Child Chain Shifts as Faithfulness to Input Prominence

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1. Introduction[1]

A Chain shift is a form of counterfeeding opacity that arises through interacting unfaithful mappings of input segments. In particular, chain shifts are characterized by a pattern like that in (1) below, where target instances of the /A/ are realized as [B] even as target instances of /B/ are realized as [C].

(1)

$$\begin{tikzcd} /A/ \arrow[dr] & /B/ \arrow[dr] & /C/ \arrow[d] \\ & [B] & [C] \end{tikzcd}$$

Certain chain shifts of this type spontaneously arise and then subside in the developing phonological systems of language learners, contrary to the predictions of most current phonological and acquisition theories. This paper addresses the issue from within the framework of Optimality Theory (McCarthy & Prince 1995, Prince & Smolensky 2004), arguing that developmental chain shifts are *natural intermediate stages* driven by specific faithfulness constraints referencing perceptually-prominent input feature combinations. These specific faithfulness constraints demand the preservation of key features on input /A/, preventing /A/ from being realized as unmarked [C] in the output. Input /B/ is not subject to these specific faithfulness constraints and thus freely surfaces as [C]. With these perceptually-motivated specific faithfulness constraints in place and biased toward high ranking, chain shifts naturally develop as positive target-language evidence drives learning.

Section 2 presents data from the L1 puzzle-puddle-pickle chain shift of Amahl (Smith 1973; see also Dinnsen, O'Connor & Gierut 2001, Macken 1980) and clarifies the theoretical challenges posed by such opaque developmental patterns. Section 3 introduces the specific IDENT constraints at work here and provides an analysis of the puzzle-puddle-pickle data. Section 4 considers further interactions of the relevant constraints and demonstrates that an OT approach can account for aspects of Amahl's chain shift that have proven challenging for previous analyses. Section 5 discusses the development of chain shift patterns and introduces data from the s→θ→f chain shift (Dinnsen & Barlow 1998) as further support for the approach developed here. Finally, Section 6 discusses the main typological predictions of this account.

2. The Puzzle-Puddle-Pickle Problem

Two non-target-like processes – loss of stridency and pre-lateral velarization – interact in the puzzle-puddle-pickle chain shift pattern of Amahl (Smith 1973).

(2) a. Loss of stridency: [+strident] → [-strident, -continuant]
b. Pre-lateral velarization: [CORONAL, -strident] → [DORSAL]/ __ (ə)l

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Loss of stridency applies across the board in Amahl’s grammar during the chain shift stage (age 2;2-2;11), causing strident segments to be realized as simple coronal stops (3a). Pre-lateral velarization is contextually restricted, causing coronals to be realized as dorsals just when they immediately precede a target lateral (3b).[2] Input dorsals are realized faithfully across contexts (3c).

(3) *‘Puzzle-puddle-pickle’ chain shift of Amahl age 2;2-2;11 - (Smith 1973)*[3]

a. /s, z, ʃ, ʧ, ʤ/ → [t, d] (all contexts) ***/s,z,ʃ,ʧ,ʤ/→ [k,ɡ]**

puzzle	[pʌ**d**əl]	*special*	[pɛ**t**əl]
parsley	[pa:**t**li:]	*Angela*	['æn**d**ələ]

b. /t, d, n/ → [k, ɡ, ŋ] (before target laterals)

puddle	[pʌ**ɡ**əl]	*sandal*	[tæ**ŋɡ**əl]
butler	[bʌ**k**lə]	*bottle*	[bɔkəl]

c. /k, g, ŋ/ → [k, ɡ, ŋ] (all contexts)

pickle	[pi**k**əl]	*uncle*	[ʌ**ŋk**əl]
chocolate	[tɔ**k**lit]	*buckle*	[ḅʌ**ɡ**əl]

Individually, both loss of stridency and pre-lateral velarization can be modeled as resulting from the kind of general MARKEDNESS >> FAITHFULNESS ranking that has been widely argued to hold during the initial stages of L1 acquisition (e.g., Demuth 1995, Gnanadesikan 2004, Smolensky 1996). The loss of stridency found in the *puzzle*→[pʌdəl] mapping, for example, can be attributed to a Markedness constraint barring surface [+strident] segments (i.e., *[+strident]) outranking the Faithfulness constraint requiring input [+strident] segments to have [+strident] output correspondents (i.e., IDENT[+strident]). This interaction is illustrated in (4).

