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Minimal Violation and Phonological Development

Joe Pater
Department of Linguistics
University of Alberta

This article examines some consequences of optimality theoretic constraint ranking and violability for the study of phonological development. It is well known that the phonetic shape of child utterances is subject to strict restrictions. When these restrictions are captured in terms of minimally violable, rather than inviolable, constraints, the effects of a constraint that is overcome in development can continue to persist through successive developmental stages and into the mature system. The empirical base for this study is provided by previously unpublished data from a longitudinal corpus of phonetically transcribed speech from four English-learning children (Compton and Streeter (1977)). Evidence for this view of development as constraint reranking is found in a comparison of the prosodic structure of child and adult English and in a developmental change in the application of consonant harmony; minimal violation in the child system itself occurs in the patterns of content preservation displayed by truncations.

1. INTRODUCTION

Perhaps the chief innovation of the approach to phonology taken in Optimality Theory (Prince and Smolensky (1993)) lies in its claim that constraints are minimally violable, that a constraint can be violated if and only if its satisfaction would interfere with the demands of a higher ranked constraint. This can be contrasted with the usually implicit view that an active constraint is inviolable at the level at which it applies. Minimal violation leads to explanatory advances in dealing with data in which constraints apply nonuniformly (Prince (1993); see also McCarthy (in press), Pater (1995))—that is, in which a constraint is satisfied, or violated, only in a particular context. In Optimality Theory, this is captured straightforwardly by constraint ranking: A constraint is satisfied except where it

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comes into conflict with a higher ranked constraint. Although it is not impossible to describe instances of nonuniformity using inviolable constraints, this usually involves simply stating where a constraint applies and where it does not, which, unlike the constraint ranking approach, does not succeed in reducing the observed facts to more basic principles (in this regard, see especially Prince and Smolensky's (1993, section 4) discussion of the "Except When" scenarios).

This article discusses some consequences of minimal violation for the analysis of children's developing phonological systems and for an understanding of their relation to the fully developed systems of adults. It is a common observation that the phonetic shape of young children's speech is subject to strict restrictions, which are overcome in the course of development. If these restrictions are formalized in terms of fully satisfied constraints, then to overcome one is to render it completely impotent.[1] However, if the constraints are minimally violable, overcoming a constraint is not equivalent to shutting it off. When a constraint is outranked by another, it will continue to be satisfied wherever it does not conflict with the requirements of the dominating constraint. Under this view, the effects of a child language constraint could persist in sometimes quite subtle ways through successive developmental stages and into the mature system.

One much-discussed restriction on the phonetic shape of child language is a bisyllabic maximum on word size, which applies at about age 2. When a child at this stage attempts longer words they are truncated so as to conform to the size limit. This has been extensively documented in both child English and child Dutch (Allen and Hawkins (1978), Archibald (1995), Demuth (1995; 1996), Demuth and Fee (1995), Echols and Newport (1992), Fee (1992; 1995), Fikkert (1994), Gerken (1994), Holmes (1927, 224), Ingram (1978), and Wijnen, Krikhaar, and den Os (1994)). Although the existing accounts of this restriction are quite varied in their theoretical premises and in the details of their analyses, for the most part they agree that whatever constraint is responsible for this word size maximum is unique to the child system and disappears during development, playing no role in the adult language.[2]

Because words in Dutch and English routinely exceed two syllables in length, such a conclusion may seem inevitable. In the second section of this article, I suggest that, contrary to initial appearances, the constraints responsible for the

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[1]See section 4, as well as Pater (1995), for discussion of the mechanisms by which the effects of inviolable constraints might be limited, rather than fully suppressed. For the present, it suffices to note that in a theory that assumes fully satisfied constraints, incomplete satisfaction requires some special explanation.

[2]As is discussed later, accounts that define the restriction in prosodic terms (Demuth (1995), Demuth and Fee (1995), Fee (1992; 1995), Fikkert (1994)) draw a connection between the child language constraint and constraints active cross-linguistically, as well as to the prosodic structure of the mature language. They mostly agree with other accounts, though, that the restriction to a single foot is not part of adult English or Dutch (with the important exception of the discussion of hypocoristic formation in Fee (1992)).

word size maximum do indeed play a role in the adult language—in the English stress system, in particular. Adapting work on prosodic morphology by McCarthy and Prince (1994a), I show that the child language restriction can be reduced to the satisfaction of several well-motivated prosodic constraints. I then demonstrate that although two of these constraints are in fact violated in adult English, they continue to have effects in the stress system. Instead of being freely violable, or turned off, they are minimally violable, or outranked.

Following the account of the word size maximum, the third section turns to the patterns of content preservation seen in the truncations of adult targets that exceed that size limit. The analysis of these patterns reveals an instance of minimal violation in the child system itself. To establish the empirical base for the analysis, I present previously unpublished data from an extensive corpus of spontaneous utterances produced by four English-learning children (see Compton and Streeter (1977) for the method of data collection and preliminary analyses). These data provide strong support for Echols and Newport's (1992) contention that truncations of initially stressed trisyllables usually preserve the initial and final syllables, with the medial one being deleted (cf. Gerken (1994), Wijnen et al. (1994)). All apparent cases of preservation of the medial rather than the final syllable can be attributed to the relative markedness of the onsets of these syllables: The medial syllable's onset is retained instead of the onset of the final syllable only when the former is less marked (i.e., less sonorous: e.g., [bʌfo] *buffalo*; cf. [ɛfɛnt] *elephant*). This parallels better known cases of onset selection in initial truncation (e.g., [bun] for *balloon*). It is here that we find evidence of minimal violation. The constraint demanding unmarked onsets is violated at this stage of development, as marked (i.e., high sonority) onsets are usually well tolerated (e.g., [jɛwo] *yellow*). Its role in determining the output of truncation, however, shows that it is not turned off.

The fourth section provides direct evidence of development as constraint reranking. Here the focus is on another well-known restriction on early child utterances; Within a word, and sometimes within a phrase (Donahue (1986)), consonants must have the same place of articulation (Compton and Streeter (1977), Cruttenden (1978), Dinnsen, Barlow, and Morrisette (1996), Drachman (1976), Ferguson, Peizer, and Weeks (1973), Goad (1996b; in press), Ingram (1974), Jespersen (1922, 109), Levelt (1994; 1995), Macken (1995), Menn (1976), Smith (1973), Spencer (1986), Stemberger (1995), Stemberger and Stoel-Gammon (1991), Stoel-Gammon and Stemberger (1994), Vihman (1978; 1980)). This restriction, often described as consonant harmony, is usually not stated as simply demanding agreement in place specification, as its application is normally limited in one or more ways. For instance, it is often the case that only coronals assimilate, so that words with a combination of labials and velars would violate a condition on place agreement. The claim here is that the limitations on the effects of this constraint are caused by its being dominated by constraints favoring a match between Input and Output representations (the Faithfulness constraints of

McCarthy and Prince (1995)). Again drawing on the corpus described in Compton and Streeter (1977), I provide evidence of a developmental progression in which this constraint is first fully satisfied and then violated when its satisfaction would require a noncoronal consonant to be altered (i.e., Stage 1: [gɔg] *dog*, [gak] *box*; Stage 2: [gɔg] *dog*, [bɔks] *box*). Following an analysis of these developmental stages, the article concludes with a discussion of some prospects and problems for further research within this framework.

2. THE PROSODY OF CHILD AND ADULT ENGLISH

Child language researchers have long recognized an early stage in which words are maximally bisyllabic and longer adult targets are truncated. Perhaps the earliest record of this stage is in Holmes's (1927, 224) description of his daughter Mollie's speech: "A word of more than two syllables seems to be consistently reduced to two. Presumably that was Mollie's syllable span."

Subsequent research has shown that the binary "syllable span" is not quite descriptively accurate. Bisyllables can be truncated as well, if they are finally rather than initially stressed. The following near-minimal pairs, produced by an English-learning child, illustrate the difference between initially and finally stressed bisyllables (from Trevor's corpus; see section 3 for details on the source and for more truncation examples). Age is given in parentheses as years;months.days.

(1) a. [ga:bɛʤ] garbage (1;10.5) [wæ:dɪt] rabbit (1;9.2)
 b. [ga:ʤ] garage (1;10.5) [wæ:f] giraffe (1;9.1)

As is typical of children at this stage, initially stressed bisyllables (1a) are produced intact, whereas finally stressed ones (1b) are reduced to monosyllables (*garage* is finally stressed in American English, which Trevor was learning). This assymetry between ˈσσ and σˈσ sequences shows up again in truncated productions of trisyllables with medial stress. The final two syllables, which form the preferred ˈσσ shape, are consistently retained. Here again are some examples from Trevor:

(2) a. [te:do] potato (1;10.2)
 b. [gɛ:di] spaghetti (1;9.2)
 c. [gɛ:dɚ] together (1;10.1)

The ˈσσ unit that is preserved in these utterances is in fact the canonical left-headed foot (or trochee) of the English stress system (Hayes (1982), Kager (1989), Pater (1995); cf. Burzio (1994)). The maximum word size of early child English is thus properly characterized not as a bisyllable, but rather as a foot.

To formally express this child language word size maximum, Allen and Hawkins (1978), Gerken (1994), and Wijnen et al. (1994) invoked templates that restrict children's words to a single strong-weak (SW; i.e., stressed-unstressed) rhythmic sequence, whereas Fee (1992) and Fikkert (1994) used a prosodically based Minimal Word template that imposes a single foot limit. Although based on somewhat different theoretical premises, these accounts all succeeded in capturing the basic convergence between the prosodic or rhythmic structure of child language and that of the adult system, as both the child and the adult language make use of the same SW unit, or trochaic foot. Next, I show that the templates that are used in these accounts to limit children's words to a single rhythmic-prosodic unit can be reduced to the interaction of independently required constraints. This atemplatic analysis has the added benefit of treating the size restriction as an instance of the general unmarkedness of child phonology. By then showing that the constraints invoked do continue to play a role in the stress system of English, I provide an example of constraints that are fully satisfied in child language becoming minimally violated (much) later in development—that is, of development as constraint reranking.

2.1. The Size Restriction Derived

The analysis of the size restriction to be presented here starts from the important observation that the maximal size of words in early child language is equivalent to the Minimal Word of many adult languages (Fee (1992; 1995), Fikkert (1994)).

The cross-linguistic import of the Minimal Word was first demonstrated in McCarthy and Prince (1986). As its name implies, the Minimal Word usually sets a lower bound on word size. For example, in Diyari, bisyllabic *kaŋa* 'man' is well formed, whereas monosyllabic lexical words such as **ka* are nonexistent (Austin (1981), McCarthy and Prince (1986)). McCarthy and Prince derived this restriction from the interaction of the prosodic hierarchy (3) with a principle of Foot Binarity.

(3) Prosodic Hierarchy (Selkirk (1980))

PrWd	Prosodic Word
|	
Ft	Foot
|	
σ	Syllable
|	
μ	Mora

The prosodic hierarchy is a hierarchy of constituency, with members of each level grouped into a constituent of the next level above. Morae are organized into syllables, syllables into feet, and so on. It appears to be a universal of prosodic representation that every constituent must have a head—that is, that it contain an element from the next level below (see Selkirk (1995)). If every Prosodic Word must contain a foot, and if by the principle of Foot Binarity feet must be binary at either the moraic or syllabic level, then it follows that every word must be bisyllabic or bimoraic. In a language like Diyari, which does not permit bimoraic syllables, the result is a bisyllabic minimum.

The Minimal Word sets an upper limit on size in much more restricted circumstances in adult languages. Conveniently, Diyari also provides an example of the Minimal Word as maximum. Reduplication fully copies bisyllabic words (4a). When the word is longer, only the first two syllables are reduplicated (4b).

(4) Diyari Reduplication

	Stem	Reduplicated form	
a.	kanku	*kanku*-kanku	'boy'
b.	kukuŋa	*kuku*-kukuŋa	'to jump'

To account for this pattern of reduplication, McCarthy and Prince (1986) posited a Minimal Word template as the lexical form of the reduplicant.

The parallel between the shape of the Diyari reduplicant and children's early productions is interesting. However, to simply state that children's early words are Minimal seems insufficient: One would like an explanation for why this should be so. Demuth and Fee (1995) suggested two such explanations (see also Salidis and Johnson (1997) for a discussion of extralinguistic factors that may favor words of only this size). The first is that the prosodic hierarchy becomes available gradually, and that children at this stage have access only to the foot, and not to the Prosodic Word. I refer the reader to Demuth and Fee (1995) and Goad (1996a) for further development of this idea.

Here I take up Demuth and Fee's other suggestion, which they do not pursue in any detail: The Minimal Word is the unmarked Prosodic Word. Under this view, the connection between Diyari and child language is that unmarked structures are characteristic both of reduplication (McCarthy and Prince (1994a), Steriade (1988)) and of the early stages of acquisition. The violability of constraints in Optimality Theory permits a definition of markedness that is extremely simple to state but rich in its implications: A form is marked if it violates a constraint (McCarthy and Prince (1994a), Smolensky (1993)). Because every structure in all likelihood violates some constraint, this standard of markedness never makes absolute judgments; structures are not simply marked or unmarked. Rather, structures are marked or unmarked with respect to various dimensions of well-formedness, and we can compare the markedness of one structure to another along each of these dimensions.

Demuth (1995) provided an optimality theoretic analysis of child truncation in which a constraint that demands a minimal Prosodic Word outranks Faithfulness constraints. However, because it takes the unmarkedness of the minimal Prosodic Word to be a primitive notion, this analysis yields few explanatory dividends beyond those that are accrued by a Minimal Word template account. A different line of attack is taken in McCarthy and Prince's (1994a) reanalysis of Diyari reduplication (see further McCarthy and Prince (1994b; in press) and Urbanczyk (1996) on this atemplatic approach to Prosodic Morphology). They showed that unmarkedness of the Minimal Word maximum can be explained in terms of its satisfaction of a few basic prosodic constraints, much in the same way that the Minimal Word minimum is reduced to the interaction of the prosodic hierarchy with Foot Binarity in McCarthy and Prince (1986). Here I show how this analysis can be extended from reduplication to child truncation.

The first ingredient in the analysis is an ALIGNMENT constraint. McCarthy and Prince (1993a) showed that alignment of the edges of prosodic and morphological domains is the motive force behind a number of phonological and morphophonological processes (see also Selkirk's (1986) edge-based theory of the interface between syntax and prosody). Of special interest in the present context is that constraints of this type formally recognize the functional importance of word edges (see especially Kager (1994)), which has long been noted by acquisitionists (e.g., Echols and Newport (1992), Slobin (1973)). The constraint needed here is one that demands coincidence of the edges of feet with the edge of the Prosodic Word. I follow McCarthy and Prince (1994a) in using ALIGNLEFT, but ALIGNRIGHT would do as well:

(5) ALIGNLEFT
 Align(Ft, L, PrWd, L)
 "Align the left edge of every foot with the left edge of the Prosodic Word."

When a Prosodic Word consists of a single foot, as in (6a), ALIGNLEFT is fully satisfied. Any additional feet will fail to be aligned with the left edge of the Prosodic Word and will cause a violation of this constraint, as in the bipedal (6b).

(6) a. $[(\sigma\sigma)_{Ft}]_{PrWd}$: ✓ ALIGNLEFT b. $[(\sigma\sigma)_{Ft}(\sigma\sigma)_{Ft}]_{PrWd}$: *ALIGNLEFT

Fully satisfied, this constraint serves to limit words to a single foot. However, for the bisyllabic (6a) to be optimal, we also need an active constraint that forces syllables to be incorporated into feet. Most recent work in prosodic theory allows foot parsing to be nonexhaustive; syllables not parsed into feet can under certain circumstances be parsed directly by the Prosodic Word (see Hayes (1995), Idsardi (1992), Itô and Mester (1992), Kager (1989), as well as most subsequent literature on metrical phonology). As (7) illustrates, the addition of such a syllable would not violate ALIGNLEFT and would create a trisyllabic word:

(7) $[(\sigma\sigma)_{Ft}\sigma]_{PrWd}$: ✓ ALIGNLEFT

Prince and Smolensky (1993) proposed PARSE-σ as the constraint that punishes this sort of nonexhaustive parsing (8):

(8) PARSE-σ

Every syllable must belong to a foot.

Finally, we must ensure that feet are strictly binary; they must be neither monosyllabic nor larger than binary. For this purpose we can invoke Foot Binarity (FTBIN; McCarthy and Prince (1986), Prince (1980), Prince and Smolensky (1993, 47)), which defines both an upper and lower bound on foot size if it is stated simply as "feet are binary." Assuming that at the stage of development with which we are concerned, syllable quantity has not emerged (see Fikkert (1994)), this constraint will require bisyllabic feet (rather than bimoraic; see section 3.3 for discussion of the monosyllables produced by truncation of finally stressed bisyllables).

Combining ALIGNLEFT, and PARSE-σ with FTBIN derives the effect of the Minimal Word template, because in concert they demand that a word consist of a single binary foot. The child language size restriction can thus be ascribed to the satisfaction of these three prosodic constraints. The satisfaction of these prosodic constraints comes at the cost of violating Faithfulness. Constraints in Optimality Theory can be broadly divided into two groups. *Structural constraints,* like the prosodic constraints that have just been discussed, evaluate the well-formedness of the Output form. *Faithfulness constraints* evaluate the relation between Input and Output (for present purposes underlying and surface form, although they can also be used to assess the relation between structures at other levels; see, e.g., Benua (1995)). Structural constraints demand an Output that is perfectly formed according to their requirements, whereas Faithfulness constraints demand a perfect match between Input and Output. Much of optimality theoretic phonology involves the resolution of conflicts between these two sets of demands.

