truncation of a name like *daniéla*, where a child is more likely to truncate it to *éwa* / *éla* while an adult to *dáni*.

We explain this discrepancy by adhering to the different functions of the two edges and the different linguistic tasks children and adults undertake. In terms of function, the left edge facilitates word recognition (Marslen-Wilson 1987, Marslen-Wilson and Zwitserlood 1989, Beckman 1998) while the right edge facilitates

perception due to the extended duration of the vowel. As for the tasks, adults are engaged in word recognition while children are preoccupied with word perception, rather than word recognition, as they have to establish a lexicon.

In this paper, we emphasize the distinction between the two types of strength, processing/recognition and perceptual, and highlight the difference between child and adult languages in terms of constraint interaction. We also note that this contrast between children and adults is untenable if we adhere to both, the Learning Hypothesis (Smolensky 1996) and the Edge-Asymmetry Hypothesis (Bye and de Lacy 2000). We cannot accept that there are no constraints referring to the right edge (the Edge-Asymmetry Hypothesis) and at the same time view learning as reranking of universal constraints (the Learning Hypothesis). We dismiss the Edge-Asymmetry Hypothesis, arguing that both edges are relevant to grammar though to different degrees in children and adults.

We continue our discussion in section 2 with a brief review of strength, where in language acquisition strength is due primarily to perceptual prominence. As we inquire whether the final and the stressed syllables are perceptually different in early acquisition, we study two languages with different stress systems and different distribution of stress patterns. As a background, we provide in section 3 the relevant details of stress in the languages we study, namely Arabic (§3.1) and Hebrew (§3.2). Based on the distribution of stress, we provide the predictions made by two approaches to language acquisition (§3.3), one advocating a universal strength hierarchy and the other promoting language-specific effects. The data obtained from the children's productions are provided in section 4 for both Hebrew (§4.1) and Arabic (§4.2). These data support the universal approach, as they lead to the conclusion that in both languages, regardless of the distribution of stress, the final syllable is stronger than the stressed one (§4.3). The strength of the right edge in child phonology promotes the discussion on the edge paradox in section 5. Concluding remarks are given in section 6.

2. Prominence in language acquisition

Studies on early speech report on a correlation between the perceptual prominence of linguistic units and their order of acquisition – the higher the perceptual prominence of a unit the earlier it is acquired. The most prominent syllables within a word are the stressed and the final syllables, as they are relatively higher in pitch (for the stressed syllable) and longer in duration (Beckman 1992, Laver 1994). In Hebrew words with final or penultimate stress, stressed syllables are longer than unstressed ones, and final unstressed syllables are longer than non-final unstressed syllables (Cohen et al. 2016). Due to these properties, these syllables are best perceived by children and thus first to be produced in the course of language acquisition (Echols and Newport 1992). Pitch and duration are often exaggerated in Child Directed Speech (CDS), what may contribute even more to the saliency of stressed and final syllables (Albin and Echols 1996).

Since perceptual prominence promotes early production, children tend to produce the stressed (or accented) and final syllables and omit unstressed (weak) and non-final ones.[1] This generalization is supported by studies on various languages, such as English (Echols and Newport 1992, Kehoe and Stoel-Gammon 1997), Dutch (Fikkert 1994), French (Paradis, Petitclerc and Genesee 1997), Hebrew (Ben-David

[1] Truncation of non-final unstressed syllables leads to telegraphic speech, as grammatical words (e.g. copulas, clitics, prepositions) are usually unstressed and non-final (Gerken 1996, Carter and Gerken 2004). That is, phonology plays a role in the deletion of grammatical words. See Carter and Gerken (2004) as well as Kehoe and Stoel-Gammon (1997) for other accounts of children's syllable truncation.