(4)

/pʌzəl/	*[+strident]	IDENT[+strident]
pʌzəl	*!	
☞ pʌdəl		*

Similarly, the pre-lateral velarization found in the *puddle*→[pʌɡəl] mapping can be attributed to *TL, an OCP-style Markedness constraint barring adjacent [-continuant] coronal segments (cf. Moreton 2000:47), outranking IDENTCORONAL, a Faithfulness constraint demanding that input coronals have coronal output correspondents.[4] This is illustrated in (5).

(5)

/pʌdəl/	*TL	IDENTCORONAL
pʌdəl	*!	
☞ pʌɡəl		*

Where problems arise is in the interaction of these two processes. As the tableau in (6) shows, when the full range of candidates and constraints are included, it becomes impossible to derive the *puzzle*→[pʌdəl] aspect of the chain shift mapping. (The 💣 symbol indicates an undesired winner.)

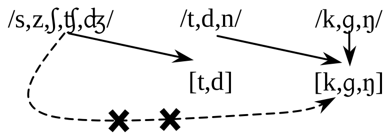
(6)

/pʌzəl/	*[+strident]	*TL	IDENT[+strident]	IDENTCORONAL
pʌzəl	*!			
pʌdəl		*!	*	
💣 pʌɡəl			*	*

[2] The quality of the target lateral (i.e., whether it is clear or dark) does not affect this process, as the presence of pre-lateral velarization in both target *puddle* (dark [ɫ]) and target *butler* (clear [l]) shows (cf. Macken 1980).
[3] The transcription conventions of Smith (1973) are retained here and throughout.
[4] Amahl’s *TL constraint is stricter than that proposed by Moreton (2000), but is arguably motivated by the same phonetic factors. Thus, Amahl’s constraint applies not only to onset clusters, but also to heterosyllabic clusters and to contexts where the lateral is syllabic / separated from the coronal stop by [ə]. See Jesney (2005) for discussion.

Having the two Markedness constraints highly ranked results in a full neutralization scenario, where both *puzzle* and *puddle* preferentially map to [pʌɡəl]. The actual chain shift pattern requires that only *puddle* – **not** *puzzle* – map to [pʌɡəl]; the pre-lateral velarization process must somehow be blocked from applying to coronal segments that are specified as [+strident] in the input.

(7)



This problem has been much discussed with respect to opacity in stable-state adult grammars. There, the most common approach is to make use of locally-conjoined faithfulness constraints (e.g., Kirchner 1996) – a solution based on the observation that the incorrectly-selected candidate [pʌɡəl] in (6) incurs a proper superset of the faithfulness violations of the correct chain shift candidate [pʌdəl].

(8) *puzzle* → [pʌɡəl] violates both IDENT[+strident] and IDENTCORONAL
puzzle → [pʌdəl] violates only IDENT[+strident]

The idea, then, is to create a conjoined constraint that is violated if and only if both of its conjuncts are violated within a given domain (here, the segment).

(9) [IDENT[+strident] & IDENTCORONAL]$_{\text{SEGMENT}}$: Assign one violation mark for any output segment that loses specification for **both** [+strident] **and** [CORONAL] relative to its input correspondent.

By ranking the conjoined constraint in (9) above the Markedness constraint *TL, the attested set of mappings can be successfully modeled.

(10)

/pʌzəl/	[IDENT[+strident]& IDENTCORONAL]$_{\text{SEG}}$	*[+strident]	*TL	IDENT[+strident]	IDENTCORONAL
pʌzəl		*!			
☞ pʌdəl			*	*	
pʌɡəl	*!			*	*

While superficially appealing, it is not at all clear how a conjoined constraint like that in (9) or a ranking like that in (10) could emerge in acquisition. The spontaneous chain shifts that arise in the course of child language learning typically occur in situations where there is no target-language evidence motivating either the requisite conjoined constraint or its high ranking. In the case of Amahl, for example, the adult grammar of English provides no evidence favouring the conjunction of IDENT[+strident] and IDENTCORONAL, let alone its position at the top of the hierarchy. This lack of positive evidence rules out the possibility that the conjoined constraint at play here might be the result of a “last resort” mechanism for resolving inconsistencies detected by the learner, as has been suggested for adult grammars (Fukazawa & Miglio 1998, Itô & Mester 2003).

