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The Role of PROMINENCE in the Acquisition of Medial Codas in Hebrew

Evidence from a slow developer

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I began my Linguistic studies seven years ago in hopes of changing my career path. At the time, I already had two children and was hopeful but unsure of my decision. Since then, I have added two more children and many more doubts. Only now are my hopes for the future coming to fruition and there are many people I would like to acknowledge. First and foremost, I would like to extend my deepest gratitude to the supervisor of this study, Professor Outi Bat-El. Outi was the first to spark my interest in Phonology, and since then has been an invariable source of inspiration, guidance and encouragement, and has provided me with a constant stream of opportunities to develop and excel. Her support was such that even during times when I was prepared to disappoint myself, I couldn't bring myself to disappoint Outi. I would also like to thank Dr. Evan Cohen, Professor Charles Kisseberth, Dr. Galit Adam and Professor Julia Horvath for their much welcome support and advice throughout the years. And again to Dr. Galit Adam, as well as, Dr. Avivit Ben-David for their time, patience and insight as external readers.

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ABSTRACT

This study provides evidence for the superiority of PROMINENCE over FREQUENCY as a licensor in the late stages of language acquisition. The focus is on the acquisition of medial codas which are acquired much after word-final codas in Hebrew. Hebrew provides the ideal conditions for testing the effects of stress on medial coda acquisition. Fewer than 20% of medial codas found in the language are located in stressed syllables. Thus any bias toward medial coda production in stressed syllables would indicate clear PROMINENCE effects. Hebrew also accepts any segment type in medial coda position. This means that segmental PROMINENCE features and reduction patterns can also be examined in order to provide additional support for any PROMINENCE theory.

To date, medial coda acquisition in Hebrew has been somewhat obscured by its late and subsequently rapid development. However, the child-subject used for this study (Y) exhibits a slow developmental pace, thus providing a unique looking-glass opportunity. By the end of the research period, Y had not acquired medial codas in full, but the data available can be divided into two distinct stages. During Stage I Y's faithful medial coda productions exhibit clear PROMINENCE effects. During Phase A of this stage, 27% of medial codas in *stressed* syllables are produced faithfully while only 12% of medial codas in *unstressed* syllables are faithfully produced. Featural restrictions are concurrently imposed on the medial coda segments produced. Y's outputs during Phase A contain only relatively salient [+continuant] medial coda segments, even though Y's targets consist of nearly 30% [-continuant] medial codas. These segmental limitations disappear during Phase B of Stage I, while the effects of stress are still apparent. During Phase B, 55% of medial codas in *stressed* syllables are faithfully produced, while only 35% of medial codas in *unstressed* syllables are faithful to their target. Stage II of medial coda acquisition reveals a gradual a decrease in PROMINENCE effects and

subsequent increase in FREQUENCY effects. During Phase C of Stage II, the bias toward medial codas in stressed syllables disappears. The faithful production of medial codas in *unstressed* syllables drastically increases to 55%, while the faithful production of medial codas in *stressed* syllables remains virtually unchanged at 59%. By Phase D PROMINENCE effects are neutralized. Y continues to produce medial codas in *stressed* syllables at a rate of 53% while faithful productions in *unstressed* syllables climb to 72% - thus exhibiting an escalation in the affects of language specific frequencies.

The results indicate that PROMINENCE has a clear influence in medial coda acquisition. However evidence as to potential the nature of PROMINENCE as a licensor comes from the systematic patterning of cluster reductions found in the *unfaithful* medial coda productions. As is familiar with onset clusters, Y's medial clusters consisting of C1 and C2 where commonly reduced to the least sonorous of the two consonants. Exceptions to this sonority pattern were found in sonority plateaus which exhibited an underlying inclination toward C1 deletions, and clusters with liquids where the liquid segment, not yet acquired by Y, was systematically deleted. These results support the common notion that C1 is a position of low perceptibility, and indeed it is likely that PROMINENCE factors were influential in the child reaching a level where he both distinguishes and recognizes medial coda segments. However, it is also clear that by the time he begins to produce medial codas, both consonants in the cluster are perceived by Y even when the cluster is reduced. Yet although the entire cluster is perceived, faithful productions are still more common in *stressed* syllables than in unstressed syllables. This may be evidence that PROMINENCE acts a facilitator, not only to perception, but to *production* as well. This can be explained through a form of late emergence of the trochaic bias – where the child utilizes a trochaic template to ease the production of new phonological structures.

1 INTRODUCTION

1.1 OVERVIEW

The purpose of this paper is to provide evidence for the fundamental role of PROMINENCE in the acquisition of medial codas in Hebrew. PROMINENCE refers to a heightened perceptual salience that is often cited as a licensor in the acquisition process. This increased salience can be provided either by segmental features or by the prosodic position of a medial coda within a stressed syllable.

The data used for this research have been extracted from detailed transcriptions of one Hebrew-speaking child (Y). Previous studies have not been able to identify a clear observable influence of PROMINENCE factors in Hebrew medial coda acquisition. This may be due to the fact that medial codas in Hebrew are acquired late in the acquisition process when the pace of language development is often increased. From the early stages of his speech development however, Y was identified as having a slow developmental pace (Adam & Bat-El 2007b). As a result, it was possible to extract a larger and more detailed inventory of data from his prolonged acquisition path. As a basis for comparison, this paper also includes a detailed account of medial coda distribution in Hebrew as evidenced by a sample of child-directed speech. This analysis of child-directed speech was necessary due to the sparseness of information currently available regarding medial codas in Hebrew.

Hebrew is the ideal testing ground for the influence of stress in the acquisition of medial codas. The majority of prosodic words in Hebrew are stressed on the final syllable (Graf & Ussishkin 2003) and, contrary to cross-linguistic tendencies; Hebrew has a strong preference for word-final codas (Graf 2003). Both stressed syllables and final syllables are universally considered prominent prosodic locations (Echols &

Newport 1992; Demuth 1996; Kehoe 2000). In language acquisition terms, this means that word-final codas in stressed syllables are essentially triply licensed; once by the PROMINENCE factor of the stressed syllable; again by the word-final POSITION; and finally by the FREQUENCY of the prosodic structure. Accordingly, Hebrew speaking children acquire codas in word-final position prior to word-medial position and word-final codas in stressed syllables are acquired prior to word-final codas in unstressed syllables (Ben-David 2001).

In comparison, medial codas are much less common (see section 1.3.2), and due to the strong propensity for final stress in Hebrew, are much more likely to be found in unstressed syllables than in stressed syllables. In fact, a sample of child-directed speech taken from this study showed that nearly 80% of medial codas are found in unstressed syllables[1]. This means that, in addition to POSITION no longer being a factor, FREQUENCY and PROMINENCE do not coincide as they do in the case of word-final codas. Thus, if medial codas in unstressed syllables are acquired at a greater relative pace, then FREQUENCY is a stronger licensor. On the other hand, if medial codas in stressed syllables are acquired at a greater relative pace, then PROMINENCE is a stronger licensor. If both are equal licensors then it is possible that medial codas will be acquired in stressed and unstressed syllables at a pace that mirrors their comparative ratios in the language.

Hebrew also fulfills the conditions needed to test any segmental effects on medial coda acquisition. This is because, contrary to cross-linguistic tendencies, any segment can occupy the medial coda position. Thus the behaviors of each segment-type can be studied within one language. The prediction is that if segmental PROMINENCE is evident, the period of influence should be parallel to what was found in the stress data.

[1] Those in stressed environments are mostly found in penultimate syllables (Graf & Ussishkin 2003).

The findings presented in Section 3.2 will show that stress as a PROMINENCE factor has a clear influence in Y's acquisition of medial codas. The acquisition data will be divided into two stages. Evidence will show that during Stage I, Y faithfully produces medial codas in stressed positions much more often in relation to their frequency in the target and child-directed speech data. By Stage II, these differences will no longer be evident. Findings will also show that Stage I can further be divided into Phase A and Phase B, where only during Phase A, Y's medial coda segments are limited in a way that may also be attributed to PROMINENCE features. Stage II can also be divided into Phase C and Phase D which show a gradual transition from a PROMINENCE >> FREQUENCY licensing hierarchy to a FREQUENCY >> PROMINENCE hierarchy.

Section 3.3 will present and analyze cluster reduction strategies employed by Y. These will show that Y adheres to the sonority pattern well-established for onset clusters but shown for medial clusters as well (Barlow 2005 and references therein) which predicts the least sonorant segment will be retained in the output. However, the behavior of sonority plateau clusters will show a tendency to delete the medial coda segment (C1), which occupies a less salient position in comparison to the adjacent medial onset consonant (C2). In contrast, when either consonant in the cluster is a liquid (which Y had not yet acquired), Y almost always retains the non-liquid segment, regardless of its position or of the nature of the other consonant in the cluster. The systematic patterning of cluster reductions seems to demonstrate that medial codas are fully perceived by the time production begins. This supports a hypothesis that in addition to likely influences in perception, PROMINENCE may also license medial coda acquisition due to facilitation in *production*.

1.2 Previous Research on Prominence Effects in Coda Acquisition

The majority of studies on coda acquisition provide only partial evidence for the influence of PROMINENCE in coda acquisition. Lleó (2003) found that word-medial codas in Spanish are acquired prior to word-final codas. This is not surprising given that approximately 80% of prosodic words in Spanish are stressed on the penultimate syllable. This means that any syllable with a medial coda is extremely likely to also be stressed. Similar findings from French, notorious for its word-final stress, show that word-final codas are acquired before word-medial codas (Lleó 2003 from Rose 2000). In both these cases, it is impossible to identify whether PROMINENCE or FREQUENCY has greater bearing.

In another study on English, it was found that children are more likely produce word-final codas in stressed syllables than in unstressed syllables (Demuth, Culvertson & Alter 2006). This is particularly notable in light of the fact that the most common context for codas in English is in unstressed word-final syllables (Kirk & Demuth 2006). Thus, FREQUENCY and POSITION license unstressed final codas, while PROMINENCE and POSITION license final codas in stressed syllables. In the case of English, PROMINENCE seems to neutralize FREQUENCY, thus providing evidence that its influence is stronger.

Importantly, all of these findings refer to initial coda productions and consequently to the beginning stages of the acquisition process. Conversely, the current study focuses on the later stages language development, where the influence of PROMINENCE factors is much less documented.

1.3 RELEVANT LANGUAGE BACKGROUND

1.3.1 STRESS

The majority of Hebrew prosodic words exhibit ultimate stress (Graf & Ussishkin 2003). Among words that are not stressed on the final syllable, most are stressed on the penultimate and on rare occasions the antepenultimate syllable (Bat-El 1993, Adam 2002, Ben-David 2001 and others). The existence of secondary stress is controversial among linguists, but if exists, occurs on every other syllable from the location of main stress[2].

Hebrew verbs exhibit a predictable stress paradigm. Almost all unsuffixed verbs contain ultimate stress, which can shift when the verb is suffixed, but again in a predictable manner that is dependent on various phonological factors present in the stem or the suffix. However, with regards to nominal stress, Hebrew is much less “well-behaved.” Some nouns are accented by a default stress pattern, but others are lexically accented (Bat-El 1989, 1993). In addition, Modern Hebrew is a Quantity Insensitive language; therefore, the syllabic structure of a given word will not predict the location of stress (Adi-Ben-Said & Bat-el 2004).