2001, Adam 2002), Greek (Kappa 2002), Japanese (Ota 2006), Russian (Zharkova 2005), and Palestinian Arabic (Massarwa 2007). A few examples are given below:

(2) Preservation of stressed and final syllables in early speech

		Target	***Child***	
a.	English	pətéɾo	tʰédɒ	'potato'
	(Kehoe & Stoel-Gammon 1997)	ɛ́ləfɪnt	ɛ́fɪnt	'elephant'
		dáɪnəsɔr	dáɪsɔ:	'dinosaur'
b.	Greek (Kappa 2002)	obréla	béla	'umbrella'
		eðó	do	'here'
		jaúrti	ɣúti	'yoghurt'
c.	Japanese (Ota 2006)	ʃobó:ša	bó:ʃa	'fire engine'
		toɾákkɯ	tákkɯ	'truck'
		hambá:gɯ	bá:gɯ	'hamburger'
d.	Russian (Zharkova 2005)	sɑbákɑ	ˈbʲákɑ	'dog'
		sʲérdʲitʂɑ	sʲétʂɑ	'is being angry'
		igólkɑ	gókɑ	'needle'

This pattern of truncation is found not only in typical development, but also in many types of atypical development, such as Down Syndrome (Pettinato and Verhoeven 2009) and Specific Language Impairment (Befi-Lopes and Rondon 2010).

Echols and Newport (1992) address the question whether final and stressed syllables are perceptually equal and thus equal in their strength. Based on 616 words gathered from three English-speaking children, they suggest that they are not equal, but the results are not conclusive; there were a few more omissions of final unstressed syllables compared to non-final stressed syllables, and the accuracy of the syllable's elements was a little higher in non-final stressed syllables. These results suggest that non-final stressed syllables are stronger the final unstressed ones, but these are mere tendencies since differences were rather small and were not statistically analyzed.

Echols and Newport (1992) is the only study that inquires into the difference between the final and the stressed syllable, and here we take this question a step further with a study of two languages with different stress patterns. Contrary to Echols and Newport (1992), our results suggest that the final syllable is significantly stronger than the stress syllable.

3. Stress in Arabic and Hebrew

In order to evaluate the strength relation between stressed and final syllables, we examined children's errors. Complying with the strength hierarchy in (1), we assume that the weaker the position is the higher the degree of errors.

We controlled the effect of stress by choosing two languages with different patterns – Modern Hebrew and Palestinian Arabic (hereafter Hebrew and Arabic). As shown in this section, the two languages differ in their stress systems and the distribution of stress patterns.

3.1. Arabic stress

The Arabic dialect we study here is the Palestinian Arabic spoken in central Israel (Muthalath). As in many other dialects of Arabic, the stress system in this dialect is entirely regular, as stated and exemplified in (3).

(3) Arabic stress

a. Stress rule (Ryding 2005, Watson 2011)
   i. Stress falls on the final super-heavy syllable (CV:C or CVCC);
   ii. Otherwise, on the penultimate heavy syllable (CV: or CVC);
   iii. Otherwise on the antepenultimate syllable, regardless of its weight.

b. Stress patterns

Antepenultimate		***Penultimate***		***Final***	
kátaba	'he wrote'	jaktúbna	'they fm. write'	baʃú:f	'I see'
zálama	'man'	amíltum	'you ms.pl. worked'	kitá:b	'book'
mádrasa	'school'	tullá:ban	'students Acc.'	biðútˁtˁ	'he puts'
kúllunaa	'all of us'	darrasú:haa	'they taught her'	ha:wálṭ	'I tried'

In order to examine the distribution of these stress patterns, we collected child directed speech (CDS) data during 30-40 minutes of parent-child interaction between 10 of the children who participated in the study (aged 1;9–2;3) and one of their parents. Our data consist of 2,892 words (major lexical items), which include 2,458 di- or trisyllabic words. As shown below, the dominant stress pattern in Arabic is penultimate.

(4) Distribution of stress patterns in Arabic CDS (tokens)

Target	***Final***	***Penultimate***	***Antepenultimate***	*Total*
Disyllabic	24% (412)	76% (1,308)		1,720
Trisyllabic	7% (52)	80% (590)	13% (96)	738
Total	19% (464)	**77%** (1,898)	4% (96)	2458

As can be read from (4), Arabic-acquiring children attend mostly (77%) to words with penultimate stress.