I take the fairly standard position (since Smith (1973)) that in child phonology the Input is equivalent to the adult surface form (minus any perceptual losses; see, e.g., Macken (1980)), whereas the Output is the child's production (see Hale and Reiss (in press) and Smolensky (1996b) for discussion in the context of Optimality Theory). From this it follows that child truncation involves a mismatch between Input and Output. In the Correspondence Theory of Faithfulness (McCarthy and Prince (1995), and most subsequent work in Optimality Theory), Faithfulness violations are assessed by directly examining the relation between the Input and the Output (cf. Prince and Smolensky (1993)). The constraint violated by truncation is MAXI-O, which demands a full realization of all Input elements in the Output. The formal statement of this constraint, which can be paraphrased as "No deletion," is given in (9).

(9) MAXI-O

Every element in the Input has a Correspondent in the Output.

The violation of MAXI-O is compelled by its being ranked beneath ALIGNLEFT, PARSE-σ, and FTBIN. To illustrate why this ranking leads to truncation, I provide an illustrative tableau in (10).

The tableau compares the violations incurred by possible Output realizations of the Input form, referred to as *candidates*. Candidates are eliminated when they violate a constraint that another candidate satisfies. This process of evaluation starts with the highest ranked constraint and continues on down the hierarchy until all but one candidate is eliminated. The candidate that remains is the optimal, or grammatical, one. The conventions of the tableau are the following: Constraints separated by a solid line are ranked with respect to one another, whereas those separated by a dashed line are unranked. Constraints are unranked when their ranking is undetermined by the data at hand, or because they do not conflict. The constraints are rank ordered left to right. Constraint violations incurred by each candidate are indicated by asterisks in the appropriate column, and an exclamation mark shows the violation that rules out a particular candidate. The optimal candidate receives a check mark to highlight its grammaticality. As our concerns are prosodic here rather than segmental, orthography suffices to indicate the retained syllables.

(10) ALIGNLEFT, PARSE-σ, FTBIN >> MAXI-O

Input: *hippopotamus*	ALIGNLEFT	PARSE-σ	FTBIN	MAXI-O
a. [(hippo)(pota)mus]	*!	*		
b.[(pota)mus]		*!		**
c. [(potamus)]			*!	**
d. [(hippo)(pomus)]	*!			*
e. [(pomus)] ✔				***

Candidates (10a) through (10d) violate one or more of ALIGNLEFT, PARSE-σ, or FOOTBIN, for the reasons detailed before. It is important to keep in mind that PARSE-σ only demands that syllables in the Output representation be incorporated into feet; it says nothing about the Input–Output relation, which is of concern only to MAXI-O. For simplicity's sake, MAXI-O violations are here assessed in terms of the number of syllables deleted, rather than segments (cf. McCarthy (in press), McCarthy and Prince (1995)). Because the three structural constraints are ranked above MAXI-O, the last candidate is optimal. The fact that the stressed and rightmost syllables are those that are retained (i.e., 'pomus' not 'hippo') is discussed in section 3.3.

As the optimal candidate violates none of the structural constraints and incurs no marks under them in the tableau, it is structurally unmarked in the sense of McCarthy and Prince (1994a). Under this analysis, child truncation can now be understood as an instance of the broader unmarkedness of child phonology

(Gnanadesikan (1995), Jakobson (1968), Stampe (1969)), rather than as a product of a specialized template. Although previous accounts have succeeded in reducing the contents of the Minimal Word template to the interaction of parameters, perhaps set at their unmarked values (e.g., the foot headedness and foot size constraints that Fikkert (1994) adopted from Dresher and Kaye (1990)), the limit of one foot per word has had to be stipulated independently of parametric considerations. The constraints that here conspire to produce the size restriction are themselves of wide generality, going well beyond the case at hand. Their effects in the languages of the world are well documented in Prince and Smolensky (1993) and McCarthy and Prince (1993a; 1993b; 1994a; 1994b; 1995), among others, and in the next section we see that they in fact play a role in the stress system of English.

2.2. Development as Reranking

As Menn (1980, 35–36) emphasized in the following passage, constraint-based theories of phonology have long held considerable appeal for child phonologists:

(11) the child's "tonguetiedness", that overwhelming reality which Stampe and Jakobson both tried to capture with their respective formal structures, could be handled more felicitously if one represented the heavy articulatory limitations of the child by the formal device of output constraints ... The child's gradual mastery of articulation then is formalized as a relaxation of those constraints.

It is therefore not surprising that a number of researchers have embraced Optimality Theory as a framework for the study of child pronunciations. Several have pursued the idea that the difference between the sound systems of child and adult language lies in a difference in the relative ranking of structural and Faithfulness constraints. As in the previous truncation example, a lower ranking of Faithfulness constraints in child language produces the observed structural unmarkedness of child utterances (see especially Gnanadesikan (1995; 1996), as well as Barlow (1996; 1997), Demuth (1995; 1996), Goad (1996a; 1996b; in press), Levelt (1995), Nouveau (1994), Stemberger (1995); see also Hale and Reiss (in press) and Smolensky (1996a; 1996b) for discussion of foundational issues).

The potential of Optimality Theory as a framework for examining phonological development has yet to be much exploited, however. Although it has often been stated that development proceeds by gradually promoting the Faithfulness constraints over the structural constraints (as well as establishing rankings among constraints of each class), most of the examples cited could equally be characterized as the elimination, or turning off of, constraints, as the structural constraints that are active in child language become completely inactive in the mature grammar.[3] A comparison of the prosody of adult and child English contributes an example of development as constraint reranking, in that structural constraints that are fully satisfied in child language are minimally violated in the adult language.

If all of FtBin, AlignLeft, and Parse-σ were fully satisfied in adult English, then words would be maximally bisyllabic, as in child English. That larger words are permitted shows that these structural constraints are dominated. First, consider the adult parsing of *banána*. In this word, there is an unstressed, unfooted syllable at the left edge (Kager (1989), Pater (1995)), which violates both Parse-σ and AlignLeft. To compel these violations, the Faithfulness constraint MaxI-O must be ranked above both of these structural constraints, in reverse of the child language situation in which it is subordinated to them. The tableau in (12) illustrates this aspect of the adult grammar.

(12) MaxI-O >> Parse-σ, AlignLeft

Input: banana	MaxI-O	AlignLeft	Parse-σ
a. (nana)	*!		
b. ba(nana)✔		*	*

If either Parse-σ or AlignLeft were ranked above MaxI-O, candidate (12a) would be preferred to candidate (12b). However, with MaxI-O dominating these two constraints, (12b) is correctly chosen as optimal.

This particular difference between the child and adult grammar is of the type that could be equally captured by constraint elimination or parameter resetting. In what we have seen thus far, Parse-σ and AlignLeft are fully obeyed by the child, and entirely disregarded by the adult, so that instead of saying that they are outranked by MaxI-O in the adult grammar, we could simply say that they are turned off. However, a closer look at the adult system shows that these constraints do play a role, that they are in fact minimally, not freely, violated.

The role of AlignLeft in English is documented in McCarthy and Prince (1993a). When a trisyllabic sequence precedes the main stress, secondary stress usually appears on the initial syllable (see McCarthy and Prince (1993a), Pater (1995) for accounts of the exceptions). The words in (13) exemplify this pattern:

(13) Tàtamagóuchi àbracadábra Kàlamazóo Wìnnepesáukee Wàpakonéta Lòllapalóoza

By having the initial foot aligned with the left edge of the Prosodic Word (i.e., *(Tàta)ma(góu)chi*), these words satisfy AlignLeft. A parsing that maintains an

[3]Gnanadesikan (1995) provided evidence of minimal violation in the child system itself, which is discussed with other examples of this type in section 3.6.

alternating rhythmic pattern (i.e., *Ta(tàma)(góu)chi*) would violate ALIGNLEFT. This indicates that ALIGNLEFT dominates ALIGNRIGHT, as the latter is better satisfied by *Ta(tàma)(góu)chi*.

PARSE-σ is ranked much higher than ALIGNLEFT in the grammar of English and has a broader range of effects, which provide further evidence that these constraints are outranked, rather than turned off. First, to allow iterative footing, PARSE-σ must dominate ALIGNLEFT:

(14) PARSE-σ >> ALIGNLEFT

Input: apalachicola	PARSE-σ	ALIGNLEFT
a. (ápa)lachicola	****!	
b. (àpa)(làchi)(có)la ✔	*	** ****

A candidate with only a single foot, as in (14a), fully satisfies ALIGNLEFT. PARSE-σ must rank above ALIGNLEFT to compel more exhaustive footing, as in (14b), in which the sole PARSE-σ violation occurs to satisfy a higher ranked NONFINALITY constraint (similar to Extrametricality; see Prince and Smolensky (1993, section 2)). The two sets of ALIGNLEFT violations are those incurred by the second and third feet, respectively, counted in terms of the number of syllables separating them from the left edge.

A more subtle PARSE-σ effect can be seen in what is commonly referred to as the "Arab rule" (Kager (1989), Pater (1995)). In a word like *Àlexánder*, the medial syllable is heavy yet stressless, in violation of the WEIGHT-TO-STRESS constraint, which demands that heavy syllables bear stress. The dominance of PARSE-σ over WEIGHT-TO-STRESS motivates the creation of a bisyllabic foot, rather than a monosyllabic one that would respect WEIGHT-TO-STRESS:

(15) PARSE-σ >> WEIGHT-TO-STRESS

Input: Alexander	PARSE-σ	WEIGHT-TO-STRESS
a. A(lèx)(án)der	**!	
b. (Àlex)(án)der ✔	*	*

More generally, PARSE-σ acts to incorporate syllables into feet wherever possible, where the limit on what is possible is defined not only by the higher rank of MAXI-O, but also by that of FTBIN. As we saw before, in a word like *banána*, the first syllable is left unparsed. In *bàndána*, by contrast, the initial syllable is footed. The difference between these words is that the initial syllable of *bàndána* is bimoraic and can thus be the sole constituent of a foot without trangressing FtBin, whereas the putative *(bà)(nána)* would violate FtBin due to its possession of a monomoraic, monosyllabic foot.

In this account, the transition from the prosodic system of early child English to that of adult English involves not the shutting off of structural constraints, but their outranking by Faithfulness constraints and ranking with respect to one another. Both Parse-σ and AlignLeft are unviolated in child language but minimally violated in the adult grammar.[4]

In child truncations, there are two points of interest: the size restriction itself and what is retained from an adult target that exceeds the size limit. Up to this point, we have been concerned solely with the former. In the next section, we turn to the patterns of content preservation displayed when children produce adult targets of various prosodic shapes. As well as fleshing out the account of child truncation, this section provides an example of an outranked structural constraint in the child system itself, thus adding to the evidence for the view of development as constraint reranking.

3. CONTENT PRESERVATION AND FAITHFULNESS

3.1. The Empirical Base

Although child truncations have been the subject of considerable study, there remains some lingering controversy over what exactly is preserved from adult targets. It is not a simple matter to resolve this data issue, because some of the relevant forms are fairly sparsely attested in child speech and there are very little phonetically transcribed developmental data that are publicly available.[5] Here I address the issue by consulting a large corpus of previously unpublished data on the acquisition of English.

The data to be discussed here were originally collected by a team under the direction of A. J. Compton in the 1970s. The method of data collection, and some preliminary analyses, were presented in Compton and Streeter (1977). The project was undertaken to map out, as precisely as possible, the development of children's sound systems. With this goal in mind, a diary method of data collection was chosen, with parents keeping track of their children's utterances by recording them in notebooks "at least four days a week and scattered throughout the child's waking hours, covering about 4 hrs. a day" (Compton and Streeter (1977, 100)).

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[4]FtBin, on the other hand, may well be inviolable in both, despite appearances to the contrary in very early stages of child language (see Goad (1996a), cf. Pater (1995, Appendix A) for discussion of some possible violations in the adult system).

[5]One important exception is the corpus of Dutch child language recently contributed to CHILDES (MacWhinney (1995)) by Paula Fikkert and Claartje Levelt (see Fikkert (1994) and Levelt (1994)).

The parents were speech pathologists and received additional training in the phonetic transcription of child speech prior to the study.

This method of data collection allowed for a particularly large and comprehensive sample to be gathered; for the four children to be discussed here, a total of over 25,000 utterances were transcribed (about 3,371 for Derek, 5,772 for Julia, 5,258 for Sean, and 13,351 for Trevor).[6] The transcriptions cover the ages of 1;0.6 to 3;2.1 for Derek, 1;2.21 to 3;1.3 for Julia, 1;1.25 to 3;2.20 for Sean, and 0;8 to 3;1.8 for Trevor. All of the children were learning American English as spoken in California; none had any language or learning-related impairments.

The obvious disadvantage of the diary method is that there is no way to verify the accuracy of the transcriptions, as no tests of interrater reliability are usually possible (let alone instrumental study of the phonetic characteristics of the utterances). However, in this case, Compton and Streeter (1977) checked the reliability of samples of the parental transcriptions by comparing them with transcriptions done simultaneously by the principal investigator and by taping some sessions so that they could also be transcribed by both the parent and the principal investigator. Compton and Streeter (1977, 100) noted that "these reliability checks indicated a high agreement of the phonetic transcriptions and, particularly, for the consonants (approximately 90%) which are the primary focus of this research." In this article we are concerned with phonetic detail only at the level of the basic place and manner features of the consonants and, to a minor extent, vowel quality. Therefore, we can have a reasonable degree of confidence in the accuracy of the transcriptions.

With such a large corpus, pencil-and-paper analysis is extremely difficult. From its inception, the aim of Compton's project was to create a computerized database, and Compton and Streeter (1977) reported on the progress of that work to that date. Unfortunately, due to the limitations imposed by the technology of the day, the computerized database was never completed, and the corpus remained mostly unanalyzed. To make use of the corpus for present purposes, I scanned a typewritten version of the transcripts to create computer readable images, and I used Optical Character Recognition software (OmniPage Pro®) to create text files. These were then checked and placed in a simple database format.

The database at present contains no indication of stress or syllable structure in the glosses. Therefore, I searched the transcripts manually for target words of particular prosodic shapes. In particular, I extracted all finally stressed bisyllables and all medially and initially stressed trisyllables, as each of these groups of target words is of particular interest for the patterns of preservation displayed in children's truncated productions of them (longer words are quite rare and were

[6]These are the number of entries in the database. They only approximate the total number of utterances as some of the entries are comments, rather than utterances. It is a relatively close approximation, however, because there are relatively few comments.

excluded, as they would yield such a small sample).[7] The gloss field of the database was then searched for all occurrences of these words. In the following tables, I supply exemplars of the patterns of preservation displayed by each child for each word and the ages at which the first and the last token was produced. This abstracts from some variation in the exact segmental makeup of the words, except where this is relevant to the issues of content preservation.

I start with the medially stressed trisyllabic targets. As mentioned in the introduction, children's truncated productions of these words almost always preserve the stressed and rightmost syllables (see Allen and Hawkins (1978), Demuth and Fee (1995), Echols and Newport (1992), Fikkert (1994), Gerken (1994), Ingram (1978), Smith (1973), Wijnen et al. (1994)). This tendency is clearly evident in the data in Table 1 as well. In most cases, the initial syllable of the child's truncated production is headed by the stressed vowel from the second syllable of the adult target, whereas the final syllable in the target and the truncated form correspond. As a perusal of the table shows, there are just a few isolated exceptions, about which I have nothing to say in the analysis: *another* and *gorilla* both have some truncated versions whose relation to the target is particularly opaque ([jəwo], and [jə] for *another*, [wʌ:ga:] for *gorilla*), and *another* has several variants that retain the initial syllable (e.g., [ənɚ]).[8] As for the onset of the child's initial syllable, it can correspond to either the onset of the medial or the initial syllable of the adult form. As has also been observed by Smith (1973) and Fikkert (1994), the initial onset is often chosen so as to replace a liquid ([dɪʃəs] *delicious*; [gʌ:wa] *gorilla*; [ma:kas] *maracas*) or a stop coronal ([bænə] *banana*; [pedo] *potato*), with the former seeming to be somewhat more consistent.

Bisyllables with final stress are also truncated by deleting the initial syllable (see Table 2). Again, the onset from the initial syllable is often retained so as to replace a liquid. In fact, for *balloon, belong, garage, Marie*, and *police*, when only one of the two target onsets is realized, the liquid is always deleted in favor of the initial nonliquid onset ([bun] *balloon*; [bɔŋ] *belong*; [ga:dʒ] *garage*; [mi] *Marie*; [pis] *police*). The one exception is Trevor's pronunciation of *giraffe* as [wæf], which turns out to be of some interest. We also have one example in Table 2 of a nasal being replaced by an obstruent ([dis] *Denise*), as well as one of a velar overriding a coronal ([ga:r] *guitar*) and of a velar replacing a labial ([gu:s] *caboose*).

[7]As the database is so large, there is the possibility of occasional lapses in attention during this process and of the resultant omission of a few relevant words. However, any word that occurred frequently enough to be of much interest would in all likelihood be picked up, regardless of attentional lapses.