1.3.2 SYLLABLE STRUCTURES

In general, Hebrew avoids complex syllable structures. Words are generally short (mostly disyllabic) and the preferred syllable structures are CV and CVC, with no contrast in vowel length and no geminates (Graf 2003). Singleton codas are most commonly found word-finally, where they are actually preferred (Graf 2003). Complex codas are relatively rare and are only found word-finally in certain verb inflections and some loan words (Adam 2002; Ben-David 2001). Complex onsets, on the other hand,

[2] Secondary stress in Hebrew holds no relevance to the purposes of this paper, as virtually all medial coda data presented is either located in the syllable containing main stress, or in the syllable adjacent to the location of main stress (and thus unstressed). Therefore, no further reference will be made to secondary stress in Hebrew.

are more common but occur for the most part word-initially (Adam 2002 from Rosen 1973; Bolozky 1972, 1978a; Bat-El 1989).

All this considered, the following hierarchy is representative of preferred bi-syllabic structures in Modern Hebrew (taken from Graf 2003).

CV.CVC > CVC.CVC > CV. CV > CVC.CV

Consistent with this hierarchy, a small sample of child-directed speech containing a total of 232 words shows that nearly 60% of words in Hebrew contain word-final codas, while only 20% contain word-medial codas.

Table 1: Distribution of codas in Hebrew

Adult Targets	Qty	Out of total targets
Final Coda Only	115	50%
Medial Coda Only	25	11%
Medial & Final Codas	21	9%
No Codas	71	31%
Total	**232**	
Total Medial codas	46	20%
Total Final codas	136	59%

1.4 Previous Research on Medial Coda Acquisition In Hebrew

Ben-David (2001) identified several stages in the acquisition codas in Modern Hebrew.

Stage I: Coda deletion in all prosodic positions.

Stage II: Faithful production of word-final codas in monosyllabic outputs where the target word contains final stress. i.e. [xot] for /*maftexot*/ ‘keys.’ Faithful production of stressed and final codas only.

Stage III: Faithful production of word-final codas regardless of the location of stress in the target.

Stage IV: Partial production of medial codas in the penultimate syllable – initial productions of medial codas are of segments that are identical to the final coda segment in the target word. (No influence of place of articulation was identified in stage IV. Only 6 of 22 outputs contained the same place of articulation as following the segment.)

Stage V: Faithful production of Medial Codas in the penultimate syllable.

Stage VI: Faithful production of all medial codas in the target.

With regards to word-final codas, Ben-David found that target word length was not influential in their faithful production, however, stress was. Yet while word-final codas in stressed syllables are acquired prior to those in unstressed syllables, the opposite was found to be the case with medial codas. Target word length was influential, but the location of stress was not. Ben-David posits that the lack of evidence with regards to the influence of stress may be due to the fact that medial codas in Hebrew are acquired at a late stage in the language development process when acquisition is rapid and details are obscured. In a study of the acquisition of Hebrew in dyspraxic children, Tubul-Lavy (2005) also did not find evidence for the influence of stress on the acquisition of medial codas. However, she did not find that stress influenced the acquisition of word-final codas in Hebrew-speaking dyspraxic children either – thus this may be a characteristic of the a-typical acquisition of dyspraxic children and possibly a strong influence in their delayed acquisition of language as a whole.

Segmentally, there is even less data available. According to the stages of coda acquisition as outlined by Ben-David (2001) and presented above, the initial outputs of medial codas are reduplications of the final coda. Based on this, it seems that the segmental order of acquisition would be dependent, at least partially, on which lexical items in the language contain a reduplicated coda.

However, since all segment types are represented in the data thus no conclusions can be drawn as to order of acquisition or any segmental PROMINENCE effects. In addition, each child exhibited only a small number of targets and among the 10 children studied only 5 exhibited this pattern.

Table 2: Reduplicated medial codas (from Ben-David 2001)

Child	Output	Target	Gloss
Gefen	*ˈmiʃmiʃ*	*ˈmiʃmiʃ*	‘apricot
	paʁˈpaʁ	*paʁˈpaʁ*	‘butterfly’
	ˈs̺ums̺um	*ˈsumsum*	‘sesame’
	ikˈfok	*lidˈfok*	‘to pound’
	bakˈbuk	*bakˈbuk*	‘bottle’
Karmel	*galˈgel*	*hitgalˈgel*	‘rolled’
	ˈtaxtox	*ˈtʁaktoʁ*	‘tractor’
	ˈbulbul	*ˈbulbul*	‘penis’ child-speak
Erez	*paŋˈpaŋ*	*paʁˈpaʁ*	‘butterfly’
	s̺ukˈs̺ik	*ˈt͡ʃupt͡ʃik*	‘thingy’
Nadav	*muxˈʁax*	*muxˈʁax*	‘must’
	taʁˈtoʁ	*ˈtʁaktoʁ*	‘tractor’
	lixˈlux	*lixˈlux*	‘dirt’
	z̺omˈʁim	*zoʁˈmim*	‘running’ as in water
Maayan	*paʁˈpaʁ*	*paʁˈpaʁ*	‘butterfly’
	s̺alˈdal	*sanˈdal*	‘sandal’

1.5 The Classification of Medial Codas

1.5.1 The behavior of medial clusters in Hebrew

When a given prosodic word contains a two-consonant[3] medial cluster VC_1C_2V, cross-linguistically there are two possibilities for syllable parsing; VC_1**.**C_2V (where C1 is in medial coda position and C2 is the onset of the proceeding syllable) or V**.**C_1C_2V (where the first syllable is coda-less and the second is headed by a complex onset). However, parsing is not simply a matter of language specific preference. There are universal tendencies related to the relative sonority of the two segments.

These tendencies are based on two fundamental observations related to consonant clusters; The Sonority Sequencing Principle (SSP) which restricts complex onsets such that the C_1 should be less than or equally sonorous to C_2 (Adam 2002 from Steriade 1982), and the Syllable Contact Law (SCL) which stipulates that a more sonorous C_1 than C_2 is preferred across syllable boundaries (Adam 2002 from Vennemann 1988).

3 Three consecutive consonants are rare in Hebrew (Graf 2003)

Both the SSP and SCL rate relative sonority based on the standard sonority scale for consonants.

Glide > Liquid > Nasal > Fricative > Stop

When a medial cluster that is in violation of the SCL, this entails that it respects the SSP. To this effect, some languages will consistently parse C_1 and C_2 in the following onset (V**.**C_1C_2V). However, other languages may accept the violation (VC_1**.**C_2V). Which option is selected may be further guided by language-specific coda restrictions and the range of onset clusters found in the given language.

In Hebrew, all obstruents can be found in C_1 position in high frequency (see section 3.1.2). Thus the potential for ambiguous parsing is relatively high. Particularly since the language accepts a wide variety of complex onsets, some of which are sonority plateaus or even SSP violations[4]. However, this study will regard all medial clusters as consisting of a C1 medial coda and C2 onset (VC**.**CV). The basis for this assumption relies on evidence found within the language.

Hebrew does not tolerate medial triple-consonant (CCC) clusters, except in loan nouns such as *ˈkornfleks* ‘cornflakes’ and verbs derived from loan words such as *transˈfer* ‘transferred.’ This is corroborated by a process of vowel insertion seen in some verbal inflections where CCC clusters are broken up on by V-insertion between C2 and C3, as seen in the following example (taken from Graf 2003).

ji+gmʁ+u → *jigmeʁu* **jigmʁu* ‘(they) will finish’

[4] Many of these violations consist of sonority plateaus, where both C1 and C2 consist of stop segments, as in *bgaˈdim* ‘clothes.’ Others are Sc clusters, which although are in strict violation of the SSP, have been shown to behave uniquely in many languages including in Hebrew (Ben-David 2006). Hebrew also contains other relatively rare /fricative+stop/ SSP violations.

This confirms that although Hebrew allows limited clusters on word margins, it virtually prohibits them on internal syllable margins. This vowel insertion occurs regardless of the segmental makeup of the cluster.

1.5.2 THE CHILD-SUBJECT AND MEDIAL CLUSTERS

It is important to note, that on their path to acquiring a language, children may select parsing options not generally accepted in that language. Thus, despite the evidence regarding the status of medial clusters in Hebrew, it is necessary to evaluate whether Y himself treats medial clusters as coda-onset clusters (VC.CV) or as complex onsets (V.CCV).

In order to attempt to answer this question, it is first necessary to analyze how Y handles clusters that violate SCL. However, half of these clusters contain a liquid segment in either C1 or C2 position (see section 3.1.3). Since Y had not yet acquired liquids and the remaining clusters exhibiting rising sonority are scattered relatively sparsely throughout all phases of development, providing an analysis is challenging in the case of Y. The strongest evidence can be found in his initial faithful medial cluster productions (see section 3.2.1.2). These will be shown to contain only one SCL violation, suggesting that Y is adhering to universal principles regarding coda-onset clusters and not complex onsets.

Additional evidence supporting this conclusion comes from a comparison of Y's acquisition of C1 consonants in medial clusters to his acquisition of word-final codas. Evidence will show that the segmental order of acquisition of C1 consonants in Y's data is identical to the order that has been shown for word-final singleton codas in Hebrew (see section 3.2.1.2). This evidence suggests that Y regards medial clusters as coda-onset clusters and is acquiring them accordingly.

On the other hand, evidence from the reduction of medial clusters will show that Y tends to preserve the less sonorous of the two consonants (see section 3.3). This sonority pattern has been well-documented in the child-speech of many languages – particularly for word-initial complex onsets. This link suggests that medial clusters, particularly SCL violations, may be interpreted by Y as word-medial complex onsets. On the other hand, it is not implausible to conclude that the sonority pattern is activated for both coda-onset and complex onset clusters. If the principle behind the sonority pattern is the universal inclination toward a low sonority segment in onset position, this is relevant for coda-onset clusters as well. If a child's productions follow the sonority pattern, the segment retained in medial clusters will surface as an onset, regardless of its underlying prosodic location. This would predict the opposite phenomenon with regards to word-final coda clusters since sonorants are universally more preferred as coda segments, however, this hypothesis cannot be tested on Hebrew which contains very few complex codas. Another way to rule out the sonority patterning as an indication that Y treats medial clusters as complex onsets it would be to compare Y's acquisition of medial clusters with his acquisition of word-initial onset clusters. However, since Y has not acquired any word-initial onset clusters during the recording period, this comparison cannot be made. Thus the fact that Y employs the sonority pattern in cluster reductions does not provide any clear-cut evidence one way the other regarding his treatment of medial clusters.

The most compelling evidence in favor of Y's treatment of medial clusters as coda-onset clusters lies in the mere fact that the acquisition of C1 consonants in medial clusters will be shown to be influenced by stress. In segmental strings of $V_1C_1C_2V_2$, where V1 is stressed, the acquisition of C1 is accelerated. This fact can be explained only by presuming that Y perceives C1 as part of the stressed syllable ($V_1C_1.C_2V_2$). If

Y were to perceive $V_1.C_1C_2V_2$, then it might be expected that C1 production would be accelerated in cases where V2 is stressed[5].

1.5.3 The status of glides in C1 position

Another issue that should be considered is the status of glides in C1 position. It is possible that glides actually occupy the position of a branching nucleus (i.e. diphthong) and not that of a coda (branching rime). However, if this is the case then glides are the only branching nuclei found in the language (see section 1.4.2). Regardless of the status of glides, both options are representative of a complex rime structure, and evidence will show that glides in C2 position appear in precise concurrence with the initial onset of Y's medial coda production. For this reason, glides will be referred to as codas. This is supported by evidence from Dutch (Fikkert 1994) showing that branching rimes are acquired prior to branching nuclei.