3.2. Hebrew stress

The Hebrew stress system is rather complicated; not only do nouns and verbs have different systems, but, as shown below, stress in nouns is contrastive, residing within the trisyllabic window regardless of syllable structure (Bat-El 1993).

(5) Lexical stress in Hebrew nouns

Stressed syllable	***Antepenultimate***		***Penultimate***		***Final***	
	télefon	'phone'	kélev	'dog'	mispó	'fodder'
CV	ʃókolad	'chocolate'	tíras	'corn'	kitá	'class'
	brókoli	'broccoli'	rakévet	'train'	xatuná	'wedding'
	ámbulans	'ambulance'	tráktor	'tractor'	ʃulxán	'table'
CVC	ámburger	'hamburger'	sávta	'grandma'	kadúr	'ball'
	béjgale	'pretzels'	mástik	'gum'	avirón	'airplane'

The stress system of verbs is regular (Graf and Ussishkin 2003), with stress residing on the final syllable in all stems and some suffixed forms, and on the penultimate syllable in other suffixed forms.

(6) Stress patterns in Hebrew

Stems		***Suffixed forms***			
Final		***Penultimate***		***Final***	
jigdál	'he will grow'	gadál-ti	'I grew'	gadl-á	'she grew'
ligdól	'to grow'	kaní-tem	'you pl. bought'	jigdel-ú	'they pl. will grow'
kaná	'he bought'	igdíl-a	'she enlarged'	tigdel-í	'you fm.sg. will grow'
jegalé	'he will reveal'	kám-u	'they got up'	tegal-í	'you fm.sg. will reveal'

Whether stress is final or penultimate in verbs depends primarily on the syllable structure of the suffix (which of course affects the syllable structure of the derived form); stress is penultimate when the suffix is consonant-initial, and final when the suffix is vowel-initial. Two systematic exceptions to the latter generalization are monosyllabic stems (e.g. *kám-u*), and stems with a high vowel in the final syllable (e.g. *igdíl-a*), where stress is always penultimate regardless of the suffix type.

As with the Arabic data (§3.1), we obtained the distribution of stress in Hebrew from CDS. The data in (7) were collected during 30-40 minute sessions of interaction between 10 children (aged 1;7-2;2) and one of their parents. The data, consisting of 2,255 di- and trisyllabic words (major lexical items), show the dominance of final stress in Hebrew.

(7) Distribution of stress patterns in Hebrew CDS (tokens)

Target	***Final***		***Penultimate***		*Total*
Disyllabic	71%	(1106)	29%	(451)	1557
Trisyllabic	64%	(447)	36%	(251)	698
Total	**69%**	**(1553)**	31%	(701)	2,255

Similar results supporting the quantitative dominance of final stress in Hebrew were obtained in Segal et al.'s (2009) study of CDS, as well as lexicon counts (see Adam and Bat-El (2009).

3.3. Predictions

Two approaches are considered here, one assuming a universal strength hierarchy and the other assuming language specific effects on relative strength. These two approaches have different predictions.

According to the *universal approach*, the relative strength of (non-final) stressed syllables and final (unstressed) syllables should be the same for all languages. Under this approach, children acquiring Hebrew and Arabic are expected to make fewer errors in the same position, regardless of the differences in the stress systems and in the distribution of the stress patterns in the two languages.

According to the *language-specific approach*, the relative strength of (non-final) stressed syllables and final (unstressed) syllables is contingent upon the distribution of stress; the position that usually hosts a stressed syllable is perceived as the stronger one. Under this approach, Arabic-acquiring children are expected to make fewer errors in penultimate position, and Hebrew-acquiring children are expected to make fewer errors in final position.

The children's production errors presented in the following section support the universal approach.