[8]The pronunciation of *gorilla* as [go:wæ] may be initial nucleus preservation as well, or it may result from misperception or misproduction of [ɪ] due to the surrounding liquids.

TABLE 1
Truncations of σ′σσ Targets

another		
Derek	[nʌdɚ]	2;2.23 ~ 2;5.11
Julia	[jəwo]	1;10.12
	[jə]	1;11.4
Sean	[ənə]	1;9.15
	[əʊ]	1;10.11
	[nʌdɚ]	2;4.2
	[ʌə]	2;4.22
	[anʌ]	2;4.24
	[nʌθɚ]	2;10.13
Trevor	[nʌ:ɚ]	2;5.17
	[nʌ:dɚ]	2;5.17
	[ənɚ]	3;2.0
banana		
Derek	[nænə]	2;3.0 ~ 2;4.0
Julia	[mænə]	1;7.16 ~ 1;10.8
	[bænə]	1;11.6 ~ 2;5.29
	[blæna]	2;3.20 ~ 2;4.5
Sean	[nænə]	1;8.28 ~ 1;11.19
Trevor	[nænə]	0;11.10 ~ 1;6.8
	[nænæ]	1;0.9 ~ 3;1.8
gorilla		
Julia	[graʊwə]	2;2.21
Trevor	[go:wæ]	1;11.12
	[wʌ:ga:]	1;11.14
	[gʌ:wa]	1;11.14
Modesto		
Trevor	[dɛsto]	2;8.15
Nathaniel		
Trevor	[fæfue]	2;1.0
	[fæ:ŋo]	2;1.17
	[fæŋo:s]	2;2.23
piano		
Julia	[pæno]	1;9.19 ~ 2;4.17
Trevor	[pæ:no]	1;11.9 ~ 2;2.23
remember		
Julia	[mɛmə]	1;10.8 ~ 3;0.1
	[mɛmbə]	2;1.18 ~ 2;7.29
spaghetti		
Julia	[dɪbi]	1;9.7
	[gɛbi]	1;10.8
	[skɛbi]	1;11.19 ~ 2;3.8
	[sketi]	2;0.29
Trevor	[gɛdi]	1;4.27 ~ 1;9.2
apartment		
Julia	[partmɛnt]	2;3.14 ~ 2;5.16
baloney		
Derek	[bwoni]	2;7.18 ~ 2;10.2
delicious		
Julia	[dɪʃəs]	1;11.27
eleven		
Julia	[dɛbən]	1;9.10
	[jɛbən]	1;9.15
	[jɛmɪn]	1;9.20 ~ 1;10.7
	[jɛvən]	2;2.24
maracas		
Trevor	[ma:kas]	2;0.27
museum		
Trevor	[zi:ʌm]	2;7.27
pajamas		
Julia	[daməs]	1;8.27 ~ 2;0.2
Sean	[dʒæməʃ]	1;11.15 ~ 2;0.23
Trevor	[da:məs]	1;7.11
	[dʒa:mas]	1;7.26 ~ 2;2.10
potato		
Julia	[pedo]	2;0.25 ~ 2;1.20
	[teto]	2;5.16
Trevor	[te:to]	1;9.19 ~ 1;10.5
salami		
Trevor	[ma:mi]	1;6.25 ~ 2;1.0
Theresa		
Trevor	[ri:sə]	2;11.10

(Continued)

TABLE 1
(Continued)

together			*tomato*		
Trevor	[gɛ:dɚ]	1;9.27 ~ 2;0.27	Julia	[meno]	1;9.22 ~ 1;10.27
				[meto]	2;0.11 ~ 2;10.30
			Trevor	[me:do]	2;0.27
tomorrow			*umbrella*		
Julia	[mowo]	1;7.16 ~ 2;0.17	Derek	[bwɛa]	1;11.30
Trevor	[moro]	1;8.12 ~ 2;1.14	Sean	[bɛla]	2;0.1
			Trevor	[brʌ:gæ]	1;11.1
				[bre:wa]	1;11.5
				[bʌwə]	1;11.5
				[bwɛ:wəz]	2;1.0 ~ 2;1.14
vagina					
Trevor	[dʒai:nə]	2;11.10			

TABLE 2
Truncations of σ′σ Targets

again			*alone*		
Julia	[gɛn]	1;10.1 ~ 2;1.24	Derek	[won]	2;6.24
Sean	[gɛ]	2;5.21	Trevor	[io:n]	2;1.26
	[gɛn]	2;7.11			
Trevor	[gɛ]	0;10.28 ~ 1;0.8			
	[gɛn]	1;6.17 ~ 2;3.3			
apart			*around*		
Trevor	[part]	1;9.29	Sean	[ound]	1;11.12
			Trevor	[wau:n]	2;0.8
away			*balloon*		
Derek	[we]	2;2.30	Derek	[bu]	1;11.6 ~ 2;2.1
Julia	[waɪ]	1;8.24 ~ 2;0.19		[bun]	2;2.25 ~ 2;4.26
Sean	[we]	2;1.25 ~ 2;8.23	Julia	[bu]	1;5.28
				[bʊn]	1;9.18 ~ 1;10.23
			Sean	[bʌ]	1;3.21
				[bu]	1;4 ~ 1;7.18
				[bum]	1;11.0
			Trevor	[bu]	1;4.19 ~ 1;4.27
				[bu:m]	1;4.27 ~ 1;6.25
				[bu:n]	1;9.29 ~ 1;11.14
behind			*belong*		
Derek	[haind]	2;3.24	Julia	[bɔŋ]	1;11.27 ~ 2;0.26
Trevor	[hai:n]	2;0.8 ~ 2;2.15	Trevor	[ɔ:ŋ]	2;1.5
caboose			*cement*		
Trevor	[gu:s]	2;4.24 ~ 2;11.17	Derek	[mɛnt]	2;11.27
Denise			*dessert*		
Trevor	[dis]	1;1.17 ~ 2;2.15	Julia	[zɚt]	2;8.7 ~ 2;9.24
enough			*excuse*		
Trevor	[nʌf]	1;10.5 ~ 1;11.25	Trevor	[ku::zə mi] (excuse me)	2;2.10 ~ 2;6.6

(Continued)

TABLE 2
(Continued)

garage			*giraffe*		
Julia	[gwa:dz]	2;8.25	Julia	[dʒwæf]	2;2.7
Trevor	[ga:dʒ]	1;10.5 ~ 2;0.24		[dræf]	2;2.17 ~ 2;6.10
	[gardʒ]	2;1.5 ~ 2;1.26		[dwæf]	2;2.22
	[gradʒ]	2;3.3	Trevor	[wæ:f]	1;9.1 ~ 1;11.14
	[gra:dʒ]	2;3.22			
guitar			*machine*		
Sean	[tar]	2;2.12	Trevor	[ʃɪʃɪm]	1;8.26 ~ 2;4.13
Trevor	[gi]	1;1.13 ~ 1;3.11		(sewing machine)	
	[ga]	1;1.19 ~ 1;6.17		[o: ʃi:n]	2;4.24
	[ga:r]	1;7.20 ~ 2;1.5		(sewing machine)	
				[so:ə ʃi::m]	2;8.5
				(sewing machine)	
Marie			*Merced*		
Trevor	[mi]	1;6.17 ~ 1;9.2	Trevor	[sɛd]	1;11.12 ~ 2;11.10
Michele			*police*		
Trevor	[ʃɛ:u]	1;6.25 ~ 2;5.26	Julia	[pismæn]	2;1.10 ~ 2;5.3
				(policeman)	
				[plis]	2;6.5
			Trevor	[pi:smæn]	2;4.13
				(policeman)	
pretend			*surprise*		
Julia	[tɛnd]	2;1.20 ~ 2;3.30	Derek	[pwaɪz]	2;7.7
today					
Derek	[de]	2;8.19 ~ 3;2.0			

3.2. The "Elephant" Data

The constraints on word size introduced in section 2 account for the fact that the trisyllables and the finally stressed bisyllables are truncated, as a target-like production would exceed the one foot maximum that the constraints impose. However, they say nothing about which syllables are preserved. Two basic approaches have been taken in the recent literature to explain why the initial syllables are deleted. Echols and Newport (1992) proposed that children have a perceptual bias to the stressed and rightmost syllables, and they pick out these syllables from the speech stream to make up their lexical representations. Production-based accounts, on the other hand, assume that children's lexical representations include the syllables that are deleted in truncation and posit a process of mapping to a template (Gerken (1994), Wijnen et al. (1994)) or of circumscription of a prosodic unit (Fikkert (1994)) to generate the output form.

For the target words we have looked at so far, choosing the final foot, or the stressed and rightmost syllables, would yield the same result. However, for initially stressed trisyllables, these two approaches make different predictions. If the target words are prosodified as $('\sigma\sigma)\sigma$ (see Hayes (1982)), the final foot consists of the first two syllables. Extraction of the final foot would thus preserve the first two syllables, whereas the stressed and rightmost syllables are the first and third.

Claims about what the observed facts are here seem to split along factional lines, but nowhere are the presented data sufficient to assess those claims. Although Echols and Newport (1992) presented statistics to show that stressed and rightmost is the dominant pattern, their analyses lump together σ'σσ and 'σσσ words, so it is impossible to tell how 'σσσ words behave (especially as these seem to be the rarer of the two).

Wijnen et al. (1994), on the other hand, claimed that in the Dutch children's truncations that they studied, both patterns occur with about equal regularity. There are, however, two confounding factors that make it difficult to accept this claim at face value. First, the words that Wijnen et al. gave as examples of targets for stressed and medial truncations are in fact suffixed (i.e., *andere* and *poppetje*), so it is difficult to know whether the reductions [ɑndə] and [pɔpə] arise for phonological or morphological reasons.[9] Second, and more important, because the unstressed final syllables in these target words are schwa final, when a child produces a truncated version of one of these words, one cannot be sure that the medial schwa, rather than the final one, is being produced. The identity of the accompanying onset fails to provide an unambiguous clue to the source of the schwa, as an onset can be drawn from a preceding syllable, as we have already seen in forms like [dɪʃəs] for *delicious* and as we shortly see for 'σσσ truncations in English. In this respect, English data are potentially very revealing. Unstressed final syllables quite often end with coda consonants (e.g., *Margaret*), syllabic sonorants (*tricycle*), or tense vowels (*buffalo*). Words such as these can provide a clear indication of whether the medial or final rime is being preserved.

Gerken (1994, 579) stated that "the S(W) production template hypothesis predicts that, in SWW words like *elephant* and *animal*, children should preserve the first weak syllable more frequently than the second." Recognizing that this prediction is not fully borne out in the relevant data that do exist, Gerken suggested that the preference for adjacent syllables is overruled by a CV(C) segmental template, which demands that syllables must possess an onset. In a word like *élephant*, the SW template would select the first two syllables. However, the second syllable does not fulfill the CV(C) template, given the additional assumption that the [l] of *elephant* is not the onset for the second syllable but instead closes the first syllable, due to its being incorporated into the stressed syllable (it must also be assumed that children are aware of this syllabification and cannot alter it). Because the final syllable possesses an onset, and it is weak, it is chosen, giving the pronunciation [ɛlfʌn] attested in Echols and Newport (1992). This account makes the interesting prediction that words that have a cluster following the stressed syllable and hence an available onset in the second

[9]Thanks to Janet Grijzenhout for pointing this out and to an anonymous reviewer and Wim Zonneveld for catching my misinterpretation of her comments. Contrary to what is claimed in Pater and Paradis (1996), *ander* and *pop* are the bare stems, not *ande* and *poppe*.

syllable (e.g., *ambulance*) should usually lose the final syllable in truncation. Gerken (1994, 581) found some evidence in data from Klein (1978) to support a difference between words like *elephant* and *ambulance*, but noted that "a more extensive examination of children's early SWW word productions is necessary" to test the predictions of her model.[10]

It turns out that the data from the corpus under study here strongly supports Echols and Newport's (1992) position that stressed and rightmost is the regular pattern, and they argue against Gerken's alternative interpretation of *elephant*-type words. The truncated productions of initially stressed trisyllabic target words are presented in Table 3. This data set demonstrates a strong tendency for the rightmost rime to be preserved. Of the words in Table 3, only two end in schwa (*camera* and *spatula*). In all the other words, the final rime can be distinguished from the medial one. For most of these words, the only attested truncations are ones in which the final rime in the target clearly corresponds to the final rime in the child's production. Syllabic [l] in final position is produced intact, or as a nonschwa vowel (e.g., [twaɪkl] for *tricycle*, [amo] for *animal*), and tense vowels are retained (e.g., [bʌfo] for *buffalo*, [baki] for *broccoli*), as are coda consonants (e.g., [sɪmɛn] for *cinnamon*, [fevət] for *favorite*). For those few words that have truncated versions that show no evidence of final rime retention ([aijə] for *Allison*, [ɔwo] for *elephant*, [sɛmə] for *sesame*), there are also variants that do ([æ:sʌn], [ɛ:fɪnt], and [semi], respectively).

Although the truncations almost always preserve the final rime, for a large set of target words the onset of the medial syllable is chosen instead of the final one (e.g., [baki] for *broccoli*). *Broccoli*, *buffalo*, *camera*, *dungarees*, *favorite*, and *spatula*[11] are always truncated in that fashion, as are some instances of *sesame* and *company*. Most of these words have but a single consonant separating the stressed and medial vowels, which shows that such consonants are in fact eligible as onsets in children's truncations, contra Gerken's (1994) solution for the *elephant* problem. What seems to determine whether the onset of the medial syllable is chosen is not whether it is part of a cluster, but whether it is less sonorous than the final syllable's onset. The basic sonority scale is given in (16) (see, e.g., Blevins (1995), Clements

[10]What Gerken in fact found is that *elephant*-type words generally preserve the final syllable, whereas *ambulance*-type words vary between medial and final syllable retention. She claimed that this is captured by her account, because in a word like *ambulance*, "either weak syllable might be inserted into the W slot of the metrical template" (Gerken (1994, 581)). However this contradicts her discussion of SWWS words earlier in the article, in which a preference for the first weak syllable is crucial, as well as the quotation cited here, in which the prediction of the S(W) production hypothesis is explicitly stated. We must conclude, then, that final-syllable preservation for the *ambulance* class of words is problematic for Gerken's analysis.

[11]Several of these words have alternate pronunciations in adult English in which the medial vowel is deleted. All of them, however, are also transcribed with the medial vowel intact in either Kenyon and Knott (1953) or *Webster's New Collegiate Dictionary* (Woolf (1981)). In any case, the consonants surrounding the deleted vowel are retained in the syncopated adult form, so an account still must be given of why the child chooses one or the other.

TABLE 3
Truncations of 'σσσ Targets

abacus				*Allison*		
Trevor	[æ:ʃɪʃ]	1;8.7		Trevor	[ai:]	1;3.5
	[æ:tʃus]	1;9.2			[aijə]	1;3.10 ~ 2;2.7
	[ækus]	1;9.2 ~ 2;0.8			[æ:sʌn]	2;0.8 ~ 2;2.3
	[æ:ʃʌʃ]	1;9.2				
animal				*bicycle*		
Derek	[æmʊ]	2;1.14 ~ 3;1.24		Julia	[baɪko]	1;8.4 ~ 1;10.13
Julia	[amo]	1;9.8 ~ 2;1.2			[baisko:]	2;0.14 ~ 2;5.7
Trevor	[nɔno]	1;5.13		Trevor	[gaiki]	1;5.5
	[amu:]	1;7.20 ~ 2;3.4				
broccoli				*buffalo*		
Julia	[baki]	1;7.6 ~ 2;0.19		Julia	[bʌfo]	2;0.14 ~ 2;3.9
camera				*cinnamon*		
Sean	[kæmʌ]	2;0.13		Julia	[sɪmɛn]	1;11.15
	[kæmrʌ]	2;0.13 ~ 2;10.9				
Trevor	[kæ:mə]	1;5.6 ~ 1;11.25				
	[kæ:mɚ]	2;0.3				
company				*dominoes*		
Julia	[kʌmpi]	1;11.14		Trevor	[da::nouz]	2;2.23
Sean	[kʌmpi]	2;0.27			[da:mno:θ]	2;4.3
Trevor	[kumni:]	2;2.23				
dungarees				*elephant*		
Trevor	[gʌŋgi:z]	1;10.1		Derek	[ɛwfən]	2;9.7 ~ 2;10.7
				Julia	[ɔwo]	1;8.0
					[apɛn]	1;10.4
					[aʊfənts]	1;10.27 ~ 2;0.13
				Sean	[adi]	1;6.1
					[ɛfɛnt]	2;1.19
					[ɛlfɪnt]	3;1.18 ~ 3;1.27
				Trevor	[ɛ:fɪnt]	1;11.14 ~ 2;6.15
					[ɛ:tʌnt]	1;11.14
favorite				*gallopey*		
Julia	[fevət]	2;0.25 ~ 2;6.1		Julia	[gabi]	1;9.14
Sean	[fevrɪt]	3;2.12				
medicine				*sesame*		
Julia	[mɛsɪn]	1;11.12		Derek	[sɛmə]	2;2.8
Sean	[wapi]	1;7.14			[semi]	2;6.26 ~ 3;1.28
Trevor	[mɛ::sɪn]	2;1.26		Sean	[diduit] (Sesame Street)	1;10.6
	[mɛ:sɪn]	2;11.10			[do dwit] (Sesame Street)	1;10.17
					[sɛsi stwit] (Sesame Street)	2;5.14
spatula				*tricycle*		
Trevor	[bæ:tʃʌ]	1;11.23		Derek	[twaɪkl]	2;8.18 ~ 2;10.4
vitamin						
Trevor	[ga:mɪn]	1;5.30				
	[bai:mi:ʃ]	1;6.9				

(1990), Gnanadesikan (1995), Hankamer and Aissen (1974), Hooper (1976), Prince and Smolensky (1993), Rice (1992), Selkirk (1984), Steriade (1982)):

(16) Vowel > Glide > Liquid > Nasal > Fricative > Stop

The scale is given in (16) in order of decreasing sonority; vowels are the most sonorous segment type, and stops the least. The way that the sonority scale plays out in the data at hand is that the onset is taken from the target's medial syllable only when it is lower in sonority than the onset of the final syllable. In all of the cases of medial onset retention, an obstruent (i.e., a fricative or a stop) from the medial syllable is chosen instead of a sonorant (i.e., a liquid or a nasal) from the final one. This is fully parallel to the data from initial truncation examined in the previous section, in which obstruents usually replaced liquids and sometimes replaced nasals.