1.6 Child-Directed Speech

Because so little research is available regarding medial codas in Hebrew, this section will focus on presenting statistics revealed by the child-directed speech[6].

1.6.1 Stress

A total of 79% of the medial codas in the child-directed speech were located in unstressed syllables. A further breakdown shows that the distribution of verbs vs. non-verbs is identical. Regardless of the differences in stress patterns found in Hebrew, the child-directed data reveals that medial codas occur in stressed vs. unstressed syllables in both verbs and non-verbs in equal proportions. 79% of *verbal* target types in the child-directed speech were found in unstressed syllables and 79% of *non-verbal* target types were located in unstressed syllables. Among the outputs with medial codas in

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[5] This is not to say that other children may take alternate routes in acquiring medial clusters.
[6] See Section 2.4 for an outline of procedures used for the child-directed speech data

unstressed syllables 42% were verbs and among the outputs with medial codas in stressed syllables 44% were verbs.

1.6.2 SEGMENTS

In an expansive study of Hebrew phonological words (Schocken 2008), a corpus of 13,720,000 words extracted from random internet sources was used to compile a lexicon of the 99,808 most frequent words in Hebrew. The results provided the following hierarchy for the distribution of segments in Hebrew.

Stops > Nasals > Liquids > (non-sibilant) Fricatives > Stridents > Glides

Table 3: Segmental distribution in Hebrew according to sonority ranking (low to high)[7]

Coda Segments	% of Total
stops	26%
non-sibilant fricatives	12%
stridents	11%
nasals	18%
liquids	16%
glides	3%

This is contrasted with results from this study regarding the distribution of segments in medial coda position.

Table 4: Child-directed speech: distribution of medial coda segments

Coda Segments	Quantity	% of Total
stops	124	20%
non-sibilant fricatives	127	21%
stridents	137	22%
nasals	59	10%
liquids	151	24%
glides	21	3%
Total	**619**	

While overall, stops are the most common segments found in Hebrew (26%), liquids, stridents, non-sibilant fricatives and stops are all in equal distribution in medial coda

[7] Results were condensed such that there is no voicing distinction

position (20~24%). Nasals, on the other hand, are relatively common in Hebrew overall (18%), but less frequent in medial coda position (10%). Glides are rare in both data sets, totaling 3% both overall and in the medial coda position.

According to these findings, all segment-types are in equal distribution in medial coda position with the exception of nasals and glides. This is contrary to universal preferences which stipulate that sonorants are preferred in coda position (Clements 1990 and others). It is particularly unusual that while nasals occur less in medial coda position than overall in Hebrew, fricatives increase in proportion relative to their overall distribution. This is likely due to a process of post-vocalic spirantization which is a remnant of Tiberian Hebrew, but still active in Modern Hebrew (Adam 2002).

Distributions between stressed and unstressed syllables show additional anomalies.

Table 5: Child-directed speech: segmental distribution per syllable type

Coda Segments	% in stressed syllables	% in unstressed syllables
stops	15%	85%
non-strident fricatives	17%	83%
stridents	17%	83%
nasals	44%	56%
liquids	25%	75%
glides	33%	67%
Totals	**21%**	**79%**

Obstruents seem to be distributed in ratios almost identical to the overall 79%-21% distribution of medial codas in unstressed and stressed syllables respectively. The distribution of liquids is also comparable in that there is a clear propensity toward unstressed syllables. Nasals and glides, however, are again set apart. Glides are still found much more commonly in unstressed syllables, but in not nearly the same proportions as obstruents. However, given that there are very few target words in Hebrew with glide medial codas, no conclusions can be drawn regarding these findings.

Even more puzzling is the fact that nasals are distributed almost equally between stressed and unstressed syllables. Further research is necessary to identify an explanation for this.

1.6.3 SYLLABLE CONTACT DATA

The only syllable contact combinations that did not exist in the child-directed speech were strident-strident, liquid-liquid and glide-glide. The double strident and glide combinations are indeed not possible in the language. However, liquid-liquid combinations do occur on occasion, mainly in loanwords (*karliˈbax* ‘Proper name’; *merˈlot* ‘merlot’; *ˈmelʁoz plejs* ‘melrose place’).

Table 6: Child-directed speech: syllable contacts

Syllable Contacts	Quantity	Percentage	Sample from data
stop-stop	35	5.7%	*bakˈbuk* ‘bottle’
stop-fricative	14	2.3%	*mikˈxol* ‘paintbrush’
stop-strident	7	1.1%	*ˈtakˈʃiv* ‘listen
stop-nasal	16	2.6%	*nadneˈda* ‘(a) swing’
stop-liquid	45	7.3%	*ˈzebʁa* ‘zebra’
stop-glide	7	1.1%	*amˈbatja* ‘bathtub’
fricative-stop	35	5.7%	*axˈbaʁ* ‘mouse’
fricative-fricative	7	1.1%	*mafˈxid* ‘scary’
fricative-strident	23	3.7%	*axˈʃav* ‘now’
fricative-nasal	23	3.7%	*befˈnim* ‘inside’
fricative-liquid	35	5.7%	*efˈʁoax* ‘chick’
fricative-glide	4	0.6%	*livjeˈtan* ‘whale’
strident-stop	88	14.2%	*lisˈpoʁ* ‘to count’
strident-fricative	16	2.6%	*misˈxak* ‘game’
strident-strident	0	0.0%	
strident-nasal	10	1.6%	*ozˈnaim* ‘ears’
strident-liquid	21	3.4%	*mazˈleg* ‘fork’
strident-glide	2	0.3%	*televizˈja* ‘television’
nasal-stop	30	4.8%	*psanˈteʁ* ‘piano’
nasal-fricative	5	0.8%	*mimˈxa* ‘from you’
nasal-strident	11	1.8%	*lehamˈʃix* ‘to continue’
nasal-nasal	3	0.5%	*siˈjamnu* ‘(we) finished’
nasal-liquid	4	0.6%	*simˈla* ‘(a) dress’
nasal-glide	6	1.0%	*meanˈjen* ‘interesting’
liquid-stop	95	15.3%	*naˈfalti* ‘(i) fell’
liquid-fricative	19	3.1%	*baʁˈvaz* ‘duck’
liquid-strident	15	2.4%	*afaʁˈsek* ‘peach’
liquid-nasal	16	2.6%	*aʁˈnav* ‘rabbit’
liquid-liquid	0	0.0%	
liquid-glide	6	1.0%	*sukaʁˈja* ‘piece of candy’
glide-stop	5	0.8%	*haˈbajta* ‘to home’
glide-fricative	0	0.0%	
glide-strident	11	1.8%	*xajˈzaʁ* ‘alien’
glide-nasal	3	0.5%	*lefaˈnejnu* ‘in front of us’
glide-liquid	2	0.3%	*ˈlajla* ‘night’
glide-glide	0	0.0%	
Totals	**619**		

The two most common combinations are strident-stop and liquid-stop. Thus, contrary to what the data regarding the medial segments alone showed, when syllable contact data is considered, it seems that more often than not, Hebrew *does* adhere to the universal preferences stipulated by the SCL. Nasals and glides are the only segments more sonorant that liquids, but as seen previously are relatively uncommon in medial coda position. This makes the liquid-stop combination the most likely candidate for an unmarked sequence containing a sonorant-obstruent. The fact that the strident-stop combination is relatively frequent is also not surprising and is in accordance with the commonly cited unique status of stridents in consonant clusters in many languages.

Thus medial clusters in Hebrew generally adhere to the SCL, although the language does allow some violations. These violations are all medial clusters that exhibit a rise in sonority between C1 and C2. Overall, 68% of the clusters comply with the SCL, while 32% are in violation. Among the SCL violations, half (101) contain a liquid segment in either C1 or C2 position.

Table 7: Child-directed speech: SCL complaint clusters vs. SCL violations

	Qty.	Percent.	
Sonority Plateaus	84	13.6%	SCL compliant (Plateaus + Falling)
Falling Sonority	335	54.1%	
Rising Sonority	200	32.3%	SCL violations
Total	**619**		

2 RESEARCH METHODS

2.1 THE CHILD-SUBJECT

The results presented in this paper are based on longitudinal data collected from one mono-lingual Hebrew-speaking male child (Y). Y was selected for this study due to the fact that he had already been established as a slow developer. Adam & Bat-El (2007b) found that, in comparison to another child, Y reached the same number of cumulative attempted targets (254) as the other child a full 8 months later, even though both children's first words appeared at virtually the same age.

It should be noted that Y's early prosodic development was also cited by Bat-El and Adam (2007b) as being a-typical in the sense that he utilized a "Take-*a*" process in early syllable selection. Y typically truncated disyllabic trochees to monosyllabic productions of the unstressed syllable if it contained an /*a*/ nucleus. This process was noted as being a possible indicator of slow development as it was compared to a rapidly-developing child whose productions of trochees where disyllabic, in accordance with other findings for Hebrew (Adam 2001, Ben-David 2001). Furthermore, Y continued the phase of truncated monosyllabic productions for an uncommonly long period.

To this effect, the fact that Y's phonological development has already been tagged as a-typical should be a considered when implying universal tendencies in acquisition based on results from his data alone. However, this is always the case when data from only child-subject is utilized. Importantly, the developmental phenomena discussed in this paper are not a-typical in nature. The influence of stress in acquiring prosodic structures has been well-documented. The fact that it has not been shown for Hebrew medial clusters, is more likely due to the fact that these clusters are acquired at a late stage and consequently the details of their development are difficult to capture in normally paced children. This is not to say that PROMINENCE is necessarily influential in the acquisition of medial clusters for all children, but that it is likely that it is influential in at least some children, even if its impact is unseen on the surface.

Thus relevant to the purposes of this paper is the fact that Y is a slow developer. Importantly, this is not equal to a late developer. Children that are late developers often begin acquisition at a later than expected age without any effect on the net duration of the acquisition process. The advantages of studying a slow developer lie in the fact that language development is prolonged rather than simply delayed. To this effect, the data drawn during each stage is likely to be more substantial in both quantity and detail. Furthermore, the process of data collection for this study was unique in that recordings were made on a rather frequent basis (see section 2.2.), thus increasing the probability of uncovering otherwise intangible evidence.

2.2 DATA COLLECTION PROCEDURES

Recordings began during the child's pre-speech (babbling) phase at age 1;00.05 and continued on a weekly basis until full phonological acquisition at age 4;01.12[8]. All sessions were approximately one hour long and took place in the child's home and in the presence of the investigator and at least one member of the child's family (mainly his mother). Recordings were made with a high quality digital recorder which was placed in the vicinity of the play area. Recordings are of spontaneous speech interactions between the investigator and the child and some naming tasks. In later recordings elicitation tactics were employed in order to encourage the production of more complex morphological structures. Picture flash cards were successfully used to elicit plural formations for nouns. Story-telling tasks were used to elicit verb production; however, these were relatively unsuccessful.

[8] Any gaps in recording were generally initiated by Y's family due to illness or clashes with other obligations

2.3 TRANSCRIPTION PROCEDURES

All sessions used for the purposes of this paper were transcribed by the investigator using CHAT conventions for CHILDES. Completed transcriptions reach the age of 3;01.02. Subsequent recordings have not yet been transcribed and are therefore not accounted for in this study.