Allowing local conjunction to exist as a general learning option does not solve this problem. Indeed, if learners were allowed to freely conjoin constraints (i.e., even in the absence of inconsistency detection), a serious instance of the Credit Problem (Dresher 1999) would arise. Learners would be constantly faced with two ways of potentially altering their grammars to better approximate the target language – constraint reranking and constraint conjunction – and no means of choosing between them. Furthermore, such free conjunction predicts that, contrary to fact, a vast range of chain shifts should be observed in the course of acquisition. These include unattested patterns like *t→s→k (i.e., *puddle→ puzzle→pickle) and *θ→s→f, both of which could arise through the conjunction of IDENT[-strident] and IDENTCORONAL (see also Section 6). Hypothesizing that all possible conjoined constraints exist innately as part of the universal constraint set CON and are freely available for reranking does no better, given the persistent lack of target-language evidence for the ranking (10) and the typological gaps alluded to above. What is needed, then, is a *principled* means of modeling the set of chain shifts that *do* arise in acquisition; the following section proposes that this can be accomplished using positional faithfulness constraints that reference instances of input prominence.

3. Faithfulness to Input Prominence

The claim advanced here is given in (11) below; the basis of this hypothesis is explained in the following paragraphs.

(11) *Faithfulness to Input Prominence Hypothesis:*
Child chain shifts are driven by specific faithfulness constraints referencing *perceptually-prominent* input feature combinations. Input feature values can be preferentially preserved in the output, leading to chain shifts, just when they are subject to these constraints.

In child chain shifts of the form A→B→C, there is necessarily some combination of features on input /A/ that is (relatively) perceptually prominent. This allows a key element of this combination (i.e., one of the feature values) to be preferentially preserved in the output. Crucially, this same prominent combination of features is not found on input /B/, and so the key element is not preserved. The diagrams below schematize this for the general case (12a) and specific one under discussion (12b).

(12) a.

/A/	/B/	/C/
[**+α**,+β]	[+α,-β]	[-α,-β]
↘	↘	↓
	[B]	[C]
	[**+α**,-β]	[-α,-β]

b.

/s,z,ʃ,ʧ,ʤ/	/t,d,n/	/k,g,ŋ/
[**COR**,+stri]	[COR,-stri]	[DOR,-stri]
↘	↘	↓
	[t,d]	[k,g,ŋ]
	[**COR**,-stri]	[DOR,-stri]

In (12a), the key [+α] feature value is found on both input /A/ and input /B/; it is only preserved by the output correspondent of the relevant segment, however, when [+α]'s prominence is enhanced in the input by the feature [+β]. In the case of the puzzle-puddle-pickle chain shift, the relevant interaction is between [+strident] and [CORONAL]. As illustrated in (12b), the key [CORONAL] feature is found on both /s,z,ʃ,ʧ,ʤ/ and /t,d,n/; however, this coronality is only preserved in the output when it is associated in the input with a prominence-enhancing [+strident] feature.

Both typological and acquisition evidence suggests that the coronality of [+strident] segments is perceptually more distinct – and therefore more prominent – than is the coronality of [-strident] segments. In segment inventories, for example, [s]~[f] contrasts – where the coronal segment is [+strident] – are strongly preferred to [θ]~[f] contrasts – where the coronal segment is [-strident] (Ladefoged & Maddieson 1996). Similarly, Velleman (1988) reports that contrasts between [θ] and [f] are more readily confused by children than are contrasts between [s] and [f].

I argue that these perceptually-driven biases are encoded in the grammar through specific faithfulness constraints that reference the relevant prominence-enhancing features. This limited set of substantively-motivated specific faithfulness constraints exists alongside the set of general faithfulness constraints that demand input-output identity across contexts. In the case at hand, the specific constraint is IDENTCORONAL/[+strident] (13a) and the general constraint is IDENTCORONAL (13b).