One apparent difference between initial and medial syllable deletion is that in the latter there is no evidence of the place specification of the consonants playing any role. However, it turns out that there are no initially stressed trisyllabic targets with the relevant array of consonants (e.g., with a labial onset preceding a coronal onset, where they are equal in sonority). Note too that onset selection that is sensitive to place of articulation is less consistent even in initial syllable truncation.

In the account of these patterns that follows, I first discuss the constraints responsible for the preservation of the stressed and rightmost syllables. I then analyze the robustly attested pattern of sonority-driven onset selection and provide evidence that this is an instance of minimal violation in the child system itself. I return to the onset choices based on place of articulation in section 4.

3.3. Stressed and Rightmost Preservation as Faithfulness

The basic intuition underlying the approach to content preservation taken here is that certain kinds of phonological elements—in particular, those that are prominent, are heads of constituents, or lie at the edges of domains—have a special status (Steriade (1993)). Here this is formalized in terms of Faithfulness constraints that specifically target such entities (see, e.g., Alderete (1995), Beckman (1995), Itô, Kitagawa, and Mester (1996), McCarthy (in press), Yip (1996)). STRESS-FAITH, for example, requires the preservation of stressed elements (Pater (1995); cf. MAXFT-HEAD in Itô et al. (1996) and HEADMATCH in McCarthy (in press)):[12]

[12] I use STRESS-FAITH, rather than a constraint on the preservation of the prosodic head, because it makes no implicit claim about whether the child's Input representation is prosodified. Preservation of the stressed syllable could simply be preservation of the most acoustically salient syllable. Given that words with secondary stress on the initial syllable, like *museum*, show preservation of the main stressed syllable, this constraint might need to be relativized to level of headedness (foot vs. Prosodic Word), or to degree of salience. On the other hand, Fikkert (1994) showed that the rightmost foot, rather than the most prominent one, is often chosen in her Dutch truncation data. A full discussion of the relevant cases would take us far off track and would require considerable querying of the corpus, so I leave this issue for further research.

(17) STRESS-FAITH

An Input stressed element must have as its Output correspondent a stressed element.

This constraint plays an important role in explicating child truncations, as they almost always preserve the stressed syllable. Across the three word types we have examined, we have seen that the stressed nucleus is consistently preserved (cf. Demuth (1996), Fikkert (1994) for discussion of violations of this constraint in a stage of child Dutch).

To ensure the preservation of the final syllable, we can invoke the notion of edge-anchoring introduced in McCarthy and Prince (1994a; 1994b; 1995). ANCHOR constraints are edge-specific Correspondence constraints, which, like the Alignment constraints of McCarthy and Prince (1993a), formally recognize the importance of the edges of domains.[13] The ANCHOR constraint relevant here is the one in (18).

(18) ANCHOR-RIGHTI-O

Elements at the right edge of the Input word and the Output word stand in correspondence.

Assuming for the moment that "element" in the formulation of these constraints refers to syllables, with STRESS-FAITH and ANCHOR-RIGHTI-O ranked above any competing constraints, the stressed and the rightmost syllables will be preserved in the truncated form.

As it stands, we have not introduced any constraints that do compete with STRESS-FAITH and ANCHOR-RIGHTI-O. The one possible conflict arises in the case of the finally stressed bisyllables, which preserve only the stressed syllable, which also happens to be the rightmost one. Fikkert (1994, 209) reported that this type of word is sometimes augmented with an epenthetic vowel to form a bisyllabic foot. In present terms, this would be driven by the need to satisfy FTBIN at the syllabic level. Interestingly, epenthesis hardly ever occurs in the present data set (a similar finding in experimental data on child English is presented in Kehoe and Stoel-Gammon (1996; 1997)). The only exception is [ku::zə mi] for *excuse me*, in which the epenthesis could well be serving to break up the [zm] cluster. The lack of epenthesis might indicate that RIGHT-ANCHOR dominates FTBIN, but it may also be that FTBIN is satisfied at the moraic level in these children's systems (cf. Fee (1992; 1995)); the statement of FTBIN in Prince and Smolensky (1993) requires syllabic or moraic binarity. Because vowel length does not appear

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[13]McCarthy and Prince (1995, 371) noted that Alignment between prosodic categories can also be formulated in terms of ANCHOR if correspondence is taken to be reflexive. Under this interpretation, a constraint demanding that a segment at the edge of a foot have a correspondent at the edge of a Prosodic Word would be satisfied if a segment that is edgemost in a foot is itself edgemost in a Prosodic Word. I retain the version of Alignment in section 2 not only for expository ease but also to facilitate comparison with McCarthy and Prince (1994a).

to be very reliably transcribed in the present corpus, and the status of bimoraic syllables in these children's systems is therefore difficult to ascertain, I leave the choice between these alternatives open.

3.4. Constraints on Onset Preservation

In this section, I start by discussing the apparent exceptions to stressed and rightmost preservation seen in truncations of initially stressed trisyllables, which as demonstrated in section 3.2, result not from free variation between the retention of final and medial syllables, but rather from the choice of a lower sonority onset. For words whose final syllables begin with obstruents, that consonant is always preserved in the truncated form.[14] In cases where the onset of the final syllable is a liquid and the preceding onset is an obstruent or nasal (e.g., *buffalo* and *camera*), when one of the onsets is deleted, it is always the liquid; if the onset of the final syllable is a nasal, it is sometimes lost if the preceding onset is an obstruent (*sesame* and *company*; although cf. *vitamin*), but not if it is another nasal (*animal, cinnamon,* and *domino*).[15] Because liquids are more sonorous than nasals, which are in turn more sonorous than obstruents, the choice of the medial onset appears to be motivated by a search for a less sonorous obstruent.

The markedness of high sonority onsets is well attested in both child language (Fikkert (1994),[16] Gnanadesikan (1995; 1996)), and in the phonologies of the world's languages (see, e.g., Clements and Keyser (1983)). The connection between the two is made particularly explicitly in Gnanadesikan (1995; 1996). She showed a clear parallel between cluster reduction processes in Sanskrit reduplication and in a stage of the phonological development of an English-speaking child (age 2;3 to 2;9). In both instances, clusters are reduced by choosing the least sonorous member.[17]

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[14]Two apparent exceptions are [aijə] for *Allison*, and [ɔwo] for *elephant*. These were very early versions of the words, produced by Trevor and Julia, respectively, which were later replaced by forms that did preserve the obstruent. These two tokens also stand out in that they do not preserve the final rime. It seems, then, that these are representative of an earlier developmental stage.

[15]There is also no evidence for a preference of stops over fricatives. The only word with a stop onset in the medial syllable and a fricative in the final one is *medicine*, and the truncations preserved the fricative rather than the stop. Further evidence is needed to determine whether this division in the sonority hierarchy plays any role here.

[16]Although sonority plays a relatively important role in the patterns of cluster reduction that Fikkert documented, as she pointed out, it cannot be the sole determining factor in order of acquisition of simple onsets, as nasals emerge consistently earlier than fricatives (Fikkert (1994, 68)).

[17]There are instances of cluster reduction in child language that run counter to the predictions of sonority preference. Some children exhibit a stage in the development of obstruent+liquid clusters in which the liquid, rather than the obstruent, is selected. This occurs following the stage in which the clusters are reduced to obstruents, and prior to the stage in which the clusters are produced faithfully (Compton and Streeter (1977), Fikkert (1994)). Fikkert referred to the choice of the liquid as a "selection strategy" and did not provide a formal account of it. In the present framework, this stage could be explained by a reranking of the faithfulness constraint I-CONTIG-σ above *A-ONS.

In the analysis of the role of sonority in truncation, we must first account for the fact that where sonority considerations do not come into play, such as when the final onset is an obstruent, or both are nasals,[18] the onset is taken from the final syllable of the target ([ækus] for *abacus*, [sımɛn] for *cinnamon*). Previously, I interpreted the constraint ANCHOR-RIGHT as requiring that a syllable at the right edge of the Input word have a correspondent at the right edge of the Output Prosodic Word. This is in fact based on an expository simplification. In McCarthy and Prince's (1995) theory of Correspondence, the elements in Correspondence are not syllables, but rather segments (see also McCarthy (in press)). Under this view, ANCHOR-RIGHT only requires that the rightmost segment of the Input and Output representations stand in Correspondence. Because it says nothing about segments internal to the word,[19] we do not yet have any explanation for why the default case is that the final syllable's onset is retained.

The relevant constraint here would appear to be the Faithfulness constraint CONTIGUITY, which is violated when nonadjacent elements in the Input become adjacent in the Output. McCarthy and Prince (1995, 371) stated the version of CONTIGUITY that targets the Input string (I-CONTIG) as in (19).

(19) I-CONTIG

The portion of S_1 standing in correspondence forms a contiguous string.

S_1 refers here to the Input string. The Input–Output mapping in (20) illustrates why [æbus] as the output for *abacus* runs afoul of I-CONTIG:

(20) I: $\underline{a_1 b_2} a_3 c_4 \underline{u_5 s_6}$ O: $a_1 b_2 u_5 s_6$

The subscripted numbers indicate the Correspondence relation between the strings, and the underlined segments in the Input string are those that stand in that relation with segments in the Output string. The break in the underlining signals that there is a violation of I-CONTIG.

This purely segmental statement of I-CONTIG is not quite sufficient, however. As (21) shows, the optimal candidate also violates it:

(21) I: $\underline{a_1} b_2 a_3 \underline{c_4 u_5 s_6}$ O: $a_1 c_4 u_5 s_6$

[18]Unfortunately, there are no data on what happens when both syllables began with approximants, but based on the instances in which nasals occurred in both positions, it is likely that the rightmost approximant would be retained.

[19]For the one case where the rightmost segment of the Input is deleted so as to yield a less marked coda (Derek's [ɛwfən] for *elephant*), we could assume that ANCHOR-RIGHT applies gradiently (Alderete et al. (1996)), so that the rightmost segment in the Output lies in correspondence with an element as close to the right edge as possible, given the dominance of higher ranking structural constraints. The other possibility would be to assume that the final segment [n] is in fact in correspondence with both Input /n/ and /t/ (that it is the result of *fusion*; see, e.g., Gnanadesikan (1995), Pater (in press)), and that ANCHOR-RIGHT is in fact fully satisfied.

Because the optimal candidate fares no better on this constraint, I-CONTIG does not rule out the alternative in (20). This problem can be remedied by relativizing contiguity to prosodic category (Lamontagne (1996)), in this case, to the syllable. The revised statement is given in (22):

(22) I-CONTIG-σ
The portion of S_1 standing in correspondence with the constituents of a syllable forms a contiguous string.

This constraint requires that the segments within a given syllable must be taken from a contiguous string within the Input. The ill-formed and the optimal candidate are compared with respect to this constraint in (23). Syllable boundaries are indicated with brackets:[20]

(23) a. I: $\underline{a_1}b_2a_3\underline{c_4}\underline{u_5}\underline{s_6}$ O: $[a_1][c_4u_5s_6]$ ✓I-CONTIG-σ
b. I: $\underline{a_1}\underline{b_2}a_3c_4\underline{u_5}\underline{s_6}$ O: $[a_1][b_2u_5s_6]$ *I-CONTIG-σ

In (23a), all of the elements within each syllable are drawn from a contiguous portion of the Input string, so I-CONTIG-σ is satisfied. In (23b), however, the constituents of the final syllable stand in correspondence with a noncontiguous input string, which incurs a violation of the constraint.

The combination of ANCHOR-RIGHT and I-CONTIG-σ yields the preservation of the final syllable, including its onset. We can now consider the cases in which the onset is taken from the medial syllable, in violation of I-CONTIG-σ. As we have seen, this occurs when the medial onset is less sonorous than the final one. The relative markedness of onsets of greater sonority can be captured by positing a set of constraints that penalize consonants of the various degrees of sonority, which are arrayed in a fixed ranking, with the degree of sonority correlating to the ranking of the constraint (see, e.g., Gnanadesikan (1995), Prince and Smolensky (1993)). Assuming that vowels and glides differ only in their syllabic position, the sonority scale in (16) yields the onset markedness hierarchy in (24):

(24) *V-ONS >> *L-ONS >> *N-ONS >> *F-ONS

*V-ONS is violated by a vocalic (glide) onset, *L-ONS by a liquid onset, *N-ONS by a nasal, and *F-ONS by a fricative.[21] Assuming that stops constitute perfect

[20] I assume an unmarked CV syllabification here. I am not aware of any evidence bearing on the question of whether children's pronunciations possess the poststress ambisyllabicity (Kahn (1980)) or resyllabification (Selkirk (1982)) claimed to exist in mature English. I also assume that the final consonant is incorporated as a coda, rather than either being unsyllabified or being syllabified as the onset of an empty-headed syllable (cf. Goad (1996a)).

[21] These constraints could be formalized without reference to a primitive notion "Onset" (see Gnanadesikan (1995) and Prince and Smolensky (1993) for two proposals), but the statements here are adopted for simplicity's sake.

onsets, there is no constraint penalizing their appearance in that position. Because liquids are realized as glides in most of the child data with which we are concerned, the ranking between *V-ONS and *L-ONS is of no particular consequence. Therefore, I will henceforth collapse them into a single constraint *A-ONS (*APPROXIMANT-ONSET).

The ranking of I-CONTIG-σ with respect to this hierarchy will generate the pattern of onset selection seen in the data. The clearest pattern is the selection of the medial onset when the final one is a liquid, as this occurs without exception for a substantial number of target words. This indicates that *A-ONS ranks above I-CONTIG-σ:

(25) *A-ONS >> I-CONTIG-σ

Input: buffalo	*A-ONS	I-CONTIG-σ
a. [bʌfo] ✔		*
b. [bʌwo]	*!	

Candidate (25a) violates I-CONTIG-σ, but it avoids the violation of *A-ONS which rules out the competing (25b). Note that ANCHOR-RIGHTI-O must also dominate I-CONTIG-σ, as both I-CONTIG-σ and *A-ONS could be satisfied by retaining the medial schwa, rather than the final vowel.

The ranking of I-CONTIG-σ relative to *N-ONS is less clearly determined by the data. *Sesame* and *company* have variants that indicate the dominance of *N-ONS ([sɛsi] and [kʌmpi]), but also others that attest to the reverse ranking ([kumni:] and [semi]), whereas the two truncations of *vitamin* both obey I-CONTIG-σ. For the one target word where it could have an effect, *F-ONS is always overruled by I-CONTIG-σ, producing [mɛ:sɪn] in all three tokens. I-CONTIG-σ thus varies somewhat in its ranking with respect to *N-ONS, but as far as can be told, dominates *F-ONS in the grammars producing these truncated forms. These rankings yield the hierarchy in (26).

(26) *A-ONS >> I-CONTIG-σ/*N-ONS >> *F-ONS

The slash in the hierarchy between I-CONTIG-σ and *N-ONS should be interpreted as indicating that the systems under consideration vary with respect to their ranking. It is impossible to know whether the ranking varies from stage to stage or from word to word. Even though the data related to nasals and fricatives are far too sparse to support any firm conclusions, it is interesting that they are consistent with the presumed fixed ranking of the onset markedness constraints, which predicts that among these three constraints, the effects of *A-ONS should be the strongest, those of *F-ONS the weakest, and those of *N-ONS in between the other two. Similar evidence can be found in the data from initial truncation, to which we turn next.

3.5. Onset Choice in Initial Truncation

Just as ANCHOR-RIGHTI-O targets only the rightmost segment when Input–Output Correspondence is mediated by segments, rather than syllables, STRESS-FAITH will only require the preservation of the vocalic nucleus bearing stress. Onset choice in initial truncation will thus be governed by the interaction of the same constraints that select the medial onset: I-CONTIG-σ and the onset markedness constraints. Here I discuss the observed parallels between the data from initial and medial truncation.