All words, phrases and sentences produced by Y were transcribed on several tiers;

Tier I: *A Phonemic transcription of Y's output using Latin characters to represent Hebrew orthography according to accepted conventions.*

Tier II: *A narrow Phonetic transcription of Y's output using IPA conventions including word stress (main stress only).*

Tiers III and IV: *Phonemic and phonetic transcriptions of the target (these were based on standard adult pronunciations without consideration for phonological contexts).*

Tier V: *A gloss tier.*

If the phonetic makeup of any part of an utterance was in question an "x-convention" was employed, where "xxx" was used to represent each prosodic word which contained incompressible elements. The x-convention was used even if the target of the utterance was understood from the context. If the phonetic makeup of an utterance was clear, but the target could not be ascertained through the context, a "babbling" convention was used. The output was transcribed phonemically and phonetically in full, but was marked as "@b" on the target and gloss tiers.

Utterances made by the investigator or other participators were transcribed only when they directly preceded or otherwise prompted the child's speech. This was done solely for contextual purposes and thus only phonemic and gloss tiers were transcribed. These productions were later extracted for the compilation of the child-directed speech data.

2.4 DATA SELECTION & FILTRATION

The first word-medial coda in Y's output appeared at age 2;06.25. From that point onward, all targets that contained medial codas were extracted from the transcriptions and divided into four groups per transcription: ***Faithful*** medial codas in a ***stressed*** environment; ***Unfaithful*** medial codas in a ***stressed*** environment; ***Faithful*** medial codas in an ***unstressed*** environment; and ***unfaithful*** medial codas in an ***unstressed*** environment. A medial coda was accepted as faithful regardless of whether it was segmentally identical to the target coda. However, any medial codas that appeared in syllables which did not correspond in their prosodic location to the target medial coda were discounted. Additional data that was excluded consists of the following:

- ⇨ Targets with liquid medial codas (l and ʁ). Y had not yet acquired these segments in any prosodic location[9].
- ⇨ Compounds, reduplications and monomorphemic expressions with double or unclear stress patterns in the target.
- ⇨ Words with an optional glide coda where coda production is rare in the adult target. This mainly consisted of the target ˈejfo/ˈefo 'where'.
- ⇨ Verbs with optional vowel epenthesis in the adult targets (i.e hoˈradti/ horadeti '(i) put (it) down') – These were extremely rare in the data.
- ⇨ Target words with medial codas followed by a glottal stop onset (i.e. pitˈʔom 'suddenly'). The adult output of these is highly inconsistent and the glottal is often dropped (pitˈʔom / piˈtom).

The remaining data was further filtered by type per recording session. If the same token was repeated more than once throughout one session it was counted as only one type as long as the outputs were identical. Outputs that differed only in the voicing feature of a

[9] Cases where the onset of the following syllable was a liquid were included in the data. Although Y often transfers the segment in the medial coda position to the empty slot left by the dropped liquid from the following onset position, this is not always the case. Y often produced a faithful medial coda and substituted a glottal stop for the liquid in the onset position of the target.

consonant (*[bej'ts͡a] or [pej'ts͡a]* for */bej'ts͡a/* 'egg') or in minor vowel qualities (vowel length[10], devoicing etc.) were regarded as identical. However, if there was any other diversity in the segments (including in place or manner of articulation) the same target was counted twice *([bak'buk] and [bax 'bux]* for */bak'buk/* 'bottle'). If more than one output of the same target differed prosodically in any way, each was counted separately. Prosodic differences included the number of syllables in the output (*['nesti] and [ex'nas'ti]* for */hex'nasti/* 'I put it in'), differences in the structure of any of the syllables in the output *([is'xak] and [is'xa]* for */mis'xak/* 'game'*)*, and differences in the location of stress in the output *([afxi'da] and ['avxida]* for */mafxi'da/* 'scary fem.'*)*. Cliticized words were considered separate types since Hebrew clitics form one prosodic word with their host. Targets containing more than one word-medial coda were counted once for each coda. If the syllable containing the medial coda was truncated, only the token for the truncated coda was discounted.

Finally, since not all recordings contained an ample number of targets with medial codas, the data was divided into periods such that each period contained a minimum number of 35 relevant targets. So, for example, if a given session contained less than 35 tokens, additional recordings were added to that period until the total number of targets exceeded 35. The maximum number of recordings grouped into one period was three (see Appendix for breakdown recording date spans per period and sample tokens). Throughout the entire recording period, the total number of target types (not including those with liquid codas) attempted by the child came to 612 and the total number of faithful medial coda productions came to 296.

For child-directed speech data, the transcriptions were scanned for all occurrences of target words with a medial coda. These were filtered according to type for the entire

[10] Hebrew does not have vowel length distinctions.

recording period so as not bias the results. The total number of target types that was collected from the child-directed speech came to 619. These were then divided into two groups; one where the syllable containing the medial coda is stressed and one where the syllable containing the medial coda was not stressed. Target words that contained more than one medial coda were counted twice, where each occurrence was categorized in correspondence to each medial coda.

Since verbs vary from non-verbs in their stress patterns and since children tend to use fewer verbs than adults, the data was further divided between verbal and non-verbal outputs. This was done in order to offer insight into any potential differences between the occurrences of medial codas in the adult data versus the child data. In addition, all data was divided into the following groups according to the medial coda segment; Stops, Non-sibilant Fricatives, Stridents[11], Liquids, Nasals and Glides. All potential syllable contact variations were also examined.

3 FINDINGS

The following section presents all findings regarding Y's medial coda production throughout the recording period. Section 3.1 presents an overview of the child's targets as a comparison to the child-directed speech. Section 3.2 presents and analyzes the stages in Y's acquisition of medial codas, with an emphasis on the licensing effects of Prominence. Section 3.3 provides a general overview of the cluster reduction patterns found in Y's unfaithful productions of medial clusters and examines how these patterns support the findings of this study.

[11] Stridents include all fricative and affricate sibilants. These were separated placed into a group of their own due to their unique acoustic properties.

3.1 CHILD TARGETS

In order to compare the results of the Y's outputs with the child-directed speech data, it is first necessary to establish whether the child target data is comparable to adult speech. The following section will provide an overview of the distribution of medial codas from Y's target productions. The targets were filtered by type using the same criteria that were used for the child-directed speech.

3.1.1 STRESS

The overall child target data consists of 320 different types with medial codas. 23% (75) of these contained medial codas in unstressed syllables while 77% (245) contained medial codas in stressed syllables. This is virtually identical to the results found in the child target data (see section 1.7.1). This means that any bias in the faithful medial coda outputs cannot be attributed to any difference between the child-directed speech and child target data. If PROMINENCE is not influential during Y's acquisition of medial cods, then faithful outputs should be found in a distribution which is comparable to the overall target data and the child-directed speech.

3.1.2 SEGMENTS

The overall distribution of medial coda segments in the child target data is almost identical to that found in the child directed speech (see section 1.6.2).

Table 8: Child Targets (types): medial coda segments

Coda Segments	Quantity	% of Total
stop	52	16%
non-sibilant fricative	74	23%
strident	71	22%
nasal	29	9%
liquid	85	27%
glide	9	3%
	320	

The largest margin is in the distribution of stop codas which was 20% in the child-directed speech and only 16% in the child target data. Although this is still within an acceptable 5% margin of error, a more detailed analysis of the segmental distribution provides additional insight.

When the distribution of each segment type in stressed versus unstressed syllables is examined, the results are, for the most part, quite similar to those found in the child-directed speech (see section 1.7.2), with stops again showing the largest disparity.

Table 9: Child targets: segmental distribution per syllable type

	Stressed Syllables		Unstressed Syllables		
Coda Segments	**Qty.**	**%**	**Qty.**	**%**	**Totals**
stops	13	25%	39	75%	52
non-strident fricatives	11	15%	63	85%	74
stridents	12	17%	59	83%	71
nasals	16	55%	13	45%	29
liquids	20	24%	65	76%	85
glides	3	33%	6	67%	9
Totals	**75**	**23%**	**245**	**77%**	**320**

In the child target data only 75% of the stop codas are located in stressed syllables compared to 85% in the child-directed speech. This is actually not surprising when considering that a large quantity of the stop codas in the child-directed speech are the result of the *hitpaʔel* verbal template (*binyan*), which contains infinitive, past, participle, future and imperative forms all with prefixes ending in the voiceless coronal stop [*t*] in an unstressed syllable. Examples from the child-directed speech include *lehit-kaˈʃer* ‘to call (on the phone)’, *hit-balˈgen* ‘became messy,’ *mit-naˈheg* ‘behave/s’, *nit-kaˈʃer* ‘(we) will call’, *tit-gaˈleʃ* ‘slide!’, *yit-kalˈkel* ‘will break.’ In total, the child directed speech data contains 23 of these forms – making up 22% of stop medial codas in unstressed syllables and 19% of stop medial codas overall. The child target data, on the other hand, contains only 2 such forms making up a mere 4% of the stop medial codas overall and 5% of the stop medial codas in unstressed syllables. In this case, it is likely that the fact that the child's outputs contain fewer verbs influenced the results. Importantly, *hitpaʔel* is the only *binjan* in Hebrew which contains prefixes with codas. Thus a similar bias is not expected with regards to other coda segments.

3.1.3 SYLLABLE CONTACTS

Table (10) shows the numbers and percentages of all possible syllable contact combinations found in the child targets in comparison to the child-directed speech.

The results are the same, showing strident-stop and liquid-stop as the two most common combinations and with no significant disparages in other syllable contact combinations.

Table 10: Child Targets: syllable contacts

Syllable Contacts	Quantity	Percentages	Child-directed speech
stop-stop	19	5.9%	5.7%
stop-fricative	5	1.6%	2.3%
stop-strident	1	0.3%	1.1%
stop-nasal	7	2.2%	2.6%
stop-liquid	17	5.3%	7.3%
stop-glide	3	0.9%	1.1%
fricative-stop	23	7.2%	5.7%
fricative-fricative	2	0.6%	1.1%
fricative-strident	13	4.1%	3.7%
fricative-nasal	13	4.1%	3.7%
fricative-liquid	20	6.3%	5.7%
fricative-glide	3	0.9%	0.6%
strident-stop	45	14.1%	14.2%
strident-fricative	6	1.9%	2.6%
strident-strident	0	0.0%	0.0%
strident-nasal	3	0.9%	1.6%
strident-liquid	16	5.0%	3.4%
strident-glide	1	0.3%	0.3%
nasal-stop	15	4.7%	4.8%
nasal-fricative	4	1.3%	0.8%
nasal-strident	1	0.3%	1.8%
nasal-nasal	4	1.3%	0.5%
nasal-liquid	0	0.0%	0.6%
nasal-glide	5	1.6%	1.0%
liquid-stop	42	13.1%	15.3%
liquid-fricative	17	5.3%	3.1%
liquid-strident	10	3.1%	2.4%
liquid-nasal	9	2.8%	2.6%
liquid-liquid	0	0.0%	0.0%
liquid-glide	7	2.2%	1.0%
glide-stop	1	0.3%	0.8%
glide-fricative	0	0.0%	0.0%
glide-strident	8	2.5%	1.8%
glide-nasal	0	0.0%	0.5%
glide-liquid	0	0.0%	0.3%
glide-glide	0	0.0%	0.0%
Totals	**320**		

The resulting distribution of syllable contacts according to the relative sonority of the two consonants is identical to that found in the child-directed speech data (see section 1.6.3).