(13) a. IDENTCORONAL/[+strident]: A [CORONAL] feature of an input [+strident] segment is preserved by its output correspondent. ⇒ *Specific Faithfulness Constraint*
b. IDENTCORONAL: A [CORONAL] feature of an input segment is preserved by its output correspondent. ⇒ *General Faithfulness Constraint*

These specific constraints are similar to other positional faithfulness constraints that place a premium on input-output identity in phonetically or psycholinguistically prominent positions (Beckman 1998, Lombardi, 1999, Steriade 2001, etc.). The key difference between the constraints here and those typically discussed in the adult literature is that the prominent environment is defined with respect to the *input* (see McCarthy 2006 for discussion of the relevance of input-oriented faithfulness constraints to zero-terminating chain shifts and Goad & Rose 2004, Rose 2000 for discussion of input-oriented specific faithfulness in acquisition).

The constraints in (13) have the violation profiles in (14). What is crucial here is that the /s/→[k] mapping violates *both* the general and specific constraints, but the /t/→[k] mapping violates *only* the general constraint. The specific constraint is vacuously satisfied by the /t/→[k] mapping because in this case there is no input [+strident] segment whose coronality is protected by IDENTCOR/[+strident]. The stringency relation that holds between the general and specific constraints (i.e., the superset-subset nature of their violation profiles) ensures that if the coronality of some but not all segments is to be preserved in the output, it will be the coronality of those segments that are specified as [+strident] in the input. This is precisely the pattern observed in the puzzle-puddle-pickle chain shift.

(14)

Input:	/s/	/s/	/s/	/t/	/t/
	|	|	|	|	|
Output:	[s]	[t]	[k]	[t]	[k]
IDENTCORONAL/[+strident]:	✓	✓	*	(✓)	(✓)
IDENTCORONAL:	✓	✓	*	✓	*

Like positional faithfulness constraints more generally, the specific faithfulness constraints proposed here are biased toward high ranking (Hayes 2004, Prince & Tesar 2004, Smith 2000, Tessier 2007), effectively giving rise to the partial hierarchy in (15) below.[5]

(15) IDENTCORONAL/[+strident] >> IDENTCORONAL

Given this ranking, two conditions must hold in order for the chain shift to emerge. First, fully-faithful realization of the first segment in the chain shift must be precluded. In the puzzle-puddle-pickle case, this can be attributed to the constraint barring output [+strident] segments (i.e., *[+strident]) outranking the faithfulness constraint demanding that input [+strident] segments preserve this feature in the output (i.e., IDENT[+strident]). The effects of this *[+strident] >> IDENT[+strident] ranking are evident throughout Amahl's phonology during the chain shift stage, as the data in (16) attest.[6]

(16)

sun	[**t**ʌn]	*zip*	[**d̥**ip]	*fish*	[wi**t**]
sausages	[**t**ə**t**ə**d**i**d̥**]	*legs*	[lɛg**d**]	*gracious*	[gei**t**ə**t**]
fetch	[wɛ**t**]	*ginger*	[**d̥**in**d**ə]	*pyjamas*	[pə**d**a:mə**d**]

Second, for the chain shift scenario to prove optimal rather than, for example, the full neutralization scenario (i.e., the scenario where **all** segments are realized as dorsals in pre-lateral position), it is necessary for the Markedness constraint triggering pre-lateral velarization to be ranked *between* the specific and general IDENTCORONAL constraints. Here, the relevant Markedness constraint is *TL, introduced in Section 2. In order for pre-lateral velarization to be triggered in any context, *TL must be ranked above the general IDENTCORONAL constraint (17a). In order for pre-lateral velarization to be blocked when the target coronal segment is specified as [+strident] in the input, however, *TL must be ranked below the specific IDENTCORONAL/[+strident] constraint (17b).

(17)

a.	*TL >> IDENTCORONAL		b.	IDENTCORONAL/[+strident] >> *TL
	puddle	[pʌ**g**əl]	*puzzle*	[pʌ**d**əl]
	butler	[bʌ**k**lə]	*parsley*	[pa:**t**li:]
	sandal	[tæ**ŋg**əl]	*special*	[pɛ**t**əl]

[5] I will not address the mechanism by which this partial hierarchy is generated here. For discussion of this issue as it pertains to ranking systems, see Hayes (2004), Prince & Tesar (2004) or Tessier (2007). For similar effects in a weighted constraint system, see Pater (2006).