As would be predicted by the ranking of *A-ONS over I-CONTIG-σ, the initial onset is almost always chosen to form a syllable with the stressed nucleus when one of the onsets is deleted and the medial syllable starts with a liquid (e.g., [dɪʃəs] *delicious*, [gʌ:wa] *gorilla*, [ma:kas] *maracas*; [bun] *balloon*, [bɔŋ] *belong*, [ga:ʤ] *garage*, [mi] *Marie*, and [pis] *police*). The σ′σ example of [wæf] for *giraffe* is discussed in the context of the evidence for minimal violation in the next subsection. In the σ′σσ data, there are two cases where the initial obstruent does not replace a following liquid onset, but these seem amenable to explanation. The first is [ri:sə] for *Theresa*, which Trevor produced at the relatively late age of 2;11.10, at which point it may well be that I-CONTIG-σ has been promoted above *A-ONS. A similar developmental sequence can be seen in Julia's [pedo] for *potato* later being replaced by [teto], though this involves the interaction of I-CONTIG-σ with the place sensitive constraints discussed in section 4 (see also Figure 71 in Fikkert (1994, 240)).

The second σ′σσ case is [ma:mi] for *salami*, in which the liquid is replaced by a nasal. It seems quite possible that this process, widespread in Trevor's corpus, is in fact an alternate means of fulfilling the demands of *A-ONS, which is exploited when there is a nasal in the Input (cf. the description of "phophylactic harmony" in Drachman (1976)). In all the examples I have been able to find, the nasal replaces an onset approximant. Unfortunately, for most of the duration of this process, there are no approximants in coda position, as liquids are generally vocalized. Some other examples include [nona] for *Lorna* (1;4.2 ~ 1;7.26), [memen] for *melon* (1;5.18 ~ 1;9.2), [mimə] (1;6.8 ~ 1;7.26) and [mimər] (1;9.1 ~ 1;9.2) for *mirror*, [niŋ] for *ring* (1;5.9 ~ 1;7.28), and [kainiŋ] for *crying* (1;7.26 ~ 1;8.14). A description and account of the full set of facts surrounding this process is clearly the topic for another article, but as far as I can tell from preliminary investigation, obstruents participate neither as targets nor as triggers (cf. the liquid harmony in the Amahl corpus in Smith (1973), discussed in detail in Goad (1996b; in press)).

Another parallel with the data from medial truncation that can be observed in initial truncation is in the relatively weak effect of *N-ONS. Though *Denise* is consistently [dis], *banana* is produced as both [bænə] and [nænə], whereas *cement, tomato,* and *tomorrow* always appear with the nasal intact. This again provides indirect evidence for the fixed ranking of *N-ONS beneath *A-ONS, but the results must continue to be treated as preliminary, and not only because of the small number of examples. Here we must also parcel out the effect of the tendency, not seen in the medial deletion data, to preserve segments with particular places of articulation. Usually labials (and sometimes velars) replace coronals (see Fikkert (1994, 239), Smith (1973)). Onset selection in all of *banana, cement, tomato,* and *tomorrow* could be affected by this labial preference.

3.6. Minimal Violation in Onset Selection

For the data we have looked at so far, *A-ONS could be taken to be fully satisfied. The only case in which we have seen it to be violated was in [ri:sə] for *Theresa*, which was claimed to be the product of a later stage, in which the ranking of *A-ONS and I-CONTIG-σ is reversed. However, this could equally be captured by eliminating *A-ONS from the grammar in this later stage. In this section, I present data that show that *A-ONS is in fact violated at the same time that it is determining the output of truncation—that it is not fully satisfied, but minimally violated. I then provide an account of these facts.

One example is Trevor's pronunciation of *giraffe* as [wæf] (1;9.1 ~ 1;11.14). This pronunciation occurs at the same time as *garage* as being produced as [ga:dʒ] (1;10.5 ~ 2;0.24).[22] In this case, the initial affricate [dʒ] in the target is itself a marked segment, for reasons independent of sonority. A nearby demonstration of its markedness is that [dʒ] surfaces as [d] in most of Julia's pronunciations of *giraffe*. Rather than alter the segment, Trevor deletes it and retains the approximant. Thus, the markedness of affricates is overriding the dispreference for approximants. The importance of this example to the current discussion is that even in the same context in which an approximant onset is generally discriminated against by replacing it with an obstruent, under certain circumstances it surfaces.

Approximant onsets can also appear in this position when the initial syllable provides no onset. For example, *eleven* surfaces as [jɛbən] (Julia, 1;9.15), and *around* as [wau:n] (Trevor, 2;0.8), which can be contrasted with *delicious* as [dɪʃəs] (Julia, 1;11.27), and *garage* as [ga:dʒ] (Trevor, 1;10.5 ~ 2;0.24). Here again, the fact that approximants are permitted in the same position from which they are eliminated when there is an available obstruent clearly shows that *A-ONS is not fully satisfied.

[22] As a reviewer pointed out, this discussion leaves unanswered the question of why [dʒ] does surface in [ga:dʒ] *garage*. One possibility is that there is a Faithfulness constraint against moving a segment from onset to coda position, as would be required in the hypothetical Output [ga:w].

TABLE 4
'σσσ Versus 'σσ Targets

				pillow	[pɪwo]	1;7.17 ~ 3;0.22
Julia	*broccoli*	[baki]	1;7.6 ~ 2;0.19	*yellow*	[jɛwo]	1;8.27 ~ 2;10.16
	buffalo	[bʌfo]	2;0.14 ~ 2;3.9	*carrot*	[kɛr/wɪt]	1;9.18 ~ 1;10.10
	favorite	[fevət]	2;0.25 ~ 2;6.1		[kɛrɪt]	1;11.14 ~ 2;5.8
				berry	[bɛri]/[bɛwi]	1;4.23 ~ 2;5.4
Trevor	*camera*	[kæ:mə]	1;5.6 ~ 1;11.25	*yellow*	[jɛ:wow]	1;8.6 ~ 1;8.7
	dungarees	[gʌŋgi:z]	1;10.1		[jɛ:jo]	1;8.11 ~ 2;0.3
	spatula	[bæ:tʃʌ]	1;11.23	*pillow*	[pɪwo]	1;5.19 ~ 2;6.1
Sean	*camera*	[kæmʌ]	2;0.13	*carry*	[kɛri]	2;0.23 ~ 3;0.17

Returning to medial truncation, we can adduce similar evidence by comparing the truncated forms in which approximants are deleted to bisyllabic targets with medial approximant onsets. Table 4 shows the result of that comparison. In the bisyllables on the right-hand side of the table, we see that approximants occur in the very same position in which they are avoided in the truncated productions on the left.

These examples are analogous to ones that Gnanadesikan (1995) introduced in her discussion of onset reduction. In the stage that Gnanadesikan described, when the target word supplies a single high sonority onset, it is represented faithfully in the child's production. It is only when the Input contains a cluster that the effects of the constraints demanding low sonority onsets are observed, in the selection of the least sonorous of the members of the cluster. This provides one of the instances of minimal constraint violation in the child language data that Gnanadesikan used to argue for an approach to acquisition based on Optimality Theory.[23] She showed that the facts can be straightforwardly captured with outranked structural constraints, but cannot be dealt with in a principled fashion under the assumptions of fully satisfied constraints or ordered rules. The analysis to follow draws heavily on Gnanadesikan's account.

The first question I address is, what permits the violations of *A-ONS in the nontruncated forms? In the truncation examples, the liquid is deleted. This means that MAXI-O, stated as "every Input segment has a Correspondent in the Output,"

[23]Instead of "minimal violation," Gnanadesikan used the term "emergence of the unmarked," following McCarthy and Prince (1994a). The emergence of the unmarked refers to a scenario in which a language generally permits a marked structure, but the unmarked counterpart emerges in a particular environment in which the constraint forcing the appearance of the marked structure (usually a Faithfulness constraint) fails to apply. The emergence of the unmarked is one subset of the broader range of cases we can describe as instances of minimal violation, which would also encompass the "emergence of the marked," where a language generally respects a structural constraint, except in a particular context (see, e.g., McCarthy (in press) on Rotuman syllable structure). The other case of the emergence of the unmarked, which Gnanadesikan discussed in more depth, is an Obligatory Contour Principle restriction that applies only when there is a choice of onsets.

must be dominated. In section 2.1, we saw that MAXI-O must be ranked below the constraints enforcing the one foot maximum, because if it were ranked above them, truncation would be blocked. Also dominating MAXI-O is the constraint *COMPLEX ("No complex onsets"; Prince and Smolensky (1993)), which rules out a candidate in which the obstruent and the liquid form a single complex onset, as in [bʌfwo] for *buffalo*.[24] This type of Output does occur following the stage in which liquids are deleted, as in Julia's [plis] for *police* at 2;6.5, which would indicate the promotion of MAXI-O above *COMPLEX. In the following illustrative tableau, FTBIN, ALIGNLEFT, and PARSE-σ are merged into a single WORDSIZE constraint.

(27) WORDSIZE, *COMPLEX >> MAXI-O

Input: buffalo	WORDSIZE	*COMPLEX	MAXI-O
a. [bʌfo] ✔			**
b. [bʌfwo]		*!	*
c. [bʌfəwo]	*!		

In the case of a bisyllable with a single intervocalic consonant, neither the word size constraints nor *COMPLEX apply. Therefore, so long as MAXI-O is ranked above *A-ONS, it will choose the candidate without deletion:[25]

(28) MAXI-O >> *A-ONS

Input: *yellow*	WORD SIZE	*COMPLEX	MAX I-O	*A-ONS
a. [jɛwo] ✔				*!
b. [jɛo]			*!	

[24]Such clusters could also be heterosyllabic, in which case a constraint other than *COMPLEX would be at work.

[25]A constraint demanding syllables with onsets (e.g., Prince and Smolensky's (1993) ONSET constraint) also favors this result and could be invoked in addition to, or instead of, MAXI-O to derive it. As Heather Goad (personal communication) pointed out, this would yield another case of minimal violation in development: ONSET is often fully satisfied at the outset of development, with epenthesis or reduplication filling empty onsets (see, e.g., Fikkert (1994)). At the stage(s) we are concerned with here, word-initial vowels are tolerated, in violation of the constraint.

This tableau shows that when the higher ranked constraints are satisfied by a faithful parsing, MAXI-O overrules the lower ranked onset markedness constraints. However, when the WORDSIZE constraints and *COMPLEX force violations of MAXI-O, the onset markedness constraint is given the opportunity to select the less marked onset:

(29) Activity of *A-ONS under domination

Input: *buffalo*	WORD SIZE	*COMPLEX	MAX I-O	*A-ONS
a. [bʌfo] ✔			**	
b. [bʌfwo]		*!		*
c. [bʌfəwo]	*!			*
d. [bʌwo]			**	*!

The WORDSIZE constraint(s) and *COMPLEX each compel one violation of MAXI-O. Because (29a) and (29d) fare equally with respect to MAXI-O, evaluation is handed on to the lower ranked *A-ONS, which decides in favor of [bʌfo].

The other cases of minimal violation would be handled in a similar fashion. For the examples in which an approximant occurs in word initial position when the target does not supply an initial obstruent (e.g., *eleven* as [jɛbən]), the constraint hierarchy we have already established would generate the correct results: [jɛbən] is chosen over [ɛbən] due to the dominance of MAXI-O over *A-ONS. For *giraffe* as [wæf], *A-ONS must be dominated by a constraint against [dʒ], as well as an IDENTITY constraint that militates against changing the affricate to an obstruent (on the form of these constraints, see McCarthy and Prince (1995)). Note that IDENTITY is also needed in all of these cases to force the approximant to surface as such, rather than as an obstruent (see Fikkert (1994, 61–62) for examples in which target approximants do in fact become obstruents).

3.7. Comparison With Other Approaches

The most robust empirical finding in the area of onset selection is that when the medial syllable of 'σσσ target words or the initial of σ'σσ or σ'σ words is truncated, the onset of the deleted syllable usually replaces the onset of the following target syllable, when the latter is an approximant and the former is a nasal or an obstruent. This was claimed to be driven by the markedness of approximant onsets relative to that of nasals and obstruents.

Fikkert (1994, 240) sketched an analysis of initial syllable deletion facts in Dutch child language that is in some respects quite similar. She drew a parallel between the onset substitutions and the fact that, in her data, approximant onsets are in general late to emerge. This led her to claim that examples in which approximants are replaced in truncation "are context-free substitutions, governed by the child's onset template." A template, as traditionally conceived, must be fully satisfied, and its effects should generally be context free (although context sensitivity can of course be stipulated). However, we have seen that the replacement of approximants in the present data set is clearly context sensitive: Approximant onsets do occur when no better onset is made available in the Input. This context sensitivity argues against the assumption of inviolability underlying Fikkert's analysis. With minimally violable constraints, the fact that an unmarked onset is selected when possible, but that a marked onset is otherwise allowed, is straightforwardly captured.

The use of STRESS-FAITH and ANCHOR-RIGHTI-O produces an account of child truncation that in some respects mimics that of Echols and Newport (1992). Because the truncations of initially stressed trisyllables examined here overwhelmingly support the predictions of that model against the alternative presented in Gerken (1994), this can be considered a positive result. There are significant differences between the approach here and that of Echols and Newport, however. First, there is no reliance here on the assumption that the syllables are lost due to misperception of the adult target. Most of the criticisms of this assumption that have emerged in the literature are based on the facts that the weak syllable is usually variably present in children's productions and that material from the unstressed syllable is preserved (see Fikkert (1994), Gerken (1994), Wijnen et al. (1994), but see also Paradis, Petitclerc, and Genesee (1996)). These observations suggest that the child perceives the unstressed syllable that is deleted in production, although Gerken (1994, 568) did show that these facts could be reasonably interpreted in a perception-based account.

A more important difference is that this analysis recognizes that there is more to truncation than simple retention of the stressed and rightmost syllables (see Fikkert (1994), Gerken (1994)). The claim here is that the forces motivating the retention of these syllables interact with well-formedness constraints—in particular, constraints that optimize syllabic structure. Crucially, these constraints are minimally violable, rather than fully satisfied. The insufficiency of fully satisfied constraints is clearly pointed to by the difficulties that the S(W) template model and the perceptual bias account have in dealing with the *elephant* data. In large part, the difficulties stem from the fact that these analyses are based on a categorical claim that the mapping from adult to child form must choose stressed and adjacent syllables, or stressed and rightmost ones. However, once restrictions on mapping are taken to be minimally violable, constraints demanding preservation of adjacent elements from the Input (i.e., CONTIGUITY) and constraints demanding preservation of edge elements (i.e., ANCHORING) can be played off against each other and against constraints demanding unmarked Output prosodic structures. The data and analyses supplied in this section illustrate some results of that interplay.

4. MINIMAL VIOLATION ACROSS DEVELOPMENT STAGES

The consequences of the novel view of child language, and especially of development, that minimal violation affords have only begun to be explored, even within phonology let alone other areas, such as morphology or syntax. Working in the framework of Natural Phonology, which is in some important respects similar to the present one, Stampe (1969) claimed that there are three ways that a child overcomes natural processes: They can be suppressed, ordered, or limited (see further Edwards and Shriberg (1983, 109 ff.)). Suppression is equivalent to shutting off a constraint; here minimal violation offers nothing new. The effects of rule ordering do overlap in certain ways with the effects of constraint ranking, and it remains to be seen whether constraint ranking captures all that rule ordering does (see Gnanadesikan (1995) for child language evidence that the reverse is not true). To limit a process, Stampe (1969, 443) said, is "to limit the set of segments it applies to or the set of contexts it applies in." In the rule-based system of Natural Phonology, the limiting conditions are specific to each process and must be stipulated for each one. The same would be true in a theory of fully satisfied constraints; if a parameter is given intermediate settings between on and off, for instance, these intermediate settings must be stated separately for each parameter. It is here that minimal violation promises significant explanatory advances, as any constraint that serves to limit the effects of a lower ranked constraint can simultaneously outrank and limit any of a number of other constraints. And to the extent that limiting conditions are not specific to particular processes, but instead are of wider generality, the present framework will continue to find empirical support. In this section, I document a case in which the effects of the limiting constraints do in fact extend beyond the specific process in question. We see that the constraints on place Faithfulness that serve to limit the scope of consonant harmony also play a role in the cases of onset selection that are motivated by place of articulation differences between the segments.

4.1. The Consonant Harmony Constraint

Consonant harmony in child language refers to a process by which nonadjacent consonants assimilate in place or manner. Here, we are concerned exclusively with the assimilation of primary place features, the most prevalent and widely discussed form of child consonant harmony. Some examples from Trevor's corpus are presented in (30).

(30) a. [gɪgʊ] *tickle* (1;7.28) d. [piwi] *TV* (1;6.25)
b. [kʌŋ] *tongue* (1;7.28) e. [bop] *boat* (1;8.12)
c. [kog] *cold* (1;8.7) f. [gɪgu] *pickle* (1;9.2)

These examples show that consonant harmony can be regressive (30a,b,d,f) or progressive (30c,e), it can target coronals (30a,b,c,d,e) or noncoronals (30f), and it can be triggered by velars (30a,b,c,f) or labials (30d,e). They further demonstrate that the target and trigger can differ in manner (30b,d)[26] and that vowels with various place specifications can intervene (cf. Levelt (1994)).