4. Children's production errors

In order to determine the strength relation between the final (unstressed) syllable and the (non-final) stressed syllable, we examined the children's production errors. Here are examples of errors from Hebrew and Arabic, distinguished by the two positions relevant for our study.

(8) Types of errors

a. Hebrew

	Non-final stressed syllable			***Final unstressed syllable***		
Syllable truncation	kóva	→ va	'hat'	máim	→ ma	'water'
Onset deletion	pétsa	→ ésa	'bruise'	néta	→ néa	Name
Coda deletion	bámba	→ bába	'snack'	máim	→ mái	'water'
Consonant harmony	kélev	→ lélev	'dog'	dúbi	→ dúdi	'teddy bear'
Vowel harmony	íma	→ áma	'mommy'	ʃéva	→ séve	'seven'
Other substitutions	sába	→ tsába	'grandpa'	píta	→ pína	'pita bread'

b. Arabic

	Non-final stressed syllable			***Final unstressed syllable***		
Syllable truncation	sí:do	→ do	'grandpa'	ʃáʤara	→ xsáʒa	'tree'
Onset deletion	bísse	→ íse	'cat'	báðar	→ báar	'sea'
Coda deletion	ʔáxdˁar	→ ʔádar	'green'	wálad	→ wála	'boy'
Consonant harmony	bíddi	→ díddi	'I want'	kálam	→ kákam	'pencil'
Vowel harmony	wárdɛ	→ wéddɛ	'flower'	ʃó:ki	→ ʃó:ko	'fork'
Other substitutions	káleb	→ xáleb	'dog'	táxet	→ tábet	'bed'

We assume that the weaker the position the greater the rate of errors in this position.

4.1. Hebrew

Participants: 115 children with typical development (TD) aged 1;7–2;5, and 30 children with Sound Disorders (SSD) aged 3;4–4;8 participated in the study. 40% of the children with SSD had SLI (Specific Language Disorder) and their PCC (Percentage Consonant Correct) scores were 47%–60% (i.e. moderate to severe articulation scores), where the normative scores for children aged 3;6 is 88%.[2]

***Materials and procedure*:** The children's productions were collected during a two-hour session of play interaction combined with picture naming. There were about 60 pictures of phonologically balanced target words, controlled for length (number of syllables), stress pattern, syllable structure and segments.

Results: Table (9) provides the total production of polysyllabic (2-3 syllables) target words for both TD and SSD children.

(9) Total production of polysyllabic target words (Hebrew)

	TD		***SSD***	
No. of children	115		30	
Total productions	10,753		2,784	
Productions with errors	4,703	43.7%	1,475	53.0%

[2] The children with Speech Sound Disorders had moderate phonological disorders, which were evaluated by using the PCC (Percentage of Consonants Correct) index. The PCC measures the percentage of correct consonants produced by the child and reflects the child's speech disorder severity (Shriberg and Kwiatkowski 1982).

The tables in (10) present the distribution of syllable truncation in polysyllabic productions for TD and SSD groups. ANOVA analysis reveals that the differences are significant ($p < .05$) for both groups for both disyllabic and trisyllabic targets.[3]

(10) Syllable truncation (Hebrew)

a. Disyllabic targets

		Initial		***Final***	
TD	Stressed	**4.3%**	42/977	0.7%	7/977
	Unstressed	92.9%	907/977	**2.1%**	21/977
SSD	Stressed	**4.2%**	17/406	0.7%	3/406
	Unstressed	93.2%	378/406	**2.0%**	8/406

b. Trisyllabic targets

		Initial		***Medial***		***Final***	
TD	Stressed	**1.2%**	12/971	1.03%	10/971	0 %	0/971
	Unstressed	96.5%	937/971	77%	748/971	**0. 3%**	3/971
SSD	Stressed	**4%**	15/377	1%	4/377	1.3%	5/377
	Unstressed	93.5%	352/377	84%	316/377	**2.6%**	10/377

The results are displayed in the strength hierarchy in (11), which shows that final (unstressed) syllables are stronger than (non-final) stressed ones. Recall that the fewer the errors the stronger the position.