[6] Target [+strident] coronal fricatives also lose their [+continuant] specifications in the output. This cannot be the crucial factor here, however, given that labial fricatives realize their [+continuant] specifications faithfully.

The two rankings required for the chain shift scenario are thus those in (18) below. These give rise to the tableaux in (19).

(18) a. *[+strident] >> IDENT[+strident]
b. IDENTCORONAL/[+strident] >> *TL >> IDENTCORONAL

(19) a.

/pʌzəl/	*[+strident]	IDENTCOR/[+stri]	*TL	IDENT[+stri]	IDENTCOR
pʌzəl	*!				
☞ pʌdəl			*	*	
pʌgəl		*!		*	*

b.

/pʌdəl/	*[+strident]	IDENTCOR/[+stri]	*TL	IDENT[+stri]	IDENTCOR
pʌzəl	*!				
pʌdəl			*!		
☞ pʌgəl					*

c.

/pikəl/	*[+strident]	IDENTCOR/[+stri]	*TL	IDENT[+stri]	IDENTCOR
pisəl	*!				
pitəl			*!		
☞ pikəl					

Given a Specific Faithfulness >> General Faithfulness bias, these rankings are expected to arise as the child encounters positive evidence that coronal stop + lateral sequences are permitted in the adult language and the initial *TL >> IDENTCORONAL/[+strident] >> IDENTCORONAL ranking is gradually adjusted. The developmental sequence is discussed further in Section 5.

4. Interactions and Exceptions

Before continuing, it is worth considering some further implications of the analysis outlined above. The focus in this section is upon two of the classes of exceptions to the general puzzle-puddle-pickle chain shift pattern identified by Macken (1980) – clusters in pre-lateral position and morphologically-complex forms. Both of these receive a principled analysis under the approach advanced here.

In Amahl’s grammar, where input non-strident coronals are velarized in pre-lateral position, target /stəl/ sequences would be expected to map to [kəl], or possibly [tkəl]. As the data in (20) reveal, however, this expectation is not met; instead, target /stəl/ sequences map to surface [təl] during the chain shift stage, resulting in an apparent exception to the pre-lateral velarization process.

(20) *pistol* [pi**t**əl]
postal [p^{h}o:**t**əl]

Target /skəl/ sequences behave distinctly, mapping to [kəl].

(21) *rascal* [ra:**k**əl]

In fact, Amahl’s realization of /s+C/ clusters in pre-lateral position follows precisely the same pattern as his realization of /s+C/ clusters more generally. Thus, in word-initial position /st/ clusters are also realized as [t] (22a) and /sk/ clusters as [k] (22b).

(22) a.	*steady*	[**t^h**ɛdi:]	b.	*sky*	[**k^h**ai]
	stars	[**t**a:rd]		*scales*	[**k**eild]
	stones	[**t**əund]		*skipping*	[**k**ipin]

The generally divergent behaviour of /st/ and /sk/ clusters indicates that the apparent exception in (20) cannot be due to the stop's place of articulation being obscured by the preceding /s/. Rather, these clusters are accurately perceived and encoded in the input; it is then left to the production grammar to determine their optimal output realization.

In Amahl's case, the result is that target /s+C/ clusters are realized as a single, vacuously coalesced segment. In Optimality Theory, such coalescence is understood to stem from *multiple* input segments standing in correspondence with a *single* output segment (McCarthy & Prince 1995). This means, in essence, that several input segments are fused together in the output, where they are realized as a single segment bearing some combination of features compatible with the targets. IDENT constraints relevant to all of input segments are active in evaluation of the output form. No input segment is literally deleted in the output; rather, multiple input segments simply share a single output correspondent. Here, for example, both the /t/ and the /s/ of target /st/ clusters stand in a correspondence relationship with the single output segment [t]. Because the stop and the [+strident] /s/ both correspond to the output segment, the mapping is subject to both the general IDENTCORONAL constraint and the specific IDENTCORONAL/[+strident] constraint. The resulting violation profiles are summarized in (23) below.[7] (Subscripts are used to indicate correspondence.)