Consonant harmony is rarely attested in a single child's corpus in the range of fashions illustrated in (30). It is usually limited in one or more ways: to regressive directionality (e.g., Cruttenden (1978), Smith (1973)), to coronal targets (Smith (1973), Stoel-Gammon and Stemberger (1994)), to velar triggers (Smith (1973)), or to consonants with an intervening homorganic vowel (Levelt (1994)). One consequence of constraint violability is that it is in principle possible to attribute different varieties of consonant harmony to a single motivating constraint, with the differences between them being captured by the ranking of that constraint with respect to others (cf. the discussion of "Color" harmony in Padgett (1995, 390)). Constraint violability also allows us to make formal use of the traditional idea that consonant harmony is itself a limited (or partial) form of the full reduplication that is so common in babbling and early speech (see, e.g., Goad (1993, 296), Jespersen (1922, 109)). It seems likely that for children at an early stage of development, there is an advantage to gestural repetition at some level of speech production (see Menn (1976), Vihman (1978)). I suggest that this preference for repeated gestures is incorporated in the child's grammar as the constraint REPEAT (see Yip (1995) for a broader formulation):[27]

(31) REPEAT
Successive consonants must agree in place specification.

The stipulation that the constraint applies specifically to the place specification of consonants is an expository simplification that could ultimately be replaced by the use of independent dominating constraints, so as to complete the connection with full reduplication. It should be emphasized that the exact nature of the constraint driving consonant harmony is to some extent independent of the line

[26]Because [voice] is difficult to accurately transcribe in child speech, examples in which the target and trigger differ in other features are more convincing of a manner difference between them.

[27]In section 5, however, it is suggested that REPEAT is in fact a child-specific constraint, because consonant harmony is a child specific. Yip (1995) used her version of REPEAT to drive morphological reduplication in adult languages. It would appear that under certain rankings, Yip's REPEAT does in fact yield childlike consonant harmony. Theories of reduplication have yet to take on the task of generating only the attested cases of "pre-specification" (see Alderete et al. (1996)), but not long distance consonant assimilation (see Gafos (1996)).

of argument here: What is crucial is how this constraint interacts with consonantal place Faithfulness (cf. Goad (1996b; in press), Levelt (1995), Stemberger (1995) for other approaches). It is to that area that we now proceed.

4.2. The Limitation of Consonant Harmony: The Data

Both Trevor and Sean display what may be referred to as velar dominant harmony, in that labials and coronals assimilate to velars. A full list of the words that undergo coronal-to-velar and labial-to-velar assimilation that I have extracted from Trevor and Sean's corpora are given in (32a,b) and (32c,d), respectively. Again, the ages at which the first and the last token of each form were produced are noted in parentheses, and the phonetic transcriptions abstract across some variation across tokens, mostly in vowel quality and the voice specification of consonants.

(32) a. Trevor's coronal-to-velar assimilation

[gɔg]	*dog*	(1;4.19 ~ 2;3.17)	[gʌk]	*duck*	(1;4.27 ~ 2;2.3)
[gʌŋgi:z]	*dungarees*	(1;10.1)	[gækɪt]	*jacket*	(1;4.19 ~ 1;10.11)
[kɪŋk]	*sink*	(1;7.6)	[gak]	*sock*	(1;5.25)
[gɪk]	*stick*	(1;7.26 ~ 1;8.14)	[kek]	*take*	(2;1.4 ~ 2;1.26)
[gægu]	*thank you*	(1;6.25 ~ 1;6.29)	[gɪgu]	*tickle*	(1;4.19 ~ 1;11.25)
[k(r)ʌk]	*truck*	(1;6.17 ~ 2;2.15)	[kʌŋ]	*tongue*	(1;4.19 ~ 1;7.25)
[kaʊg]	*cloud*	(1;8.27)	[kok]	*coat*	(1;5.18)
[kog]	*cold*	(1;6.29 ~ 1;9.2)	[rɛkɪk]	*record*	(1;7.20 ~ 2;0.8)
[gɛ:g]	*good*	(1;6.17 ~ 1;10.5)	[kɪkar]	*guitar*	(2;1.5 ~ 2;4.3)
[kɪk]	*kiss*	(1;5.18 ~ 1;7.20)			

b. Trevor's labial-to-velar assimilation

[gæk]	*back*	(1;9.1 ~ 1;11.2)	[ga(r)k]	*bark*	(1;8.14 ~ 1;10.9)
[gɪg]	*big*	(1;9.21 ~ 1;10.9)	[gaik]	*bike*	(1;5.4 ~ 1;10.11)
[gægi]	*blanket*	(1;3.1 ~ 1;6.25)	[gʊk]	*book*	(1;5.4 ~ 1;10.2)
[gak]	*box*	(1;5.25 ~ 1;9.24)	[gʌgɪt]	*bucket*	(1;7.20)
[gʌk+gu]	*buckle*	(1;8.12)	[gʌki]	*Bucky*	(1;6.25 ~ 1;8.2)
[gʌg]	*bug*	(1;5.13 ~ 1;8.2)	[gʌgi]	*buggy*	(1;6.17 ~ 1;10.11)
[kʌg]	*plug*	(1;6.17 ~ 1;10.2)	[gækʌm]	*vacuum*	(1;6.29 ~ 1;7.4)
[kʌk]	*cup*	(1;5.5 ~ 1;5.30)	[gak]	*Mark*	(1;5.13)
[kɪku]	*pickle*	(1;5.6 ~ 1;11.1)			

c. Sean's coronal-to-velar assimilation

[kɪkʌ]	*chicken*	(1;6.27)	[kʊko]	*circle*	(1;8.24 ~ 1;10.17)
[gɔgi]	*doggie*	(1;8.11 ~ 2;5.21)	[gwiŋk]	*drink*	(2;0.18 ~ 3;1.13)
[gʌk]	*duck*	(1;11.11 ~ 2;1.19)	[gækɪt]	*jacket*	(1;11.11 ~ 2;1.23)
[kwiŋ]	*string*	(1;10.6 ~ 2;2.13)	[gʌk]	*stuck*	(1;10.12 ~ 1;11.11)
[kek]	*take*	(2;2.22 ~ 3;2.19)	[kekiŋ]	*taking*	(2;9.11 ~ 3;1.0)
[kɔk]	*talk*	(2;0.18 ~ 2;5.14)	[kæŋk]	*thank*	(1;6.1 ~ 3;2.0)
[kɪkak]	*tick tock*	(1;6.22 ~ 2;1.11)	[kaigə]	*tiger*	(2;2.7)
[kʌŋ]	*tongue*	(1;10.10 ~ 2;9.20)	[krɪk]	*trick*	(2;11.17 ~ 3;0.20)
[k(r)ʌk]	*truck*	(1;9.17 ~ 3;0.8)	[kok]	*cold*	(1;10.29 ~ 1;11.6)
[gægi]	*glasses*	(1;4.2 ~ 1;4.6)	[kaik]	*kite*	(2;3.7)

d. Sean's labial-to-velar assimilation

[gʊk]	*book*	(1;9.21 ~ 1;10.8)	[gogɛn]	*broken*	(1;8.2 ~ 1;10.10)
[kok]	*fork*	(1;9.13 ~ 1;9.15)	[gauk]	*milk*	(1;9.15 ~ 1;11.11)
[gækɪk]	*vacuum*	(1;10.22)	[kaki]	*coffee*	(1;9.15 ~ 1;11.4)

A comparison of the ages at which the last token of each form is produced shows that the assimilation of coronals persisted longer than that of labials. Neither child produced a word displaying labial-to-velar assimilation after the 2-year mark, whereas both children produced examples of coronal-to-velar assimilation for some time thereafter, with Sean's harmony lasting until past the age of 3.

Particularly revealing in this respect is the development of the phrase *dog barking* in Trevor's corpus:

(33) *dog barking* through time

[gɔgarkɪŋ]	(1;8.14)
[gɔga:kɪŋ]	(1;9.1)
[gɔ:ga:kɪŋ]	(1;9.2)
[gɔ:ga:kɪŋ]	(1;9.23)
[gɔg ga:kɪŋ]	(1;9.29)
[gɔg ga:kɪŋ]	(1;10.9)
[gɔg ba:rkɪŋ]	(1;10.13)
[gɔg barkɪŋ]	(1;11.1)
[gɔg ba:rkɪŋ]	(1;11.5)

The initial labial of *barking* began to be produced at (1;10.13), whereas the coronal of *dog* continued to be assimilated to the velar. The unassimilated version of *dog* first appears at 2;1,[28] with free variation between it and [gɔg] lasting until 2;3.17.

To further illustrate the earlier disappearance of labial-to-velar assimilation, I provide in (34) a set of near minimal pairs of velar-harmonizing words with labial and coronal initial consonants that were recorded for Trevor at approximately the ages of 1;9 and 2;0.

(34)

a.	[gʌk]	*duck*	(1;9.1)				[gɔg]	*dog*	(1;8.7)
b.	[gʌg]	*bug*	(1;8.2)	[kʌg]	*plug*	(1;9.27)	[gak]	*box*	(1;9.1)
c.	[gʌk]	*duck*	(2;0.3)				[gɔg]	*dog*	(2;0.3)
d.	[bʌg]	*bug*	(1;11.9)	[pʌg]	*plug*	(1;11.1)	[bɔks]	*box*	(1;11.5)

[28]There is in fact one instance of [dɔg] at 1;4.23, which was noted to have been said twice that day. This contrasts with 4 occurrences of [gɔg] on the same day, 6 in preceding days, and at least 50 before the next instance of [dɔg] at 2;1.0.

At 1;9, the coronals (34a) and labials (34b) equally underwent velar harmony. At 2;0, the coronals continued to be targeted (34c), whereas the labials had already ceased to harmonize at the beginning of the previous month (34d).

To show that the examples in (34) are indicative of a larger trend in Trevor's data, and to ease any possible worries that the earlier disappearance of labial harmony in (32) is due to an accidental gap in the corpus (i.e., that the target words containing labials simply ceased to occur), Table 5 provides an exhaustive listing of the target words containing combinations of coronals and velars, and labials with velars that occur during two 1-month periods: from the beginning to the end of 1;9 and 2;0. Alongside each word are listed the numbers of harmonized (+H) and nonharmonized (–H) versions of each word, along with the percentage of harmonized forms (H%). These figures are also given for each word type. At 1;9, regressive coronal-to-velar assimilation is extremely productive. Target words in which a coronal precedes a velar (called Coronal/Velar targets in the table) are subject to harmony in every one of Trevor's productions recorded during this month. Labial-to-velar assimilation, however, has already begun to recede; Trevor's mother notes that the first instance of nonassimilated [pʌg] for *plug* occurs during this month. By 2;0, labial/velar targets are completely immune to the effects of harmony, whereas coronal-to-velar assimilation is still fairly frequent. Before turning to the analysis of this developmental change in the application of harmony, I briefly comment on two other important aspects of the data, which for reasons of scope and space cannot receive a thorough treatment here.

The first aspect is the fact that consonant harmony does not apply wholly consistently, except for the coronal/velar targets at 1;9. The change in these forms at 2;0 nicely illustrates what seems to be general fact about phonological development; intermediate between the application and nonapplication of a process, there is a stage in which it applies optionally.[29] It should be stressed that this variation is not merely the product of sampling data from two stages that happen to fall within the 1-month period, as assimilated and nonassimilated versions of the same word alternate across time. Within Optimality Theory, the usual analytic move for coping with variation both in child phonology (e.g., Curtin (1997) and Demuth (1995; 1997)) and phonological theory (e.g., Antilla (in press), Kiparsky (1993), and Reynolds (1994)) is to allow a certain set of constraints to vary freely in their ranking. In this particular instance, REPEAT would dominate the Faithfulness constraint FAITH(COR) at 1;9 (see the next subsection), become freely ranked with it by 2;0, and then be dominated by it at later stages.

It is also significant that progressive assimilation occurs at a much lower frequency than regressive. For instance, at 1;9, in only 35.3% of the instances

[29]Interestingly, the same pattern can be seen in prosodic data from these time periods. At 1;9 the one foot maximum appears to be absolute, whereas at 2;0 there are both truncated and nontruncated versions of words.

TABLE 5
Possible Harmony Targets From Trevor's Corpus

Age	*Target*	*+H*	*–H*	*H%*
1;9	Coronal/Velar			
	dog	6	0	100.0
	duck	5	0	100.0
	tickle	1	0	100.0
	truck	8	0	100.0
	Total	20	0	100.0
	Velar/Coronal			
	candy	0	4	0.0
	cat	0	1	0.0
	clouds	0	2	0.0
	cold	3	1	75.0
	good	2	2	50.0
	green	0	1	0.0
	record	1	0	100.0
	Total	6	11	35.3
	Labial/Velar			
	back	9	5	64.3
	bark(ing)	6	0	100.0
	big	2	9	18.2
	block	0	1	0.0
	book	3	0	100.0
	box	2	0	100.0
	buckle	0	3	0.0
	buggy	2	0	100.0
	pack	1	0	100.0
	park	2	0	100.0
	pickle	2	0	100.0
	pig	0	1	0.0
	plug	2	2	50.0
	Total	31	21	59.6
	Velar/Labial			
	camel	0	1	0.0
	coffee	0	2	0.0
	come	0	2	0.0
	covers	0	4	0.0
	cup	0	1	0.0
	gum	0	1	0.0
	Total	0	10	0.0
2;0	Coronal/Velar			
	truck	9	9	50.0
	dog	4	0	100.0
	duck	1	0	100.0
	Total	14	9	60.9

(Continued)

TABLE 5
(Continued)

Age	*Target*	*+H*	*–H*	*H%*
	Velar/Coronal			
	good	0	1	0.0
	cold	0	3	0.0
	record	2	1	66.7
	cat	0	1	0.0
	kitty	0	1	50.0
	Total	2	7	22.2
	Labial/Velar			
	Berkeley	0	2	0.0
	back	0	7	0.0
	bag	0	1	0.0
	big	0	2	0.0
	bike	0	8	0.0
	book	0	1	0.0
	broken	0	1	0.0
	bug	0	1	0.0
	buggy	0	2	0.0
	plug	0	1	0.0
	pocket	0	1	0.0
	Total	0	27	0.0
	Velar/Labial			
	camera	0	2	0.0
	com(ing)	0	6	0.0
	cough	0	1	0.0
	cup	0	1	0.0
	Total	0	10	0.0

in which a velar precedes a coronal does assimilation occur, compared with the 100% for coronal/velar words.[30] This directional asymmetry is also evident in comparisons of the relative incidence of harmony between coronal/velar and velar/coronal targets at 2;0, and between velar/labial and labial/velar targets at both ages. At first glance, this may suggest that the effects of REPEAT should be separated into two separate constraints, demanding regressive and progressive assimilation, respectively. However, as mentioned in the previous section, in principle it should be possible to derive this asymmetry from the interaction of a single harmony constraint with an independent constraint that blocks progressive assimilation, the exact nature of which I must leave open for future research. In

[30]It is important to note that another pattern of assimilation occurred for some of these words, which is not represented in this table. Velar/coronal targets with a front vowel intervening between the consonants are often subject to regressive coronal harmony (e.g., [tɪs] for *kiss*, [tæt] for *cat*). Even including these cases as instances of harmony, the percentage of harmonized forms for velar/coronal targets remains relatively low, at 50% at both 1;9 and 2;0.

the next section, we turn to the analogous example of how the limitation of harmony to coronal targets can be achieved through constraint ranking.

4.3. Repeat and Faithfulness

The data presented in the previous subsection indicate that there are two stages in Sean's and Trevor's consonant harmony data: In the first, both labials and coronals assimilate to velars, and in the second, only coronals assimilate. To account for these patterns, we must invoke along with REPEAT a set of constraints that control the relation between the place specifications of Input and Output consonants. For present purposes, we can refer to them as FAITH(LAB), FAITH(DOR), and FAITH(COR): labial, dorsal (i.e., velar), and coronal Faithfulness, respectively. They could be conceived of either as MAX constraints that target individual features, demanding that Input features have Output correspondents, or as featural Identity constraints that require segments in Correspondence to bear identical place specifications. The choice between the two is of no particular consequence here (see Alderete et al. (1996), Lombardi (1995), McCarthy (in press), and Pater (in press) for discussion of differences between the two approaches).

In the first stage, in which the labials and coronals assimilate to the velars, REPEAT is fully satisfied.[31] When an Input word consists of segments that have different places of articulation, one of the segments is always altered. To determine which one, the place Faithfulness constraints come into play. For the words with coronal-to-velar assimilation, both REPEAT and FAITHDOR must dominate FAITHCOR. This ranking is illustrated in (35):

(35) FAITH(DOR), REPEAT >> FAITH(COR)

Input: *duck*	FAITH(DOR)	REPEAT	FAITH(COR)
a. [dʌk]		*!	
b. [dʌt]	*!		
c. [gʌk] ✔			*

In the absence of any assimilation, REPEAT is violated (35a). With velar-to-coronal assimilation, FAITH(DOR) is violated (35b). If both of these constraints dominate FAITH(COR), the alternative of assimilating the coronal (35c) is chosen as optimal, as it violates only the outranked constraint. Note that we must also assume a

[31]A caveat here is that this abstracts from some lexical exceptionality, as well as the effects of directionality: Labial-to-velar assimilation is much less robust when the velar precedes the labial.

dominant MAX constraint to block deletion. As this constraint is unviolated and common to all the tableaux, I have left it out.

For the instances of labial-to-velar assimilation, the same sort of ranking is involved, with FAITH(LAB) replacing FAITH(COR):

(36) FAITH(DOR), REPEAT >> FAITH(LAB)

Input: *bug*	FAITH(DOR)	REPEAT	FAITH(LAB)
a. [bʌg]		*!	
b. [bʌb]	*!		
c. [gʌg] ✔			*

Here labial faithfulness is sacrificed (36c) so as to satisfy the higher ranked FAITH(DOR) and REPEAT.