(11) Strength hierarchy according to % of truncation (errors)

		TD	***SSD***
Strong	a. Final stressed	0.7%	0.7%
	b. **Final** unstressed	2.1%	2.0%
	c. Initial **stressed**	4.3%	4.2%
Weak	d. Initial unstressed	92.9%	93.2%

The same hierarchy was obtained on the basis of sub-syllabic and segmental errors in polysyllabic productions. The results, given below for children with TD (12a) and for children with SSD (12b), show more errors in stressed (non-final) syllables than in final (unstressed) ones. ANOVA analysis revealed that the differences were all significant ($p < .05$) for both groups.

(12) Sub-syllabic and segmental errors (Hebrew)

a. TD children

		Non-final		***Final***	
	Total[4]	***Unstressed***	***Stressed***	***Unstressed***	***Stressed***
Onset deletion		58.8%	40%	0.7%	0.5%
	403	237	161	3	2
Onset assimilation		67%	27%	5%	1%
	221	262	105	20	4
Coda deletion		40%	34%	15%	11%
	2,035	814	692	305	224
Other segmental errors		51%	35%	8%	6%
	309	157	108	25	19

[3] Note that many productions had more than one error type. For example, the production *méme* for the target *ʃémeʃ* 'sun' has both onset assimilation and final coda deletion.

b. SSD children

		Non-final		*Final*	
	Total	***Unstressed***	***Stressed***	***Unstressed***	***Stressed***
Onset deletion		57%	31%	8%	4%
	134	76	42	11	5
Onset assimilation		58%	32%	7%	3%
	79	46	25	6	2
Coda deletion		28%	30%	22%	20%
	669	187	200	147	134
Other segmental errors		43%	32%	15%	10%
	148	64	47	22	15

4.2. Arabic

The Arabic data are drawn from the Muthallath dialect spoken in central Israel, and were collected and transcribed by native speakers of this dialect.

Participants: 14 typically developing Arabic-acquiring children, aged 1;9–2;3, participated in the study. All participants were monolingual speakers, with no hearing or language impairments.

Materials and procedure: The children's productions were obtained during a two-hour session of play interaction combined with picture naming. About 60 pictures of phonologically balanced target words were introduced to the children all controlled for length (number of syllables), stress pattern, syllable structure and segments.

Results: The total production of polysyllabic target words elicited from Arabic-speaking children was 1,380, out of which 560 (40.6%) were productions with errors. The distribution of the errors, according to type, position, and stress is provided below.

(13) Arabic errors

		Non-final		*Final*	
	Total	***Unstressed***	***Stressed***	***Unstressed***	***Stressed***
Syllable truncation		94.6%	3.8%	1.2%	0.4%
	257	243	10	3	1
Onset deletion		63%	30%	4%	3%
	306	193	92	12	9
Onset assimilation		51%	30%	12%	7%
	122	62	36	15	9
Coda deletion		45%	35%	11%	9%
	498	224	174	55	45
Other segmental errors		46%	41%	6%	7%
	83	38	34	5	6

As the table above suggests, the final (unstressed) syllable is stronger than the (non-final) stressed one, exactly as in Hebrew. Throughout all error types, there were fewer errors in final (unstressed) syllables than in stressed (non-final) syllables. Results are significant ($p < .05$) for all errors except for syllable truncation, probably due to the small number of productions where the final and/or stressed syllables were truncated.

4.3. Discussion

The data provided above support the universal approach to strength hierarchy, since both the Arabic- and the Hebrew acquiring children displayed the same distribution of errors regardless of the different distribution of the stress patterns in their ambient languages.

Our results are not compatible with those of Echols and Newport's (1992), where English-speaking children showed more errors in final (unstressed) syllables than in (non-final) stressed syllables (see §2). That is, according to this study, the stressed syllable, and not the final one, is the strongest among these two.