(23)

(23)	Input:	/s$_1$ t$_2$/	/s$_1$ t$_2$/	/s$_1$ k$_2$/	/s$_1$ k$_2$/
	Output:	[t$_{1,2}$]	[k$_{1,2,}$]	[t$_{1,2}$]	[k$_{1,2,}$]
	IDENTCOR/[+stri]:	✓	*	✓	*

Under this approach, the behaviour of target /st/ clusters is fully regular. Pre-lateral velarization is blocked due to the fused nature of the output segment and IDENTCORONAL/[+strident]'s domination of *TL.

(24)

/pis$_1$t$_2$əl/	IDENTCOR/[+stri]	*TL	IDENTCOR
☞ pit$_{1,2}$əl		*	
pik$_{1,2}$əl	*!		*

Target /sk/ clusters, for their part, are realized as [k] due to high-ranking IDENTDORSAL. This constraint demands that input [DORSAL] segments – like the /k/ in /sk/ clusters – be preserved by their output correspondents, and has been argued to be universally ranked above IDENTCORONAL (e.g., Pater 1997). The distinction between target /sk/ and /st/ clusters in initial and pre-lateral position is thus a consequence of the constraint system; no recourse to other factors is required.

A constraint-based approach to the analysis of chain shifts also sheds light on a set of apparent exceptions that arise in morphologically-complex forms. As discussed, the *TL >> IDENTCORONAL ranking normally causes target coronal stops in pre-lateral position to velarize. In cases where the target coronal is part of a root and the target /l/ is part of a suffix, however, the process of velarization is exceptionally blocked (25a). Crucially, this only occurs when the target coronal does not undergo velarization in the corresponding bare root; in cases where velarization also occurs in the root, it persists in the derived form (25b).

(25)		Base	Derived form		
	a.	[ha:**d**]	[ha:**d**li:]	*hard ~ hardly*	cf. [bʌ**k**lə] *butler*
		[sɔf**t**]	[sɔf**t**li:]	*soft ~ softly*	
		[tai**t**]	[tai**t**li:]	*tight ~ tightly*	
	b.	[dɛ**ŋk**əl]	[dɛ**ŋk**li:]	*gentle ~ gently*	

[7] Instances of non-vacuous coalescence are also found in Amahl's phonology – e.g., target /sw/ is realized as [f] in [fim] *swim* and [fiŋiŋ] *swinging*. See Gnanadesikan (2004) for further discussion of coalescence in child phonology.

This is an effect of high-ranking Output-Output Faithfulness, which demands identity between derived forms and their corresponding bases (Benua 1997; see Dinnsen & McGarrity 2004 for Amahl's case, and Hayes 2004 and Tessier 2005, 2007 for more general discussion of high-OO-Faith biases in acquisition). Ranked above *TL, OO-FAITH *rules out* velarization in the derived form when the target coronal in the base is faithfully realized (as in (25a)), but *demands* velarization in the derived form when the target coronal in the base also undergoes this process (as in (25b)).

It is thus not the case that target /tl/ sequences cannot be faithfully realized by Amahl. Indeed, such sequences readily emerge in the output under pressure from higher-ranked Specific Faithfulness or OO-Faithfulness constraints. The pattern of blocking found in the chain shift scenario is part of a larger system of constraint interaction that admits similar effects elsewhere in the grammar.

5. Development

As alluded to in Section 3, a certain amount of constraint reranking is necessary in order for the chain shift stage to emerge. The initial state of language acquisition is characterized by a ranking of Markedness over all Faithfulness (e.g., Demuth 1995, Gnanadesikan 2004, Smolensky 1996); with respect to the constraints relevant to the chain shift, this entails the initial set of rankings in (26).

(26) *Stage 1 (initial state):*

M1 >> F1	***[+strident]** >> IDENT[+strident]
M2 >> SpecF >> GenF	***TL** >> IDENTCOR/[+stri] >> IDENTCOR

At *stage 1,* then, full neutralization is expected in pre-lateral position (i.e., target *puzzle, puddle* and *puggle* all map to output [pʌgəl]).