Combining these rankings produces the hierarchy in (37).

(37) FAITH(DOR), REPEAT >> FAITH(LAB), FAITH(COR)

We have no evidence for a ranking between FAITH(DOR) and REPEAT, as both are fully satisfied in the data under consideration. We also have not seen anything that would fix the ranking between FAITH(LAB) and FAITH(COR). The dominance of FAITH(LAB) over FAITH(COR) could be established empirically in the present data set by looking at instances in which a labial and a coronal occur in a word. In both Trevor's and Sean's corpora, these words go through a stage in which the coronal assimilates to the labial (e.g., Trevor's [piwi] *TV* and [bop] *boat*). This would be generated by the ranking REPEAT, FAITH(LAB) >> FAITH(COR).

However, motivation for the FAITHLAB >> FAITHCOR ranking goes far beyond the labial harmony data. It seems to be a universal of child consonant harmony systems that coronals are always included as targets; no process targets labials or velars, to the exclusion of coronals, whereas coronals are quite commonly picked out as the sole targets (see Smith (1973), Stoel-Gammon and Stemberger (1994)). This is parallel to what has been observed of place assimilation between adjacent consonants in the languages of the world. As Mohanan (1993, 76) put it, if noncoronals undergo assimilation, so do coronals (see further Jun (1995); see also Avery and Rice (1989) and Rice (1994) for a feature geometric approach to the facts).

The implicational relation between noncoronal and coronal targets can be captured if the dominance of FAITH(DOR) and FAITH(LAB) over FAITH(COR) is universally fixed (Kiparsky (1994); cf. Gnanadesikan (1995) and Jun (1995) for slightly different proposals). With this fixed ranking, any time that REPEAT compels the assimilation of labials or velars by being ranked above FAITH(DOR) or FAITH(LAB), it will necessarily cause coronals to assimilate. For example, whenever the ranking REPEAT, FAITH(DOR) >> FAITH(LAB) motivates labial assimilation, as in tableau (36), it will also lead to coronal assimilation, as this ranking, combined with the universal FAITH(LAB) >> FAITH(COR), will create the hierarchy REPEAT, FAITH(DOR) >> FAITH(LAB) >> FAITH(COR). Included in this full hierarchy is the ranking REPEAT, FAITH(DOR) >> FAITH(COR), which, as demonstrated in tableau (35), assimilates coronals to velars.

The hierarchy for the first stage of Trevor's and Sean's consonant harmony now stands as in (38).

(38) REPEAT, FAITH(DOR) >> FAITH(LAB) >> FAITH(COR)

In the second stage, the labials stop assimilating to the velars, whereas the coronals continue to undergo harmony. This pattern is produced by the ranking of FAITH(DOR) and FAITH(LAB) above REPEAT, with only FAITH(COR) below. Tableau (39) shows the blocking of assimilation that this ranking generates.

(39) FAITH(DOR), FAITH(LAB) >> REPEAT >> FAITH(COR)

Input: *bug*	FAITH(DOR)	FAITH(LAB)	REPEAT	FAITH(COR)
a. [bʌg] ✔			*	
b. [bʌb]	*!			
c. [gʌg]		*!		

Both FAITH(DOR) and FAITH(LAB) are crucially ranked above REPEAT, so as to block labial-to-velar (39c) and velar-to-labial assimilation (39b).

With FAITH(COR) dominated by REPEAT and FAITH(DOR), coronal-to-velar assimilation still occurs:

(40) FAITH(DOR), FAITH(LAB) >> REPEAT >> FAITH(COR)

Input: *duck*	FAITH(DOR)	FAITH(LAB)	REPEAT	FAITH(COR)
a. [gʌk] ✔				*
b. [dʌk]			*!	
c. [dʌt]	*!			

The pattern of development is thus characterized as the outranking of REPEAT by place Faithfulness constraints. In the first stage REPEAT is dominant, and fully satisfied, in the second it is dominated, and minimally violated. Of importance, with the fixed ranking of FAITH(COR) beneath FAITH(LAB), it is predicted that the reverse developmental scenario, in which coronals are the first to stop assimilating, should be impossible. It should be noted because the ranking between FAITH(DOR) and FAITH(LAB) is not universally fixed (cf. Gnanadesikan (1995), Jun (1995)); either labials or velars can dominate the other in assimilation. This seems consistent with the known child language facts (for evidence of velar-to-labial assimilation, see Cruttenden (1978), Gnanadesikan (1995, footnote 22), and Macken (1995, 679)). Labial-to-velar assimilation is reported in Menn (1976), as well as in the present study.[32] In the domain of adult phonology, only labial-to-velar assimilation is attested, but because the targets in the adult cases are codas, this may be due to the general preference for velar codas (see Jun (1995), cf. Rice (1994)).

4.4. Place Faithfulness in Truncation

In this section I demonstrate that the constraints that limit the effects of REPEAT can be seen to play a role in determining the output of truncation. Recall that Trevor produced *caboose* as [gu:s] from 2;4.24 to 2;11.17, and *guitar* as [ga] or [ga:r] from 1;1.19 ~ 2;1.5. In these cases of onset selection, it is the place specification of the consonants, rather than their sonority, that is of import. Somewhat similar cases are reported in Smith (1973) and Fikkert (1994). However, in those data, coronals are the only segments to be replaced; as far as I know, [gu:s] for *caboose* is the first attested instance in which a velar is chosen from initial position to replace a labial. Undoubtedly, the uniqueness of this instance of onset selection is related to the unusualness of Trevor's labial-to-velar consonant assimilation: The survey in Stoel-Gammon and Stemberger (1994) noted only 5 children who displayed this type of harmony, as opposed to 19 who had coronal-to-velar assimilation.

The connection between these two processes falls out directly from the previous analysis of consonant harmony. For the consonant harmony pattern we made crucial use of a ranking between FAITH(DOR) and FAITH(LAB); this same ranking chooses [gu:s] over [bu:s] in the case of truncation:[33]

---

[32]Stoel-Gammon and Stemberger (1994) cited five instances of labial-to-velar assimilation, and nine cases of velar-to-labial assimilation. Because no information is given on individual children's patterns, and the source of the data for each of these cases is not mentioned, it is impossible to know whether some, or all, of the instances of apparent velar-to-labial assimilation are in fact accompanied by the total absence of velars in the child's data at the relevant stage, as in Donahue (1986).

[33]If the Faithfulness constraints are conceived of as Featural Identity constraints, we must also assume that this apparent case of deletion is in fact fusion. If the velar is deleted in (42a), for instance, no violation of FAITHDOR would be incurred, as Featural Identity only applies to segments in Correspondence, and a deleted Input segment lacks an Output correspondent. This problem is avoided if the Output onset is in fact in Correspondence with both Input onsets, so that the choice between the place features can be made by the Identity constraints (see Gnanadesikan (1995) for discussion).

(41) Faith(Dor) >> Faith(Lab)

Input: *caboose*	Faith(Dor)	Faith(Lab)
a. [gu:s] ✔		*
b. [bu:s]	*!	

It is quite interesting that the effects of the ranking of Faith(Dor) over Faith(Lab) are seen at this late a date in Trevor's development. Labial-to-velar assimilation dies out before age 2, even though this truncation pattern is attested from 2;4.24 to 2;11.17. Thus, the high ranking of Faith(Dor) persists across developmental stages, even though its effects change due to the reranking of other constraints (in particular, Faith(Lab) over Repeat, which blocks labial-to-velar assimilation).

To get this result, we must also assume that Faith(Dor) dominates I-Contig-σ, as I-Contig-σ would prefer to preserve the labial. This is straightforward, so I do not provide a tableau (see section 3.4 for relevant discussion). However, as we now have an intersection between the set of constraints invoked in the discussion of truncation and those employed in the analysis of consonant harmony, it is useful to examine a tree diagram summarizing the established rankings, so as to make sure that there are no ranking paradoxes.

(42) Summary of rankings

```
                         AlignLeft, Parse-σ, FtBin, *Complex
                                          |
                                        MaxI-O
                                          |
                                       *A-Ons
                                          |
StressFaith, Anchor-RightI-O          *N-Ons      Faith(Dor)
                              \           |       /         |
                                    I-Contig-σ      Faith(Lab)
                                          |                 |
                                       *F-Ons           Repeat
                                                            |
                                                      Faith(Cor)
```

Dominance in the tree indicates dominance in ranking. The rankings depicted here are those motivated on the basis of Trevor's data at about age 2;0, abstracting from variation such as that noted in section 4.2, and from the uncertainty with regard to the ranking between *N-Ons and I-Contig-σ that arises due to the lack of relevant forms (see section 3.1).

5. CONCLUSIONS

In this article, we have examined several cases that provide support for the position that when child language constraints are overcome, they are outranked, not shut off. In the domain of foot and word-level prosodic structure, constraints that serve to limit child words to a single foot were shown to play a role in the adult English stress system. In the adult system, these constraints are neither inviolable as they are in the child system nor freely violable as they would be if they were turned off. Instead, they are minimally violable, asserting themselves whenever they are not fettered by the restrictions of higher ranked constraints. In the domain of syllable structure, a constraint on onset markedness was shown to be minimally violable in the child system itself; it plays a crucial role in determining the output of truncation, yet in other cases it is violated. Finally, at the level of the segment, explicit evidence of the developmental process of constraint outranking was provided: A constraint causing consonant harmony is first unviolated, assimilating both coronals and labials to velars, and later minimally violated, assimilating only coronals.

Besides providing evidence for a view of development as constraint reranking, these cases demonstrate the fruitfulness of the view of markedness as constraint violation. As opposed to parochial theories of markedness that apply only to particular subdomains within phonology (e.g., underspecification for segmental phonology, unmarked parameter settings for syllable structure), markedness in Optimality Theory is domain independent. The generality of this approach to markedness allows phenomena beyond the reach of traditional markedness theories, such as the word size maximum, to be formally treated as instances of the broad unmarkedness of child language. Given the wide scope of the framework, further progress along these lines appears readily achievable.

Some puzzles do remain to be addressed, of course. Chief among them is the fact that although consonant harmony is extremely common in child language, it is unattested in this form in adult languages, where primary place assimilation applies only locally, not across intervening vowels (see, e.g., Shaw (1991)). Drachman (1976) pointed to this and other disparities between the domains of child and adult phonology in a challenge to Stampe's (1969) claims that the two areas are subject to the same set of natural processes and, in particular, that it is the application of natural processes in child language that is responsible for much of historical sound change (see also Vihman (1980)). Putting the issue of the locus of sound change to the side, the problems that Drachman raised for the theory of Natural Phonology continue to apply equally to almost any approach in which phonological theory is applied to child phonology, including the present one (see Macken (1995) for relevant discussion).

By following Jespersen (1922) and drawing a connection between consonant harmony and early child reduplication, the position here is that the constraint REPEAT is constructed by the child in response to the pressures imposed by the developing production system, which entails that at least some constraints of child phonology are inductively learned, rather than innately given (see Menn (1976) and Vihman (1978) on consonant harmony and Stampean innateness, Kiparsky and Menn (1977, 75) for a stance on the relation between adult and child phonology similar to the one taken here, and Hayes (in press) for other motivations for constraint induction). To explain the child–adult asymmetry, it would also have to be the case that Repeat and other constraints like it are eliminated from the grammar, because if they were simply low ranked, it would be predicted by Factorial Typology (Prince and Smolensky (1993)) that some languages would show their effects in "emergence of the unmarked" scenarios (McCarthy and Prince (1994a)). Clearly, the introduction of child-specific constraints has implications for learnability theory that cannot be taken lightly. Not only would constraint reranking have to be shown to be computationally tractable (see, e.g., Pulleyblank and Turkel (1996), Tesar and Smolensky (in press), Turkel (1994)), but an account would also have to be given of constraint genesis and of constraint extinction. This is a considerable task, but one that appears worth undertaking, as it has the potential to contribute to a sufficiently restrictive theory of adult phonology and to an explicit depiction of the relation between developing and mature sound systems.

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REFERENCES[34]

Alderete, J. (1995) "Faithfulness to Prosodic Heads," ms., University of Massachusetts, Amherst. [ROA-94]

[34]Papers cited as [ROA-XX] can be downloaded from the Rutgers Optimality Archive at http://ruccs.rutgers.edu/roa.html or ftp://ruccs.rutgers.edu/pub/OT/TEXTS/archive/

Alderete, J., J. Beckman, L. Benua, A. Gnanadesikan, J. McCarthy, and S. Urbanczyk (1996) "Reduplication and Segmental Unmarkedness," ms., University of Massachusetts, Amherst. [ROA-134]

Allen, G. and S. Hawkins (1978) "The Development of Phonological Rhythm," in A. Bell and J. Hooper, eds., *Syllables and Segments*, Elsevier-North-Holland, New York.

Antilla, A. (in press) "Deriving Variation From Grammar," in F. Hinskens, R. van Hout, and L. Wetzels, eds., *Variation, Change and Phonological Theory*, John Benjamins, Amsterdam, The Netherlands.

Archibald, J. (1995) "The Acquisition of Stress," in J. Archibald, ed., *Phonological Acquisition and Phonological Theory*, Lawrence Erlbaum Associates, Inc., Hillsdale, New Jersey.

Austin, P. (1981) *A Grammar of Diyari, South Australia*, Cambridge University Press, Cambridge, England.

Avery, P. and K. Rice (1989) "Segment Structure and Coronal Underspecification," *Phonology* 6, 179–200.

Barlow, J. (1996) "The Development of On-Glides in American English," in A. Stringfellow, A. D. Cahana-Amitay, E. Hughes, and A. Zukowski, eds., *Proceedings of the 20th Annual Boston University Conference on Language Development*, Cascadilla Press, Somerville, Massachusetts. [ROA-111]

Barlow, J. (1997) *A Constraint-Based Account of Syllable Onsets: Evidence From Developing Systems*, Doctoral dissertation, Indiana University, Bloomington, Indiana.

Beckman, J. (1995) "Shona Height Harmony: Markedness and Positional Identity," in J. Beckman, L. Walsh, and S. Urbanczyk, eds., *Papers in Optimality Theory: University of Massachusetts Occasional Papers* 18, 53–74, GLSA, University of Massachusetts, Amherst.

Benua, L. (1995) "Identity Effects in Morphological Truncation," in J. Beckman, L. Walsh, and S. Urbanczyk, eds., *Papers in Optimality Theory: University of Massachusetts Occasional Papers* 18, GLSA, University of Massachusetts, Amherst. [ROA-74]

Blevins, J. (1995) "The Syllable in Phonological Theory," in J. Goldsmith, ed., *A Handbook of Phonological Theory*, Blackwell, Cambridge, Massachusetts.

Burzio, L. (1994) *Principles of English Stress*, Cambridge University Press, Cambridge, England.

Clements, G. N. (1990) "The Role of the Sonority Cycle in Core Syllabification," in J. Kingston and M. Beckman, eds., *Papers in Laboratory Phonology 1: Between the Grammar and Physics of Speech*, Cambridge University Press, New York.

Clements, G. N. and Keyser, S. J. (1983) *CV Phonology: A Generative Theory of the Syllable*, MIT Press, Cambridge, Massachusetts.

Compton, A. J. and M. Streeter (1977) "Child Phonology: Data Collection and Preliminary Analyses," in *Papers and Reports on Child Language Development* 7, Stanford University, Stanford, California.

Cruttenden, A. (1978) "Assimilation in Child Language and Elsewhere," *Journal of Child Language* 5, 373–378.

Curtin, S. (1997) "The Acquisition of Stress in Dutch: An OT Account," ms., University of Southern California, Los Angeles.

Demuth, K. (1995) "Markedness and the Development of Prosodic Structure," in J. Beckman, ed., *Proceedings of the North East Linguistics Society* 25, GLSA, University of Massachusetts, Amherst. [ROA-50]

Demuth, K. (1996) "Alignment, Stress, and Parsing in Early Phonological Words," in B. Bernhardt, J. Gilbert, and D. Ingram, eds., *Proceedings of the UBC International Conference on Phonological Acquisition*, Cascadilla Press, Somerville, Massachusetts.

Demuth, K. (1997) "Multiple Optimal Outputs in Acquisition," paper presented at the Johns Hopkins Optimality Workshop/Maryland Mayfest, Baltimore.

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

Dinnsen, D., J. Barlow, and M. Morrisette (1996) "Long-Distance Place Assimilation With an Interacting Error Pattern in Phonological Acquisition," ms., Indiana University, Bloomington, Indiana.

Donahue, M. (1986) "Phonological Constraints on the Emergence of Two-Word Utterances," *Journal of Child Language* 13, 209–218.

Drachman, G. (1976) "Child Language and Language Change: A Conjecture and Some Refutations," in J. Fisiak, ed., *Recent Developments in Historical Phonology*, Mouton, The Hague, The Netherlands.

Dresher, B. E. and J. Kaye (1990) "A Computational Learning Model for Metrical Phonology," *Cognition* 34, 137–195.

Echols, C. and E. Newport (1992) "The Role of Stress and Position in Determining First Words," *Language Acquisition* 2, 189–220.

Edwards, M. L. and L. Shriberg (1983) *Phonology: Applications in Communication Disorders*, College-Hill Press, San Diego, California.