Table 11: Child Targets: SCL complaint clusters vs. SCL violations

	Qty.	Percent.	
Sonority Plateaus	44	13.8%	SCL compliant
Falling Sonority	175	54.7%	SCL compliant
Rising Sonority	101	31.6%	SCL violations
Total	**320**		

Also like the child-directed speech, half (54) of the SCL violations contain a liquid segment in either C1 or C2 position.

3.2 STAGES IN MEDIAL CODA ACQUISITION

Taking into account the findings from the child-directed speech, the goal of this study is to test whether the child acquires medial codas in accordance with the common structures found in Hebrew, or whether his acquisition is influenced by other factors – namely PROMINENCE. The expectation is *not* that the child will elicit a larger number of medial codas in unstressed syllables than in stressed syllables. This is unlikely due to the extremely large gap in the distribution of medial codas per syllable type. Rather, if PROMINENCE is stronger than FREQUENCY, then the expectation is that the child will elicit a larger percentage of medial codas in stressed syllables as opposed to unstressed syllables, *relative to their respective natural occurrence in the language*. If segmental PROMINENCE is significant, it is expected that the period of influence will overlap with the influence of stress thus providing further evidence for the importance of PROMINENCE in the acquisition process.

3.2.1 STAGE I: PROMINENCE OVER FREQUENCY

This section will take a close look at Y's initial phases of medial coda production and will examine the effects of PROMINENCE. Section 3.2.1.1 will focus on the effects of stress. An analysis of the segmental data will be pursued later in section 3.2.1.2.

3.2.1.1 STRESS EFFECTS

Overall Y's medial coda productions exhibit a trend of increasing faithfulness, as would be expected.

Table 12: Periods 1-12 Total faithful medial codas

Period	Age range	Total Faithful outputs	Total Targets	% of faithful outputs
1	(2;10.29-2;11.05)	6	45	13%
2	(2;07.15- 2;07.29)	10	62	16%
3	(2;08.20- 2;08.27)	11	46	24%
4	(2;09.03- 2;09.10)	20	51	39%
5	(2;09.17)	32	53	60%
6	(2;10.07- 2;10.14)	31	65	48%
7	(2;10.29- 2;11.05)	28	42	67%
8	(2;11.13)	22	43	51%
9	(2;11.20- 2;11.27)	32	51	63%
10	(3;00.03- 3;00.16)	30	42	71%
11	(3;00.28)	47	78	60%
12	(3;01.02)	27	34	79%
Totals		**296**	**612**	

However, in order determine whether stress influences the acquisition of medial codas, it is necessary to examine the percentages of faithful acquisitions per syllable type for each period[12]. Note that in section 3.1 the intention was to compare child target data with child-directed speech and it was thus necessary to use identical filtering procedures – types per the entire recording period. In this case, targets stand in comparison to faithful outputs and thus targets were filtered per recording session and targets with liquid codas were excluded.

[12] The percentages were calculated in relation to the number of targets in the respective environment and not in relation to the total number of targets with medial codas

Despite the differing filtering methods, the end result is almost identical. Among Y's 612 targets with medial codas, 155 (25%) were found in stressed syllables, while 457 (75%) were found in unstressed syllables.

Table 13: Periods 1-12 outputs and targets per stress environment

		Medial Codas in **Stressed** Syllables			Medial Codas in **Unstressed** Syllables		
Period	Age range	Faithful Outputs	Targets	% Faithful	Faithful Outputs	Targets	% Faithful
1	(2;06.29-2;07.08)	1	6	17%	5	39	13%
2	(2;07.15- 2;07.29)	5	16	31%	5	46	11%
3	(2;08.20- 2;08.27)	4	16	25%	7	30	23%
4	(2;09.03- 2;09.10)	8	17	47%	12	34	35%
5	(2;09.17)	17	20	85%	15	33	45%
6	(2;10.07- 2;10.14)	6	18	33%	25	47	53%
7	(2;10.29- 2;11.05)	6	11	55%	22	31	71%
8	(2;11.13)	10	11	91%	12	32	38%
9	(2;11.20- 2;11.27)	5	6	83%	27	45	60%
10	(3;00.03- 3;00.16)	3	10	30%	27	32	84%
11	(3;00.28)	10	18	56%	37	60	62%
12	(3;01.02)	5	6	83%	22	28	79%
Totals		**80**	**155**		**216**	**457**	

A closer look shows that Periods 1-5 all show larger ratios of faithfulness to codas in stressed syllables, whereas during Periods 6-12 faithfulness to medial codas in unstressed syllables continues to increase, while faithfulness to medial codas in stressed syllables becomes sporadic and finally levels with those in unstressed syllables. The results can therefore be condensed into Stage I and Stage II in order to show a clearer illustration of the trend.

Table 14: Stages I and II: faithful medial codas per stress environment

		Medial Codas in **Stressed** Syllables			Medial Codas in **Unstressed** Syllables			
Stage	Age range	Faithful Outputs	Targets	% Faithful	Faithful Outputs	Targets	% Faithful	Total Targets
I	(2;06.29-2;09.17)	35	75	47%	44	182	24%	257
II	(2;10.07- 3;01.02)	45	80	56%	172	275	63%	355

During Stage I, 47% of medial codas in stressed syllables are faithfully produced, while in only 24% of those found in unstressed syllables are faithfully produced. This shows that, while in number, Y produces more medial codas in the *unstressed* environment, the relative quantity of faithful medial codas in *stressed* environments is much greater. Conversely, during Stage II faithful productions are found in nearly equal proportions between the two syllable types - 56% in stressed syllables and 63% in unstressed syllables, with faithful outputs in *unstressed* syllables even slightly surpassing those in *stressed* syllables. In conclusion, a PROMINENCE >> FREQUENCY hierarchy can categorize the initial licensing of medial codas, while FREQUENCY >> PROMINENCE in later stages. Although this paper does not include data from the final stages of medial coda acquisition, the prediction is that either medial codas will in unstressed syllables will continue to be produced faithfully more often, or proportions will eventually converge again before the acquisition process is complete.

3.2.1.2 SEGMENTAL EFFECTS

During the initial onset of coda production, Y's outputs contained very few faithful medial coda productions.

Table 15: Periods 1-2 faithful medial coda productions[13]

Output	Target	Gloss
bejˈt͡sa	*bejˈt͡sa*	'egg'
ˈkista	*ˈkiʃta*	'scat'
asˈta	*asˈta*	'(she) did'
aftaˈʔa	*haftaˈʔa*	'surprise'
bejˈt͡sa	*bejˈt͡sa*	'egg'
bejˈta	*bejˈt͡sa*	'egg'
ɪsˈba	*niʃˈbaʁ*	'(it) broke'
ˈtaxˈti	*hit͡sˈlaxti*	'(i) did it'
asˈwe	*masˈmeʁ*	'nail'
eˈsafta	*le#ˈsavta*	'to grandma'
abejˈta	*ha#bejˈt͡sa*	'the egg'
ˈit͡sxa	*ˈixsa*	'yuck'
aˈʔisxa	*ˈixsa*	'yuck'
iʒˈtot	*liʃˈtot*	'to drink'
ˈsafta	*ˈsavta*	'grandma'
uxuxˈʔax	*meluxˈlax*	'dirty'

[13] Each target was counted as only one type per recording session for identical outputs (section 2.1.3). However, identical types may occur within the same period if respective outputs were produced during different recording sessions.

As stated in section 1.4 Ben-David (2001) found that earliest medial coda outputs of Hebrew-speaking children are reduplication of final codas. Yet this is not the case with Y. Only one of Y's initial medial coda outputs is a reduplication of the final coda (*[uxux'ʔax]* for */melux'lax/* 'dirty'). Furthermore, only two of the targets contain a final coda. This is interesting as it may actually be evidence that Y initially has difficulties producing two consecutive syllables with codas (possibly related to his slow developmental pace) and selectively avoids targets with cumulative complexity.

Furthermore, when the medial clusters are broken down according to syllable contact type, Y shows a clear propensity for outputs that adhere to the SCL (93.8% in total). This indicates that Y is adhering to cross-linguistic tendencies regarding codas at a ratio much greater than what is found in the child-directed speech (see section 1.6.3) and the child targets (see section 3.1.3).

Table 16: Periods 1-2 syllable contact types

	Qty.	Percent.	
Sonority Plateaus	2	12.5%	SCL compliant
Falling Sonority	13	81.3%	
Rising Sonority	1	6.3%	SCL violations
Total	**16**		

The segment types in these initial 16 productions are also limited.

Table 17: Periods 1-2 faithful medial codas per segment

Coda Segments	Quantity	% of Total Faithful Outputs
stops	0	0%
non-sibilant fricatives	5	31%
stridents	7	44%
nasals	0	0%
glides	4	25%
Total	**16**	

During this initial phase, the only medial codas elicited are either fricatives (sibilant and non-sibilant) or glides. Recall the targets with liquids were removed as Y does not have liquids in his phonetic inventory at this stage.

The lack of stops at this stage is inconsistent with their language-specific FREQUENCY, but it is in complete accordance with universal tendencies which identify stops as the least-favored coda segment. Nasals, on the other hand, being high in sonority, are universally preferred in coda position. Thus their complete absence at this stage is surprising. Particularly in light of the fact that they are more likely to be found in stressed syllables in relation to their occurrence, than any other segment (see section 3.1.2). This may be evidence that PROMINENCE is not the only licensor of coda acquisition and FREQUENCY must still be considered. Since nasals are relatively rare in medial coda position in Hebrew, they are not among the first segments to be acquired here.

Interestingly, however, this lack of nasal codas is actually in accordance Ben-David (2001), who found similar results with regards to word-final coda acquisition in Hebrew. According to Ben-David, instead of avoiding low sonority segments in the early stages of coda acquisition, Hebrew speaking children actually avoid segments that are lacking the feature [+continuant]. Thus nasals and stops, both [–continuant], are not produced. Note that the target data from the same period contains 29% [-continuant] medial coda segments, so the lack of these in the output data needs to be attributed for.

Table 18: [+cont] vs. [-cont] medial coda targets

	Qty.	Percent.
[+continuant] codas	76	71%
[-continuant] codas	31	29%
Total	107	

Thus it may actually be the double licensing of Frequency and [+continuant] that leads to the early production of stridents and non-sibilant fricatives in medial coda position.

Related to the [+continuant] feature in fricatives and stridents is an increased acoustic prominence due to a high-pitched hissing sound that results (this is particularly true for stridents) (Ladefoged 1993). Since C1 in consonant clusters has been documented as a position of low perceptibility (Pycha, Shin & Shosted from Fujimura et al. 1978, Ohala 1990), the Prominence effects associated with these features may facilitate the perception of these segments and have an effect on production as well.