In order for the learner to progress toward the target adult grammar, both of the rankings in (26) must be inverted so that Faithfulness outranks Markedness. Abundant positive evidence to this effect is available in adult English, allowing the child to gradually rerank the necessary constraints.[8] Which intermediate stages develop during the process of reranking is dependent upon the order in which the relevant rankings are adjusted. The chain shift occurs as *stage 2* when *TL is the first constraint to be partially demoted, and its demotion has proceeded just to a point where it rests between specific IDENTCORONAL/[+strident] and general IDENTCORONAL (see the tableaux in (19)).

(27) *Stage 2 (chain shift):*

M1 >> F1	*[+strident] >> IDENT[+strident]
SpecF >> **M2** >> GenF	IDENTCOR/[+stri] >> ***TL** >> IDENTCOR

Different "escape routes" from the chain shift stage are then possible, depending upon the order in which further reranking proceeds. In Amahl's case, emergence from the chain shift occurs by way of *stage 3a*, as, at approximately age 2;11, he begins to accurately realize [+strident] features in the output (28a). Target non-strident coronals continue to be velarized in pre-lateral position (28b).

(28)

a.	Stage 2: /s, z, ʃ, ʧ/ → [t, d]		Stage 3a: /s, z, ʃ, ʧ/ → [s, z, t^S]	
	puzzle	[pʌ**d**əl]	*puzzle*	[pʌ**z**əl]
	special	[pɛ**t**əl]	*special*	[spɛ**s**əl]
	pencil	[b̥ɛ**t**əl]	*pencil*	[pɛn**s**əl]
b.	Stage 2: /t, d, n/ → [k, g, ŋ]		Stage 3a: /t, d, n/ → [k, g, ŋ]	
	sandal	[tæŋgəl]	*sandal*	[sæŋgəl]
	bottles	[bɔkəld]	*bottles*	[bɔkəlz]
	handle	[æŋgəl]	*handle*	[hæŋgəl]

[8] I assume here that reranking proceeds conservatively, with constraints being demoted or promoted by only one stratum at a time.

This change between *stage 2* and *stage 3a* is due to Amahl's demotion of *[+strident] to below IDENT[+strident], as in (29). This allows [+strident] features to surface faithfully.

(29) *Stage 3a (emergence – possibility #1 – Amahl):*

F1 >> **M1**	IDENT[+strident] >> ***[+strident]**
SpecF >> M2 >> GenF	IDENTCOR/[+stri] >> *TL >> IDENTCOR

The specific faithfulness constraint continues to be obeyed, but, as in the adult grammar, the defining input context (i.e., the [+strident] feature) is now also faithfully realized in the output. The mappings at *stage 3a* are thus those in (30) below.

(30) *Stage 3a mappings in Amahl's grammar (before target laterals)*

/s,z,ʃ,ʧ,ʤ/ [COR,+stri]	/t,d,n/ [COR,-stri]	/k,g,ŋ/ [DOR,-stri]
↓	↘	↓
[s, z, t^S] [COR,+stri]		[k,g,ŋ] [DOR,-stri]

Evidence for a second possible "escape route" from the chain shift stage – *stage 3b* – comes from the s→θ→f child chain shift pattern discussed by Dinnsen & Barlow (1998). The s→θ→f chain shift is very similar to the puzzle-puddle-pickle pattern of Amahl, involving the preservation of the coronality of input [+strident] segments (here, /s/), but not of input [-strident] segments (here, /θ/). Specifically, the target [+strident] coronal /s/ is realized as the coronal [θ] (31a), while the target [-strident] coronal /θ/ loses its coronality and is realized as the labial [f] (31b). (All data are from R.H. – a typically-developing child studied by Dinnsen & Barlow 1998.)