Fee, J. (1992) "Exploring the Minimal Word in Early Phonological Acquisition," *Proceedings of the 1992 Annual Conference of the Canadian Linguistic Association*, Toronto Working Papers in Linguistics, Toronto, Canada.

Fee, J. (1995) "Segments and Syllables in Early Language Acquisition," in J. Archibald, ed., *Phonological Acquisition and Phonological Theory*, Lawrence Erlbaum Associates, Inc., Hillsdale, New Jersey.

Ferguson, C., D. Peizer, and T. Weeks (1973) "Model-and-Replica Phonological Grammar of a Child's First Words," *Lingua* 31, 35–65.

Fikkert, P. (1994) *On the Acquisition of Prosodic Structure*, Doctoral dissertation, Holland Institute of Generative Linguistics, Leiden University, Leiden, The Netherlands.

Gafos, A. (1996) "On the Proper Characterization of 'Nonconcatenative' Languages," ms., Johns Hopkins University, Baltimore, Maryland. [ROA-106]

Gerken, L. (1994) "A Metrical Template Account of Children's Weak Syllable Omissions From Multisyllabic Words," *Journal of Child Language* 21, 564–584.

Gnanadesikan, A. (1995) "Markedness and Faithfulness Constraints in Child Phonology," ms., University of Massachusetts, Amherst. [ROA-67]

Gnanadesikan, A. (1996) "Child Phonology in Optimality Theory: Ranking Markedness and Faithfulness Constraints," in A. Stringfellow, A. D. Cahana-Amitay, E. Hughes, and A. Zukowski, eds., *Proceedings of the 20th Annual Boston University Conference on Language Development*, Cascadilla Press, Somerville, Massachusetts.

Goad, H. (1993) *On the Configuration of Height Features*, Doctoral dissertation, University of Southern California, Los Angeles.

Goad, H. (1996a) "Codas, Word Minimality, and Empty-Headed Syllables," in *Proceedings of the 28th Annual Child Language Research Forum*, Stanford University, Stanford, California.

Goad, H. (1996b) "Coronals Are Not Underspecified," in *Proceedings of the West Coast Conference on Formal Linguistics*, CSLI Publications, Stanford University, Stanford, California.

Goad, H. (in press) "Consonant Harmony in Child Language: An Optimality-Theoretic Account," in S.-J. Hannahs and M. Young-Scholten, eds., *Generative Studies in the Acquisition of Phonology*, John Benjamins, Amsterdam, The Netherlands. [ROA-213]

Hale, M. and C. Reiss (in press) "Formal and Empirical Arguments Concerning Phonological Acquisition," *Linguistic Inquiry*. [ROA-170]

Hankamer, J. and J. Aissen (1974) "The Sonority Hierarchy," in M. W. LaGaly, R. A. Fox, and A. Bruck, eds., *Papers From the Parasession on Natural Phonology*, Chicago Linguistics Society, Chicago.

Hayes, B. (1982) "Extrametricality and English Stress," *Linguistic Inquiry* 13, 227–276.

Hayes, B. (1995) *Metrical Stress Theory: Principles and Case Studies*, University of Chicago Press, Illinois.

Hayes, B. (in press) "Phonetically Driven Phonology: The Role of Optimality Theory and Inductive Grounding," in *Proceedings of the 1996 Milwaukee Conference on Formalism and Functionalism in Linguistics*. [ROA-158]

Holmes, U. T. (1927) "The Phonology of an English-Speaking Child," *American Speech* 2, 219–225.

Hooper, J. B. (1976) *An Introduction to Natural Generative Phonology*, Academic Press, New York.
Idsardi, W. (1992) *The Computation of Prosody*, Doctoral dissertation, Massachusetts Institute of Technology, Cambridge.
Ingram, D. (1974) "Phonological Rules in Young Children," *Journal of Child Language* 1, 49–64.
Ingram, D. (1978) "The Role of the Syllable in Phonological Development," in A. Bell and J. Hooper, eds., *Syllables and Segments*, Elsevier-North-Holland, New York.
Itô, J., Y. Kitagawa, and A. Mester (1996) "Prosodic Faithfulness and Correspondence: Evidence From a Japanese Argot," *Journal of East Asian Linguistics*, 5. [ROA-145]
Itô, J. and A. Mester (1992) "Weak Layering and Word Binarity," ms., University of California, Santa Cruz.
Jakobson, R. (1968) *Child Language, Aphasia and Phonological Universals* (A. Keiler, Trans.), Mouton, The Hague, The Netherlands. (Original work published 1941)
Jespersen, O. (1922) *Language: Its Nature, Development and Origin*, W. W. Norton, New York.
Jun, J. (1995) *Perceptual and Articulatory Factors in Place Assimilation: An Optimality Theoretic Approach*, Doctoral dissertation, University of California, Los Angeles.
Kager, R. (1989) *A Metrical Theory of Stress and Destressing in English and Dutch*, Foris, Dordrecht, The Netherlands.
Kager, R. (1994) "Generalized Alignment and Morphological Parsing," ms., University of Utrecht, The Netherlands. [ROA-36]
Kahn, D. (1980) *Syllable-based Generalizations in English Phonology*, Garland, New York.
Kehoe, M. and C. Stoel-Gammon (1996) "Acquisition of Stress: An Investigation of Rhythmic Processes in English-Speaking Children's Multisyllabic Word Productions," in A. Stringfellow, A. D. Cahana-Amitay, E. Hughes, and A. Zukowski, eds., *Proceedings of the 20th Annual Boston University Conference on Language Development*, Cascadilla Press, Somerville, Massachusetts.
Kehoe, M. and C. Stoel-Gammon (1997) "The Acquisition of Prosodic Structure: An Investigation of Current Accounts of Children's Prosodic Development," *Language* 73, 113–144.
Kenyon, J. and T. Knott (1953) *A Pronouncing Dictionary of American English*, 4th ed., G. C. Merriam Co., Springfield, Massachusetts.
Kiparsky, P. (1993) "Variable Rules," paper presented at ROW-1, Rutgers University, New Brunswick, New Jersey.
Kiparsky, P. (1994) "Remarks on Markedness," paper presented at TREND 2, Stanford University, Stanford, California.
Kiparsky, P. and L. Menn (1977) "On the Acquisition of Phonology," in J. Macnamara, ed., *Language Learning and Thought*, Academic Press, New York.
Klein, H. (1978) *The Relationship Between Perceptual Strategies and Production Strategies in Learning the Phonology of Early Lexical Items*, Doctoral dissertation, Columbia University, New York.
Lamontagne, G. (1996) "Contiguity and Syllabic Prosody," ms., University of British Columbia, Vancouver, British Columbia. [ROA-150]
Levelt, C. (1994) *On the Acquisition of Place*, Doctoral dissertation, Holland Institute of Generative Linguistics, Leiden University, Leiden, The Netherlands.
Levelt, C. (1995) "Unfaithful Kids: Place of Articulation Patterns in Early Vocabularies," colloquium presented at the University of Maryland, College Park, Maryland.
Lombardi, L. (1995) "Why Place and Voice Are Different: Constraint Interactions and Featural Faithfulness in Optimality Theory," ms., University of Maryland, College Park, Maryland. [ROA-105]
Macken, M. (1980) "The Child's Lexical Representation: The 'Puzzle-Puddle-Pickle' Evidence," *Journal of Linguistics* 16, 1–17.
Macken, M. (1995) "Phonological Acquisition," in J. Goldsmith, ed., *A Handbook of Phonological Theory*, Blackwell, Cambridge, Massachusetts.
MacWhinney, B. (1995) *The CHILDES Project: Tools for Analyzing Talk*, 2nd ed., Lawrence Erlbaum Associates, Inc., Hillsdale, New Jersey.

McCarthy, J. (in press) "Extensions of Faithfulness: Rotuman Revisited," *Natural Language and Linguistic Theory*. [ROA-110]

McCarthy, J. and A. Prince (1986) "Prosodic Morphology," ms., University of Massachusetts, Amherst, and Brandeis University, Waltham, Massachusetts.

McCarthy, J. and A. Prince (1993a) "Generalized Alignment," in G. Booij and J. van Marle, eds., *Yearbook of Morphology 1993*, Kluwer, Dordrecht, The Netherlands.

McCarthy, J. and A. Prince (1993b) "Prosodic Morphology I: Constraint Interaction and Satisfaction," ms., University of Massachusetts, Amherst, and Rutgers University, New Brunswick, New Jersey.

McCarthy, J. and A. Prince (1994a) "The Emergence of the Unmarked: Optimality in Prosodic Morphology," in M. Gonzalez, ed., *Proceedings of NELS 24*, GLSA, University of Massachusetts, Amherst. [ROA-13]

McCarthy, J. and A. Prince (1994b) "Prosodic Morphology: An Overview," papers presented at the OTS/HIL Workshop on Prosodic Morphology, University of Utrecht, The Netherlands. [ROA-59]

McCarthy, J. and A. Prince (1995) "Faithfulness and Reduplicative Identity," in J. Beckman, L. Walsh, and S. Urbanczyk, eds., *Papers in Optimality Theory: University of Massachusetts Occasional Papers* 18, 249–384, GLSA, University of Massachusetts, Amherst. [ROA-60]

McCarthy, J. and A. Prince (in press) "Faithfulness and Identity in Prosodic Morphology," in H. van der Hulst, R. Kager, and W. Zonneveld, eds., *The Prosody Morphology Interface*, Cambridge University Press, Cambridge, England. [ROA-216]

Menn, L. (1976) *Pattern, Control, and Contrast in Beginning Speech: A Case Study in the Development of Word Form and Word Function*, Doctoral dissertation, University of Illinois, Champaign.

Menn, L. (1980) "Phonological Theory and Child Phonology," in G. Yeni-Komshian, J. Kavanagh, and C. Ferguson, eds., *Child Phonology: Vol. 1. Production*, Academic Press, New York.

Mohanan, K. P. (1993) "Fields of Attraction in Phonology," in J. Goldsmith, ed., *The Last Phonological Rule*, University of Chicago Press, Illinois.

Nouveau, D. (1994) *Language Acquisition, Metrical Theory, and Optimality: A Study of Dutch Word Stress*, Doctoral dissertation, University of Utrecht, The Netherlands.

Padgett, J. (1995) "Feature Classes," in J. Beckman, L. Walsh, and S. Urbanczyk, eds., *Papers in Optimality Theory: University of Massachusetts Occasional Papers* 18, 385–420, GLSA, University of Massachusetts, Amherst. [ROA-112]

Paradis, J., S. Petitclerc, and F. Genesee (1996) "Word Truncation in Early Child Language: Perception or Production?" ms., McGill University, Montreal, Canada.

Pater, J. (1995) "On the Nonuniformity of Weight-to-Stress and Stress Preservation Effects in English," ms., McGill University, Montreal, Canada. [ROA-107]

Pater, J. (in press) "Austronesian Nasal Substitution and Other NC Effects," in H. van der Hulst, R. Kager, and W. Zonneveld, eds., *The Prosody Morphology Interface*, Cambridge University Press, Cambridge, England. [ROA-160]

Pater, J. and J. Paradis (1996) "Truncation Without Templates in Child Phonology," in A. Stringfellow, A. D. Cahana-Amitay, E. Hughes, and A. Zukowski, eds., *Proceedings of the 20th Annual Boston University Conference on Language Development*, Cascadilla Press, Somerville, Massachusetts.

Prince, A. (1980) "A Metrical Theory of Estonian Quantity," *Linguistic Inquiry* 11, 511–562.

Prince, A. (1993) "Minimal Violation," paper presented at ROW-1, Rutgers University, New Brunswick, New Jersey.

Prince, A. and P. Smolensky (1993) "Optimality Theory: Constraint Interaction in Generative Grammar," ms., Rutgers University, New Jersey, and University of Colorado at Boulder.

Pulleyblank, D. and W. Turkel (1996) "Optimality Theory and Learning Algorithms: The Representation of Recurrent Featural Asymmetries," in J. Durand and B. Laks, eds., *Current Trends in Phonology: Models and Methods*, European Studies Research Institute, University of Salford, Salford, Manchester, England.

Reynolds, W. (1994) *Variation and Phonological Theory*, Doctoral dissertation, University of Pennsylvania, Philadelphia.

Rice, K. (1992) "On Deriving Sonority: A Structural Account of Sonority Relationships," *Phonology* 9, 61–99.

Rice, K. (1994) "Peripheral in Consonants," *Canadian Journal of Linguistics* 39, 191–216.

Salidis, J. and J. Johnson (1997) "The Production of Minimal Words: A Longitudinal Case Study of Phonological Development," *Language Acquisition* 6, 1–36.

Selkirk, E. (1980) "The Role of Prosodic Categories in English Word Stress," *Linguistic Inquiry* 11, 563–605.

Selkirk, E. (1982) "The Syllable," in H. van der Hulst and N. Smith, eds., *The Structure of Phonological Representations*, Vol. 1, Foris, Dordrecht, The Netherlands.

Selkirk, E. (1984) "On the Major Class Features and Syllable Theory," in M. Aronoff and R. T. Oehrle, eds., *Language Sound Structure*, MIT Press, Cambridge, Massachusetts.

Selkirk, E. (1986) "On Derived Domains in Sentence Phonology," *Phonology Yearbook* 3, 371–405.

Selkirk, E. (1995) "The Prosodic Structure of Function Words," in J. Morgan and K. Demuth, eds., *Signal to Syntax*, Lawrence Erlbaum Associates, Inc., Mahwah, New Jersey.

Shaw, P. (1991) "Consonant Harmony Systems: The Special Status of Coronal Harmony," in C. Paradis and J.-F. Prunet, eds., *The Special Status of Coronals*, Academic Press, New York.

Slobin, D. (1973) "Cognitive Prerequisites for the Development of Grammar," in C. Ferguson and D. Slobin, eds., *Studies of Child Language Development*, Holt, Rinehart, and Winston, New York.

Smith, N. (1973) *The Acquisition of Phonology: A Case Study*, Cambridge University Press, Cambridge, England.

Smolensky, P. (1993) "Optimality, Markedness, and Underspecification," paper presented at Rutgers Optimality Workshop I, Rutgers University, New Brunswick, New Jersey. [ROA-37]

Smolensky, P. (1996a) "The Initial State and 'Richness of the Base' in Optimality Theory," Tech. Rep., Department of Cognitive Science, Johns Hopkins University, Baltimore, Maryland. [ROA-154]

Smolensky, P. (1996b) "On the Comprehension/Production Dilemma in Child Language," *Linguistic Inquiry* 27, 720–731. [ROA-118]

Spencer, A. (1986) "Toward a Theory of Phonological Development," *Lingua* 68, 3–38.

Stampe, D. (1969) "The Acquisition of Phonetic Representations," *Papers from the 5th Regional Meeting of the Chicago Linguistics Society*, Chicago Linguistics Society, Chicago.

Stemberger, J. (1995) "Why Is There Consonant Harmony?" paper presented at the Memphis Phonology Conference, Tennessee.

Stemberger, J. and C. Stoel-Gammon (1991) "The Underspecification of Coronals: Evidence From Language Acquisition and Performance Errors," in C. Paradis and J.-F. Prunet, eds., *The Special Status of Coronals*, Academic Press, New York.

Steriade, D. (1982) *Greek Prosodies and the Nature of Syllabification*, Doctoral dissertation, Massachusetts Institute of Technology, Cambridge.

Steriade, D. (1988) "Reduplication and Syllable Transfer in Sanskrit and Elsewhere," *Phonology* 5, 73–155.

Steriade, D. (1993) "Positional Neutralization," paper presented at NELS 24, University of Massachusetts, Amherst.

Stoel-Gammon, C. and J. Stemberger (1994) "Consonant Harmony and Phonological Underspecification in Child Speech," in M. Yavas, ed., *First and Second Language Phonology*, Singular Publishing, San Diego, California.

Tesar, B. and P. Smolensky (in press) "Learnability in Optimality Theory," *Linguistic Inquiry*. [ROA-156]

Turkel, W. (1994) "The Acquisition of Optimality Theoretic Systems," ms., University of British Columbia. [ROA-11]

Urbanczyk, S. (1996) *Patterns of Reduplication in Lushootseed*, Doctoral dissertation, University of Massachusetts, Amherst.

Vihman, M. (1978) "Consonant Harmony: Its Scope and Function in Child Language," in J. Greenberg, ed., *Universals in Human Language*, Stanford University Press, Stanford, California.

Vihman, M. (1980) "Sound Change and Child Language," in E. Traugott, R. Labrum, and S. Shepherd, eds., *Papers from the 4th International Conference on Historical Linguistics*, John Benjamins, Amsterdam, The Netherlands.

Woolf, H. B., ed. (1981) *Webster's New Collegiate Dictionary,* G. C. Merriam Co., Springfield, Massachusetts.

Wijnen, F., E. Krikhaar, and E. den Os (1994) "The (Non)realization of Unstressed Elements in Children's Utterances: Evidence for a Rhythmic Constraint," *Journal of Child Language* 21, 59–83.

Yip, M. (1995) "Repetition and Its Avoidance: The Case of Javanese," in K. Suzuki and D. Elzinga, eds., *Arizona Phonology Conference 4: Features in Optimality Theory*, University of Arizona Coyote Papers, Tucson. [ROA-83]

Yip, M. (1996) "Feet, Tonal Reduction and Speech Rate at the Word and Phrase Level in Chinese," ms., University of California, Irvine. [ROA-159]