Also surprising is the fact that glides make up such a large percentage of Y's faithful output data, despite the fact that glide codas are extremely rare in the language overall and in medial coda position. Note that this is not because Y produces a variety of words with glide codas. All of the 4 outputs counted are related to the same target; *bejˈt͡sa* 'egg' (*ha-bejˈt͡sa* 'the egg' is also included). On the one hand, this may seem problematic if Y has simply incorporated this word in full into his lexicon. However, this is not the case. During Period 1-2, Y had a total of 6 targets of related to *bejˈt͡sa* 'egg', thus not all were produced accurately. Also important to note is the fact this word is stressed on the final syllable, thus any PROMINENCE effects cannot be related to stress. Importantly, glides are the only sonorants in Y's inventory at this stage that are [+continuant]. The increased salience (and thus PROMINENCE) of glides makes them more likely to be produced faithfully at this stage. These results are also in agreement with Ben-David's finding regarding word-final codas.

When Periods 3-5 of Stage I are examined, these segmental effects are no longer apparent. By the end of Stage I, the occurrence of faithful coda segments has neared the distribution ratios in the language (again with exception of liquids).

Table 19: Periods 3-5 faithful codas per segment

Coda Segments	Quantity	% of Total Outputs	Child-directed data
stops	23	28%	20%
non-sibilant fricatives	24	29%	21%
stridents	23	28%	22%
nasals	5	6%	10%
glides	8	10%	3%
Total	**87**		

Stage I can thus be further divided into two phases.

Phase A: where the influence of acoustic prominence (manner of articulation and stress) is evident in the segments elicited in medial coda position.

Phase B: where only stress remains a factor in medial coda production.

3.2.2 STAGE II: THE REGRESSIVE INFLUENCE OF PROMINENCE

Clearly Y is able to produce medial codas more accurately when they are in an environment of increased PROMINENCE, but only during Stage I. Since medial codas in stressed syllables are licensed only by PROMINENCE and medial codas in unstressed syllables are licensed only by FREQUENCY, this is evidence to the fact that PROMINENCE (stress) and FREQUENCY (common prosodic structure) are *not* equal licensors of coda acquisition.

Stage I exhibited a trend of the decreasing influence of PROMINENCE, but only relative to the segmental data. The effects of stress seem to persist throughout Stage I. However, when the percentage of faithful outputs in stressed syllables is contrasted with the rapidly increasing percentage of faithful outputs in unstressed syllables, the overall regressive nature of PROMINENCE as a licensor of medial codas becomes apparent.

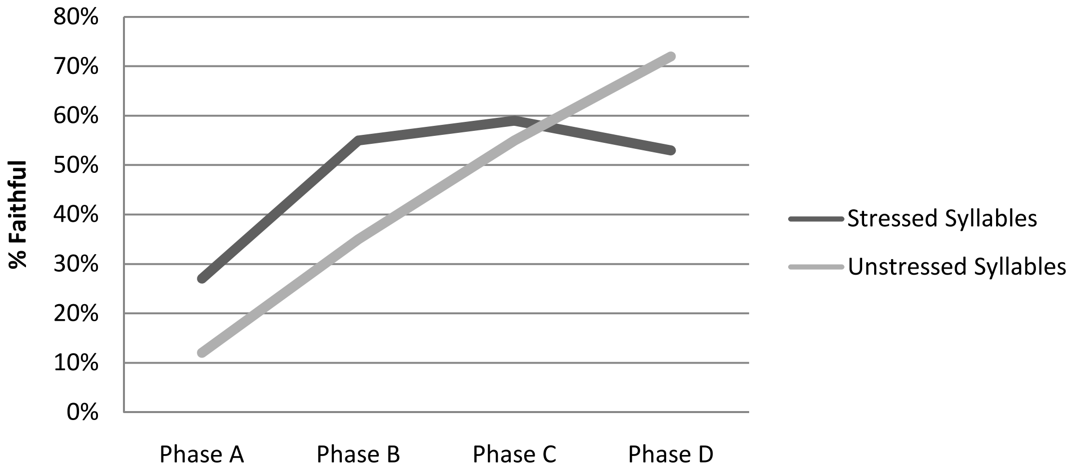
Table 20: Faithful outputs per phase and stress environment

		Medial Codas in **Stressed** Syllables			Medial Codas in **Unstressed** Syllables			
Stage	Periods (age range)	Faithful Outputs	Targets	% Faithful	Faithful Outputs	Targets	% Faithful	Total Targets
Stage I	**1-2 (Phase A)** (2;06.25-2;07.29)	6	22	27%	10	128	12%	150
	3-5 (Phase B) (2;08.20-2;09.17)	29	53	55%	34	165	35%	218
Stage II	**6-9 (Phase C)** (2;10.07-2;11.27)	27	46	59%	86	155	55%	201
	10-12 (Phase D) (3;00.03-2;01.02)	18	34	53%	86	120	72%	154

During Phase A, 27% of medial codas in stressed syllables are produced faithfully while only 12% of medial codas in unstressed syllables are faithfully produced. This trend continues through to Phase B where 53% of medial codas in stressed syllables are produced faithfully and 35% of medial codas in unstressed syllables are faithfully produced. This shows an increase in overall faithful productions, but with the bias toward faithful productions in stressed syllables still noticeably evident. On the other hand, a further breakdown of Stage II into Phase C and Phase D exhibits the opposite trend.

While the percentage of faithful medial codas in stressed syllables does not change much between Phase B of Stage I (55%) and Phase C of Stage II (59%), there is quite a difference in the ratios of faithful medial codas in unstressed syllables which jumps from 35% to 55%. This illustrates the leveling out of PROMINENCE as an influential factor. By Phase D, The percentage of faithful medial codas in unstressed syllables surpasses those in stressed syllables by a margin of 19%. This shows that the effects of PROMINENCE have waned and the FREQUENCY is becoming the main licensor in medial coda production. A graphic illustration of the regressive influence of stress between Phase A and Phase D illustrates this trend clearly.

Figure 1: The regressive influence of stress



These results are similar to those find by Adam & Bat-El (2007) regarding the emergence of a trochaic bias in the early productions of a Hebrew-speaking child. The study showed that while iambs are overwhelmingly more frequent in Hebrew, the child exhibited an early preference for trochaic structures. Adam and Bat-El further show that this preference, grounded in universal predispositions, gradually disappears until child productions mirror the ratios found in language-specific frequencies.

3.3 MEDIAL CLUSTER REDUCTION STRATEGIES

The following section presents a synopsis of patterns found in the 549[14] targets containing medial clusters (VC_1C_2V) which were simplified via the deletion of one of the two consonants. In accordance with universal constraints, the remaining consonant was parsed as the onset of the second syllable regardless of its original position ($V.C_1V$ or $V.C_2V$). A total of 42 productions did not contain a medial coda in the output but could not be categorized strictly as a C1 or a C2 deletion. The majority of these included; outputs that deviated excessively from the target, such as [otaˈpek] for /afaʁˈsek/ 'peach' and [ĭsaʔeˈʔot] for /psanteˈʁot/ 'pianos;' and outputs where one or both consonants were conserved, but in a remote location within the prosodic word,

[14] Note this number is larger than expected as it contains all the targets with liquid medial codas that were discounted up to this point.

such as [tipiˈʔaa] for /*pitʁiˈja*/ 'mushroom' and [maxaˈja] for /laxmanˈja/ 'bun.' These cases were omitted from the analysis.

The reduction data was divided between medial clusters where neither C1 nor C2 is a liquid segment (Liquid-Free Clusters) and medial clusters where either C1 or C2 is a liquid segment (Liquid Clusters). Although Y does produce some faithful medial codas in cases where C2 is a liquid (the liquid is substituted by a glottal stop in these cases), the fact that he has no liquids in his inventory is enough to warrant this division.

3.3.1 LIQUID-FREE CLUSTERS

3.3.1.1 EVIDENCE OF THE SONORITY PATTERN

Liquid-free clusters are all medial cluster combinations where neither consonant is a rhotic or lateral segment. Both C1 and C2 reductions can be found in the data.

Table 21: Examples of liquid-free cluster reductions

	Output	Target	Gloss
C1 Deletions	*iˈpax*	*niʃˈpax*	'(it) spilled'
	aˈba	*axˈbaʁ*	'mouse'
	ˈsata	*ˈsavta*	'grandma'
	iˈzo	*ligˈzoʁ*	'to cut'
	iˈxak	*misˈxak*	'game'
C2 Deletions	*hisaˈpati*	*histaˈpaʁti*	'I got my hair cut'
	diˈiza	*teleˈvizja*	'television'
	iˈga	*migˈdal*	'tower'
	nadeˈda	*nadneˈda*	'(a) swing'
	oˈtem	*otˈxem*	'you (def.)'

However, findings confirm that C1 deletions are much more prevalent than C2 deletions in liquid-free clusters, making up 84% of the deletion patterns and showing an equal distribution between stressed and unstressed syllables. This is not surprising due to the low acoustic prominence associated with C1 consonants in all clusters.

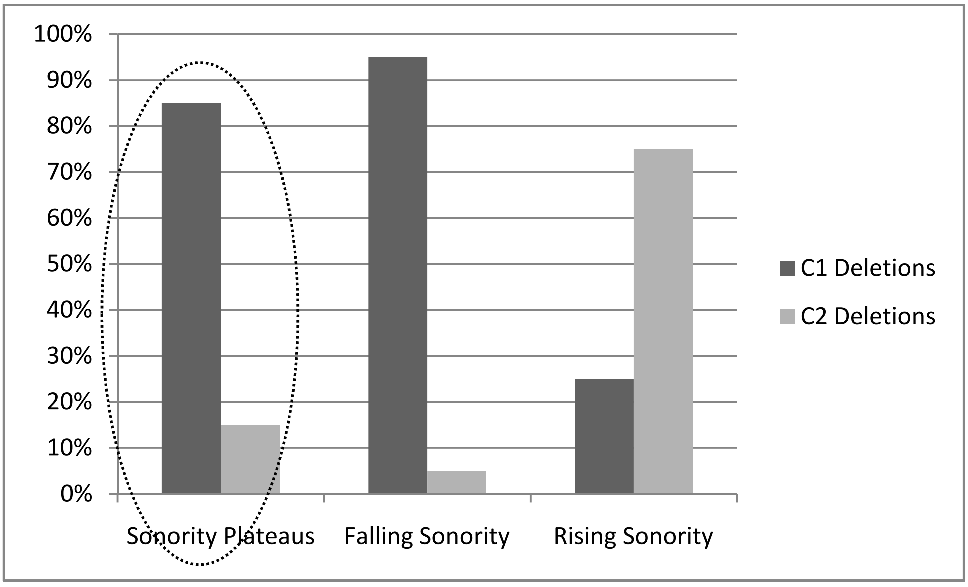
A close examination of some of the cluster types provides a further analysis for this behavior.

Table 22: Reduction patterns per syllable contact and stress in liquid-free clusters

	Totals for Entire Research Period				
	C1 Deletions		C2 Deletions		Totals
Sonority Plateaus	63	85%	11	15%	74
Falling Sonority	106	96%	4	4%	110
Rising Sonority	10	34%	19	66%	29
totals	**179**	**84%**	**34**	**16%**	**213**
	C1 Deletions		C2 Deletions		Totals
Stressed	54	78%	15	22%	69
Unstressed	123	83%	26	17%	149

Falling sonority clusters are those clusters where the C1 is more sonorous than C2 and are thus in compliance with the SCL. These exhibit a strong preference for C1 deletions at 95%. On the other hand, clusters exhibiting a rising sonority (C1 is less sonorous than C2) and are in violation of the SCL, show a clear bias for C2 deletions (75%). This is consistent with what is known as the "sonority pattern," which predicts that children will generally reduce onset and medial clusters to the target segment lower in sonority (Barlow 2003 and references cited therein) and abides by the strong cross-linguistic preference for onsets of the lowest possible sonority (Clements 1990). Since more clusters in Hebrew are compliant with SCL than not, this explains the overall bias toward C1 deletions. Thus the only evidence in support of a true bias toward C1 deletions can be found in the sonority plateau clusters (where C1 and C2 are equal in sonority). This confirms that indeed the C1 position is one of reduced salience. On the other hand, it is important to note that the fact that clusters exhibiting rising sonority tend toward C2 deletions, proves that C1 segments must be perceived, since in these cases they are faithfully produced.