This incompatibility is intriguing since in English, as in Arabic, the dominant stress pattern is penultimate. However, a breakdown of the distribution of stress according to the number of syllables reflects a preference for ante-penultimate stress in words with 3-4 syllables (Clopper 2002). In addition, since Echols and Newport's (1992) results were not statistically significant, further study on English is required. Moreover, in order to support our claim that the strength hierarchy is universal, we need to obtain acquisition data from languages with different stress patterns, in particular those with initial stress, like Hungarian.

5. The edge paradox

Within the constraint-based framework of Optimality Theory (Prince and Smolensky 1993/2004), our findings suggest that early speech is restricted by the following ranking of faithfulness constraints:

(14) Constraint ranking in early speech

FAITHEDGER » FAITHSTRONGσ

a. FAITHEDGER: Be faithful to the **syllable** at the **right edge** of the target word

b. FAITHSTRONGσ: Be faithful to the **stressed syllable** of the target word

Note that these constraints refer to target-production correspondence, with no intension to imply that the target is the children's underlying representation (see discussion in Menn and Matthei 1992 and Tesar and Smolensky 1998).

In adult phonologies, FAITHSTRONGσ (14b) is an active "positional faithfulness" constraint (Steriade 1994, Beckman 1998), which accounts for the power of segments in stressed syllables to resist alternation (Hyman 1975). This constraint is active in adult phonology, such as Palauan (Josephs (1975), where stressed vowels resist vowel reduction while unstressed vowels become schwas (e.g. *báð – bəðúð – bəðəmán* 'rock – our INCL rock – our EXCL rock'.

Another position that often resists alternation in adult phonology is word initial position. For examples, languages that resolve onsetless syllables in word medial position often preserve word initial onsetless syllables (e.g. Berber, Diegueño). As claimed in Gow et al. (1996), the beginning of words are 'islands of reliability' in connected speech, facilitating word recognition and lexical segmentation (see also Marslen-Wilson and Zwitserlood 1989, Goodglass et al. 1997, Smith 2002).

This is the point where children and adults differ; while the right edge (final) is stronger than the left one in child phonology, the left edge (initial) is stronger than the right one in adult phonology. This implies that somewhere along the course of language acquisition, the ranking in (15a) changes to (15b).

(15) Faithfulness constraint reranking

a. Children: FAITHEDGE**R** » FAITHEDGE**L**

b. Adults: FAITHEDGE**L** » FAITHEDGE**R**

We argue that the contrast between (15a) and (15b) is due to the different linguistic tasks undertaken by children and adults.

The children's major linguistic task is to build a lexicon (the other one is to construct a grammar), and for this purpose they have to attend to the input, i.e. to adult speech. Attending to speech employs perceptual (and auditory) capacities, and therefore the perceptually more salient positions are the most important ones.

The adults' major linguistic task is word recognition and processing, which involve mapping of auditory input to lexical items in their mental lexicon. Mapping proceeds from left-to-right, and therefore the beginning of the word (first segment, first syllable) is the most important position (Marslen-Wilson 1987, Marslen-Wilson, and Zwitserlood 1989).

While the explanation for this "edge paradox" is straightforward (see "prominence paradox" in Dinnsen and Farris-Trimble 2008), the theoretical account is challenging in light of the following two conflicting hypotheses:

(16) Conflicting hypotheses

a. *The Edge-Asymmetry Hypothesis* (Bye and de Lacy 2000:122)
No constraint may refer to the right edge of a constituent

b. *The Learning Hypothesis* (Smolensky 1996:17)
In Optimality Theory, learning a target adult language requires a child to determine the relative rankings of universal constraints

According to the Edge-Asymmetry Hypothesis (16a), there cannot be a constraint such FAITHEDGER (15a), which requires faithfulness to the right edge. This hypothesis relies on the observation that languages tend to refer to the left edge of the word and neglect the right edge (see also Nelson 1998).