Figure 2: Sonority plateaus reveal a tendency for C1 deletions



The fact that the vast majority (85%) of sonority plateau clusters were reduced by deleting C1 is comparable to results those noted by Smith (1973). However, evidence for ambiguity of sonority plateaus is revealed by the fact that these words contained the most inter-word variation, where the same target triggered both C1 and C2 deletions.

Table 23: variation in the cluster simplification of sonority plateaus

C1 Deletion - Output	C2 Deletion - Output	Target	Gloss
baˈbuk	*bəˈkux*	*bakˈbuk*	'bottle'
iˈda	*iˈga*	*migˈdal*	'tower'
aˈʃaf	*aˈxav*	*axˈʃav*	'now'
aˈtato	*aˈt͡sakə*	*aˈtʁaktoʁ*	'the traktor'

3.3.1.2 THE SONORITY PATTERN PER DEVELOPMENTAL PHASE

The results are similar when broken down per phase and per stage, as defined for medial coda development in section 3.2.

Table 24: Reductions per phase

	Phase A					Phase B				
	C1 Deletions		C2 Deletions		Totals	C1 Deletions		C2 Deletions		Totals
Sonority Plateaus	23	82%	5	18%	28	18	82%	4	18%	22
Falling Sonority	32	94%	2	6%	34	33	97%	1	3%	34
Rising Sonority	3	50%	3	50%	6	1	10%	9	90%	10
totals	**58**	**85%**	**10**	**15%**	**68**	**52**	**79%**	**14**	**21%**	**66**
	C1 Deletions		C2 Deletions		Totals	C1 Deletions		C2 Deletions		Totals
Stressed	12	75%	4	25%	16	17	77%	5	23%	22
Unstressed	46	88%	6	12%	52	35	80%	9	20%	44

	Phase C					Phase D				
	C1 Deletions		C2 Deletions		Totals	C1 Deletions		C2 Deletions		Totals
Sonority Plateaus	16	94%	1	6%	17	6	86%	1	14%	7
Falling Sonority	33	100%	0	0%	33	8	89%	1	11%	9
Rising Sonority	5	45%	6	55%	11	1	50%	1	50%	2
totals	**54**	**89%**	**7**	**11%**	**61**	**15**	**83%**	**3**	**17%**	**18**
	C1 Deletions		C2 Deletions		Totals	C1 Deletions		C2 Deletions		Totals
Stressed	17	77%	5	23%	22	8	89%	1	11%	9
Unstressed	35	80%	9	20%	44	7	78%	2	22%	9

Table 25: Reductions per stage

	Stage I					Stage II				
	C1 Deletions		C2 Deletions		Totals	C1 Deletions		C2 Deletions		Totals
Sonority Plateaus	41	82%	9	18%	50	22	92%	2	8%	24
Falling Sonority	65	96%	3	4%	68	41	98%	1	2%	42
Rising Sonority	4	25%	12	75%	16	6	46%	7	54%	13
totals	**110**	**82%**	**24**	**18%**	**134**	**69**	**87%**	**10**	**13%**	**79**
	C1 Deletions		C2 Deletions		Totals	C1 Deletions		C2 Deletions		Totals
Stressed	29	76%	9	24%	38	25	81%	6	19%	31
Unstressed	81	84%	15	16%	96	42	79%	11	21%	53

Note, however that clusters of rising sonority seem to be much less stable in their behavior – exhibiting an almost even split between C1 deletions and C2 deletions in each phase other than Phase B, which exhibits 90% C2 deletions. This is suspicious and may support the notion that these clusters behave differently as far as the sonority pattern is concerned.

The following table shows all cases of rising sonority where C1 was deleted – that is, the sonority pattern was not followed.

Table 26: Rising sonority C1 deletions

Phase A		Phase B		Phase C		Phase D	
Output	Target	Output	Target	Output	Target	Output	Target
i'ma	*nig'maʁ*	*avaviyuts*	*agvan'jot*	*i'zo*	*$ig'zoʁ*	*ke'jon*	*'kenjon*
ni'ma	*nig'maʁ*			*o'xʌm*	*ot'xem*		
'ii'ma	*nig'maʁ*			*o'xa*	*ot'xa*		
				ava'jot	*agvan'jot*		
				ava'jot	*agvan'jot*		

Not only do several of targets overlap[15], the mere number of these cases is so small, that any change would have large consequences on the statistics. Thus the only conclusion that can be drawn here is that there is not enough data in this case to provide any explanations.

3.3.2 LIQUID CLUSTERS

A liquid cluster refers to all medial clusters where either C1 or C2 is a rhotic or a lateral liquid segment. Among the medial clusters that exhibited either C1 or C2 deletion, 336 (61%) contain liquid segments. 265 (79%) contain a liquid segment in C1 position, whereas only 71 (21%) contain a liquid in C2 position.

[15] Recall types were counted per recording session and each phase contains a relatively large number of sessions.

According to the "sonority pattern," a child that has acquired liquids in his/her inventory would be expected to delete the liquid segment unless the other member of the cluster was a more sonorous glide. The reduction data contained a total of 34 productions of targets that fulfill this limited criteria. The outputs were all related to the same 4 base types; *aʁˈje* 'lion,' *sukaʁˈja* 'piece of candy,' *alˈjad* 'nearby.' All of the C1 deletions in rising sonority clusters can be attributed to these productions, except for the target *klavˈlav* 'doggy.'

Table 27: Reductions patterns per syllable contact in no-liquid clusters

	C1 Deletions		C2 Deletions		Totals
Falling Sonority	217	94%	13	6%	230
Rising Sonority	36	34%	70	67%	106
totals	**253**	**75%**	**83**	**25%**	**336**

Given that liquids are among the most sonorous segments, it is not surprising that the results are similar to those found with the liquid-free cluster types. However, it cannot be ignored here that Y does not have liquids in his inventory. Thus any sonority patterning should be irrelevant. Thus it is crucial that liquids are also deleted in the cases they would be expected to be produced if Y had liquids in his inventory (liquid-glide and glide-liquid clusters).

In Y's case, clusters containing liquids are unique in that their reduction pattern is basically completely dependent on the location of the liquid within in the cluster.

Table 28: Reduction patterns in clusters with liquids

	C1 Deletions		C2 Deletions		Totals
C1 = liquid	251	95%	14	5%	**265**
C2 = liquid	2	3%	69	99%	**71**
totals	**253**		**83**		**336**

C1 liquid deletions include outputs such as [ˈatik] for /ˈaʁtik/ 'popsicle,' [oˈxim] for /holˈxim/ '(we are) going,' [saˈseʔet] for /ʃaʁˈʃeʁet/ 'necklace,' [aˈnav] for /aʁˈnav/ 'rabbit,' and [aˈje/] for /aʁˈje/ 'lion,' representing all C2 segment types[16]. Almost all C2 deletions in words where the liquid is in C1 position were related to the same target /baˈʔaz/ for baʁˈvaz 'duck.' Only one other is of /sukaˈʔa/ for sukaʁˈja '(a piece of) candy.'[17] Note that Y employs a substitution pattern for liquids and often replaces them with a glottal stop. Given this substitution, these reductions actually follow the sonority pattern which retains the least sonorant segment. These are therefore examples of a "conspiracy" (Kisseberth 1970) between the substitution pattern and the reduction pattern.

C2 liquid deletions include examples such as [ˈzeba] for /*ˈzebʁa*/ 'zebra,' [oˈxi] for /*oxˈlim*/ '(we are) eating,' and [gaˈzim] for /*gozˈʁim*/ '(we are) cutting.' The only cases where the C2 consonant was preserved were in the outputs [kaˈʔav] and [aˈʔav] for /*klavˈlav*/ 'puppy dog.' Again, in this case, Y follows the sonority pattern after replacing the liquid with a glottal stop.

The results of the liquid-cluster reductions provide further evidence that C1 consonants must be perceived in full at this stage, as Y is able to produce these segments consistently when they are followed by a C2 segment not in his phonetic inventory.

3.4 DISCUSSION

A common presumption is that PROMINENCE acts as a licensor in acquisition due to an increased acoustic salience which contributes to perception (Echols & Newport 1992 and citations mentioned therein). However, additional studies have shown that syllables and segments of low PROMINENCE are clearly perceived by children even when they do

[16] liquid+liquid clusters do not occur in the child-directed speech either (see section 1.7.3)
[17] The appearance of the glottal stop may be ambiguous, but is more likely a substitution for the liquid.

not appear in the child's surface production (Smith 1973; Smolensky 1996; Fikkert 2000, Gnanadesikan 1995, among others). The evidence provided by the cluster reduction patterns presented in section 3.3 supports this claim.

C1 consonants are commonly deleted in sonority plateaus where segmental prominence is neutralized, thus providing evidence that the C1 position is prosodically weaker. However, in clusters of rising sonority, as well as clusters of falling sonority, the least sonorant segment is preserved more often. This seems to contradict any perception theory since the C1 segment is retained in cases of rising sonority, and must therefore be clearly perceived. It should be noted that the SCL is partially based on the notion that the larger the sonority gap between C1 and C2, the more perceptible C1 becomes. Thus clusters that adhere to this universal should be perceived more readily. However, the results of liquid clusters again support the idea that Y perceives both consonants, since he is able to consistently produce the cluster segment that is not a liquid.

If Y is able to clearly perceive both cluster consonants even in cases where the cluster is reduced, then how does this fall in line with the results of the faithful cluster productions which show a clear predisposition toward acoustically prominent medial codas in the early stages of medial cluster acquisition? One possible explanation is that PROMINENCE not only licenses medial coda acquisition by facilitating perception, but also by facilitating *production*. Since, perception must precede production this dual role is not contradictory.

The idea that PROMINENCE facilitates production has been previously explored. It is well-known that children's early productions have been shown to initially include stressed and final syllables. If the stressed and the final syllable are one and the same, these tend to be monosyllabic productions of the word-final syllable carrying stress. If stress is on the non-final syllable, however, output productions are disyllabic, including both the stressed and the final syllable, forming a trochaic foot. This phenomenon, known as the "trochaic bias" predicts most early disyllabic productions will be trochees and not iambs, regardless of the language. As discussed in section 3.2.2 Adam and Bat-el (2007) have also shown this to be the case for Hebrew, even though language specific frequencies show relatively few prosodic words with trochaic feet. Gerken (1994) describes this tendency in terms of a S(W) production template. Where S refers to a stressed syllable (strong) and W refers to an unstressed syllable (weak). The weak syllable is incorporated into the template only when one is available, thus explaining why words with final stress are produced as monosyllables. According to Gerken, in later stages, this same template is applied iteratively as longer words are acquired, thus accounting for the tendency to omit some non-final weak syllables more often than others. Regardless, in order to apply to later stages, this theory entails that the target language should contain secondary stress. Since not all languages contain secondary stress, this would need to be explored further. However, the idea that this template facilitates the production of additional syllables can be elaborated on to include the notion that it may facilitate the production of complex syllable structures.