Given the strong evidence presented in this paper and elsewhere that children do refer to the right edge, and actually neglect the left edge, the constraint FAITHEDGER must be present in their grammar. If the Edge-Asymmetry Hypothesis is correct, then we must assume that FAITHEDGER somehow vanishes in the course of language development.

However, this assumption is untenable given the Learning Hypothesis (16b), according to which the language-learning task involves ranking of universal constraints. This implies that the constraints active in child speech must be part of adult language knowledge. That is, constraints do not vanish.

We argue that the Edge-Asymmetry Hypothesis (16a) is not only in conflict with the Learning Hypothesis (16b) but also suffers from counterevidence. Indeed, reference to the right edge of the word is relatively mild in adult phonology, but this does not mean that it is eliminated from adult knowledge.

The most conspicuous linguistic reference to the right edge is found in rhymes. Speakers' ability to produce and identify rhymes, as well as recognize "bad" rhymes, suggest that there are constraints that refer to the right edge. As rhymes are the product of adults, we can find the same rhymes in adult poetry and nursery rhymes; e.g. *If I'm in bed each night by ten; I may get back my looks again* (Observation by Dorothy Parker) vs. *All the king's horses and all the king's men; Couldn't put Humpty together again* (Humpty Dumpty, obscure origin).

Reference to the right edge is also found in some blends in Israeli Sign Language (ISL). Every sign has two locations (L_1 and L_2) and a movement (M) between them (Sandler 2012). In the blend (or clipped compound) denoting *gold*, whose base signs are *ring* and *yellow*, the location features at the right edge of each

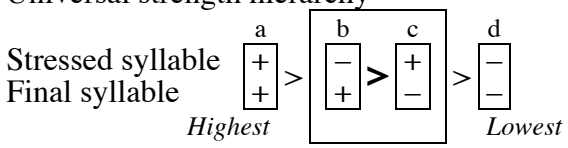
base sign survive in the blend (Neria 2016); that is, $L1_{s1}\ M_{s1}\ \mathbf{L2_{s1}} + L1_{s2}\ M_{s2}\ \mathbf{L2_{s2}} \Rightarrow L2_{s1}\bullet M_{s2}\bullet\ L2_{s2}$. This pattern contrasts with clipped compounds in spoken Hebrew and other languages, where the left edge of the two base words survives. It also contrasts with blends, where the left edge of the first base word and the right edge of the second base word survive (Bat-El 1996).

We thus conclude that faithfulness constraints referring to the right edge do exist in adult phonological knowledge, though their effect is relatively weak. Thus, during the course of language development children rerank the constraints, promoting faithfulness to the left edge, as this is the edge most important for processing.

6. Conclusion

In the course of language development, the children's productions deviate from those of adults, where the latter ones are considered the target. This deviation is not sporadic, but rather follows (among other things) the strength hierarchy in (17). In this hierarchy, the question mark presented in (1) is replaced with a 'bigger than' sign on the basis of the results obtained in our study.

(17) Universal strength hierarchy



The hierarchy indicates that between the two strong positions within a word, the final position is stronger than the stressed one. This conclusion has been reached on the basis of data from child speech, where significantly fewer errors were made in final syllables than in stressed syllables. Our assumption was that the fewer the errors, the stronger the position.

We argue that this hierarchy is universal, because our data were obtained from two languages with different stress patterns. Nevertheless, we would like to see further support to this hierarchy from other languages.

Given the strength of the right edge in child phonology, we attended to the contrast with adult phonology, where the left edge is stronger than the right edge. We attributed this contrast to the different linguistic tasks of children and adults, and analyzed the difference in terms of constraint reranking. Under this analysis, FAITHEDGER is active in both children and adult phonologies, and the Edge-Asymmetry Hypothesis (16a) must be rejected.

Finally, our study provides further support to the universal approach to language acquisition, which credits the children with universal principles specific to linguistic knowledge, in addition to the input and the general cognitive capacity.

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