Revithiadou & Tzakosta (2004) showed that Greek children tend to preserve segmental content in stressed syllables more often than in unstressed syllables and classify "stressed syllable faithfulness" as the "core grammar of intermediate stages of development." Based on results from Ben-David (2001), Hebrew-speaking children acquire codas in final stressed syllables sooner than in unstressed final syllables, and based on the results presented in section 3.2.1 of this paper, stress also facilitates the acquisition medial codas. Thus, it can be concluded that, in addition to the segmental content, *prosodic structure* is also preserved more faithfully in stressed syllables. This also makes sense in light of the fact that stressed syllables are longer and thus provide more time in which to produce additional elements.

It has already been shown that segments are perceived regardless of whether they are in a stressed or unstressed syllable. However, it may be the case that the production of complex structures is less demanding for children when the output aligns with the S(W) template – a sort of late emergence of the trochaic bias. Importantly, codas in Hebrew first occur in monosyllabic outputs of targets with word-final stress, and only later in disyllabic iambs (Ben-David 2001, Dromi, Most & Yehuda 1993). Thus codas are initially produced in words that comply with the S(W) template, and the fact that final codas in Hebrew are acquired prior to medial codas does not contradict this hypothesis.

Furthermore, Bat-El (2006) and Levinger (2007) have shown another form of late emergence of the trochaic bias where children acquiring new morphological categories in Hebrew tend to initially favor targets and output forms with trochaic structures, even though this bias no longer existed in other elements of speech - Bat-El for the acquisition of verb morphology and Levinger for the acquisition nominal plurals. If there is indeed a reemergence of the trochaic bias when new morphological structures arise in child speech, it is not far-fetched to propose that the same is true for new *phonological* structures.

How can this theory incorporate the result of the segmental acquisition of medial codas in Hebrew, which showed initial productions of stridents, non-sibilant fricatives and glides only? Studies have shown that sonorant codas are generally acquired prior to obstruents, a result which can be predicted from that fact that sonorants codas are universally unmarked. However, Hebrew exhibits a different tendency. Results for final codas (Ben-David 2001) and results for medial codas (section 3.2.2.1) show that

Hebrew codas are licensed based on their feature [+/- continuant], where [+continuant] (stridents, fricatives, liquids & glides) segments are acquired prior to [– continuant] (stops and nasals).

The correlation between sonorants and continuants is undeniable. The basis for these two natural classes is essentially an increased acoustic energy. Although this increased acoustic energy may be achieved differently, the resulting increase in PROMINENCE is the same. Stop segments are the only segments which are neither sonorant nor continuant. However, it has already been shown that stops in medial coda position are perceived, as they are commonly produced when the cluster is reduced. Thus the fact that they are initially not produced as medial codas, may again be due to influences on ease-of-production and not ease-of-perception. Further research is necessary to determine the nature of this influence which may be purely a phonetic.

4 SUMMARY

Previous studies have not been able to provide conclusive evidence for the superiority of either PROMINENCE or FREQUENCY as licensors in the late stages of language acquisition. A combination of the prosodic structures found in Hebrew along with the rare acquisition data from a child with a slow developmental pace, has made it possible to provide evidence for the PROMINENCE >> FREQUENCY hierarchy in the initial phases of medial coda acquisition.

By the end of the research period, Y was able to produce medial codas with approximately 50% accuracy in *stressed* syllables and 70% accuracy in *unstressed* syllables. This is a reflection of the distribution of medial codas in Hebrew which are found in much greater proportions in unstressed syllables. However, before reaching this point, it is possible to identify two distinct stages in the developmental process.

During Stage I, Y exhibits a clear propensity toward prominent medial codas. Phase A of Stage I exhibited both stress-based and segment feature-based PROMINENCE effects. By Phase B, segmental effects disappeared, while stress effects still lingered. Stage II of Y's medial coda acquisition shows signs of a gradual regression of PROMINENCE effects and subsequent dominance of language-specific FREQUENCY. During Phase C of Stage II the proportion of faithful medial codas in *unstressed* syllables equals that of *stressed* syllables and by Phase D medial codas in *unstressed* syllables are produced faithfully more often than those in stressed syllables.

The results indicate that PROMINENCE has a clear influence during the initial phases of medial coda acquisition. Most studies have assumed that PROMINENCE acts as a licensor by facilitating *perception*. However evidence extracted from Y's cluster reductions indicates that Y perceives medial segments that he does not yet produce. Y's medial clusters where commonly reduced to the less sonorous of the two consonants, regardless of the underlying position of the segment, following the "sonority pattern." Exceptions included sonority plateaus which exhibited an underlying inclination toward C1 deletions and clusters with liquids where the yet un-acquired liquid segment was systematically deleted. These results support the common notion that C1 is a position of low salience, but simultaneously support the fact that prior to the onset of medial coda production, both C1 and C2 are perceived by Y regardless of any stress-based or feature-based PROMINENCE. This leads to a hypothesis that PROMINENCE licenses coda acquisition *not* only by facilitating perception, but also by facilitating *production*. Studies on children acquiring Hebrew have shown that children tend to revert to a trochaic structure when acquiring new morphological structures. The findings from this study indicate that the same may be true regarding the acquisition of new *phonological* structures.

APPENDIX

Sample Productions of Medial Codas in Stressed and Unstressed Environments

Period 1 (2;06.25- 2;07.08)					
Stressed			**Unstressed**		
Output	**Target**	**Gloss**	**Output**	**Target**	**Gloss**
'kista	*'kiʃta*	‘schoo’	*bej't͡sa*	*bej't͡sa*	‘egg’
			afta'ʔa	*hafta'ʔa*	‘surprise’
Period 2 (2;07.15- 2;07.29)					
Stressed			**Unstressed**		
Output	**Target**	**Gloss**	**Output**	**Target**	**Gloss**
'taxti	*hit͡s'laxti*	‘I did it’	*abej'ta*	*ha-bej't͡sa*	‘the egg’
'it͡sxa	*'ixsa*	‘yuck’	*ɪs'ba*	*niʃ'baʁ*	‘(it) broke’
e'safta	*le-savta*	‘to grandma’	*as'we*	*mas'meʁ*	‘nail’
Period 3 (2;08.20- 2;08.27)					
Stressed			**Unstressed**		
Output	**Target**	**Gloss**	**Output**	**Target**	**Gloss**
'patjot	*am'batjot*	‘bathtubs’	*is'xak*	*mis'xak*	‘game’
amboga'ʔot	*'ambugeʁot*	‘hamburgers’	*sɪnta'ʔotʰ*	*psante'ʁot*	‘pianos’
'batjḁ	*am'batja*	‘bath’	*aw'va*	*ax'baʁ*	‘mouse’
Period 4 (2;09.03- 2;09.10)					
Stressed			**Unstressed**		
Output	**Target**	**Gloss**	**Output**	**Target**	**Gloss**
a'bajta	*ha'bajta*	‘home’	*iz'ba*	*niʃ'baʁ*	‘(it) broke’
'mastik	*'mastik*	‘gum’	*ik'not*	*lik'not*	‘to buy’
'pasta	*'pasta*	‘pasta’	*itpa'ʔaʔim*	*mispa'ʁaim*	‘scissors’
Period 5 (2;09.17)					
Stressed			**Unstressed**		
Output	**Target**	**Gloss**	**Output**	**Target**	**Gloss**
akej'zon	*la'kenjon*	‘shopping mall’	*ex'nasti*	*hex'nasti*	‘I put it in’
ex'nasti	*hex'nasti*	‘I put it in’	*iʃpe'xu*	*niʃpe'xu*	‘they spilled’
'batja	*'batja*	‘Proper name	*ov'dim*	*ov'dim*	‘they work’
Period 6 (2;10.07- 2;10.14)					
Stressed			**Unstressed**		
Output	**Target**	**Gloss**	**Output**	**Target**	**Gloss**
a'naxnu	a'naxnu	‘we’	*kav'ʔav*	*klav'lav*	‘doggy’
'axnu	a'naxnu	‘we’	*is'pa*	*mis'paʁ*	‘number’
'zebʔot	*'zebʔot*	‘zebras’	*bak'buk*	*bak'buk*	‘bottle’

Period 7 (2;10.29- 2;11.05)					
Stressed			Unstressed		
Output	Target	Gloss	Output	Target	Gloss
ˈiixsa	ˈixsa	‘yuck’	*exˈmad*	*nexˈmad*	‘nice’
ˈzebʔa	*ˈzebʔa*	‘zebra’	*afˈteax*	*mafˈteax*	‘key’
aˈbimba	*ha-ˈbimba*	‘the riding car’	*igˈda*	*migˈdal*	‘tower’

Period 8 (2;11.13)					
Stressed			Unstressed		
Output	Target	Gloss	Output	Target	Gloss
ˈtejʃa	*ˈtejʃa*	‘nine’	*gozˈʔim*	*gozˈʁim*	‘cutting’
ˈsamti	*ˈsamti*	‘I put (it)’	*igˈma*	*nigˈmaʁ*	‘all done’
ˈsafta	*ˈsavta*	‘grandma’	*efˈʃa*	*efˈʃaʁ*	‘(it’s) possible’

Period 9 (2;11.20- 2;11.27)					
Stressed			Unstressed		
Output	Target	Gloss	Output	Target	Gloss
xafˈpasti	hitxaˈpasti	‘I dressed up’	*azˈʔeg*	*mazˈleg*	‘fork’
ˈtaxti	*xaˈtaxti*	‘I cut (it)’	*mafˈxid*	*mafˈxid*	‘scary’
ˈdebʔa	*ˈzebʁa*	‘zebra’	*wifˈtoʔax*	*lifˈtoax*	‘to open’

Period 10 (3;00.03- 3;00.16)					
Stressed			Unstressed		
Output	Target	Gloss	Output	Target	Gloss
t͡siˈʔamnu	siˈjamnu	‘we finished’	*asˈpik*	*masˈpik*	‘enough’
ˈkofʔes	*ˈkonfleks*	‘cornflakes’	*axˈʃaf*	*axˈʃav*	‘now’
aˈkofʔes	*ˈkonfleks*	‘the cornflakes’	*adbeˈka*	madbeˈka	‘sticker’

Period 11 (3;00.28)					
Stressed			Unstressed		
Output	Target	Gloss	Output	Target	Gloss
xiˈpasti	*xiˈpasti*	‘I looked (for)’	*kaftoˈʔim*	*kaftoˈʁim*	‘buttons’
ˈdakti	*zaˈʁakti*	‘I threw’	*miʃtaˈʔa*	*miʃtaˈʁa*	‘police’
teˈvizja	*teleˈvizja*	‘television’	*atˈxa*	*otˈxa*	‘(acc) you’

Period 12 (3;01.02)					
Stressed			Unstressed		
Output	Target	Gloss	Output	Target	Gloss
ˈtajson	*ˈtajson*	‘Proper name’	*tikˈxi*	*tikˈxi*	‘you take! (fem)’
taˈfasti	*taˈfasti*	‘I caught’	*tisapˈʔi*	*tesapˈʁi*	‘you tell (fem)!’
ˈʔaxti	*aˈlaxti*	‘I went’	*afˈpa*	*nafˈla*	‘(she) fell’

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