(31)

a. /s/ → [θ]		b. /θ/ → [f]		c. /f/ → [f]	
sew	[**θ**oʊ]	*thorn*	[**f**ɔrn]	*fire*	[**f**aɪɚ]
sink	[**θ**ɪŋk]	*thumb*	[**f**ʌm]	*five*	[**f**aɪf]
icy	[aɪ**θ**i]	*bathy*	[bæ**f**i]	*beautiful*	[bjudə**f**əl]
vase	[veɪ**θ**]	*tooth*	[tu**f**]	*leaf*	[li**f**]

The s→θ→f chain shift is driven by the same general IDENTCORONAL and specific IDENTCORONAL/[+strident] faithfulness constraints as the puzzle-puddle-pickle chain shift. Indeed, the only difference between the two cases is the key markedness constraint at work. Thus, whereas it is *TL that intervenes between the two faithfulness constraints in the puzzle-puddle-pickle chain shift, it is *θ, a Markedness constraint militating against output non-strident coronal fricatives, that intervenes between the two faithfulness constraints in the s→θ→f chain shift. R.H.'s chain shift stage (i.e., his *stage 2*) thus instantiates the rankings in (32) below. This set of rankings should be compared with Amahl's chain shift ranking in (18) and the associated tableaux in (19).

(32) a. *[+strident] >> IDENT[+strident]
b. IDENTCORONAL/[+strident] >> ***θ** >> IDENTCORONAL

While Amahl emerges from his chain shift stage by demoting *[+strident] to below IDENT[+strident] and passing through *stage 3a*, R.H. instead simply continues to demote the key constraint that intervenes between the specific and general IDENTCORONAL constraints – i.e., *θ. He therefore escapes from the chain shift by passing through *stage 3b*.

(33) *Stage 3b (emergence – possibility #2 – R.H.)*

M1 >> F1	*[+strident] >> IDENT[+strident]
SpecF >> GenF >> **M2**	IDENTCOR/[+stri] >> IDENTCOR >> ***θ**

As this new ranking takes hold, variation begins to emerge in the realization of target /θ/. Whereas at *stage 2* the segment was invariably realized as [f], it is now faithfully realized as [θ] in at least some productions (34b). The realization of target /s/ remains unaffected (34a).

(34)	a.	Stage 2: s → θ		Stage 3b: s → θ	
		sew	[θoʊ]	*sew*	[θoʊ]
		icy	[aɪθi]	*icy*	[aɪθi]
		vase	[veɪθ̬]	*vase*	[veɪθ̬]
	b.	Stage 2: θ → f		Stage 3b: θ → f / θ → θ	
		thumb	[**f**ʌm]	*thumb*	[**θ**ʌm]
		mouthy	[maʊfi]	*mouthy*	[maʊfi]
		tooth	[tuf]	*tooth*	[tuf]

The set of *stage 3b* mappings in R.H.'s grammar is thus that in (35) below.

(35) *Stage 3b mappings in R.H.'s grammar*

/s/	/θ/	/f/
[COR,+stri]	[COR,-stri]	[LAB,-stri]
↘	↓	↓
	[θ]	[f]
	[COR,-stri]	[LAB,-stri]

The mappings found at *stage 3a* for Amahl (30) and at *stage 3b* for R.H. (35) are, of course, still not those found in adult English. As compared to the chain shift stage, however, the *stage 3a* and *stage 3b* mappings are closer to the target language in two ways. First, as the learners progress into *stage 3a* or *stage 3b* there is an increase in the number of segments that are faithfully produced. Amahl realizes both target dorsals and target [+strident] coronals faithfully at *stage 3a*, whereas he only realized target dorsals faithfully at *stage 2*. Similarly, R.H realizes both target /f/ and target /θ/ faithfully at *stage 3b*, whereas he only realized target /f/ faithfully at *stage 2*. Second, the rankings corresponding to *stage 3a* and *stage 3b* more closely match the Faithfulness >> Markedness ranking required by the target adult language – given in (36) below – than do the rankings corresponding to *stage 2*. This is a result of the continued demotion of markedness constraints that gives rise to *stage 3a* and *stage 3b*.

(36) *Stage 4 (adult):*

F1 >> **M1**	IDENT[+strident] >> ***[+strident]**
SpecF >> GenF >> **M2**	IDENTCOR/[+stri] >> IDENTCOR>> ***TL, *θ**

The chain shift stage, then, is a natural developmental stage that surfaces as the learner gradually reranks constraints on the basis of positive target-language evidence. Progression out of the chain shift stage is equally natural, occurring as the learner continues to use positive target-language evidence for constraint reranking.

6. Typological Predictions

The analysis of child chain shifts outlined here makes strong typological predictions about the range of such patterns that should be able to emerge in developing grammars. These predictions stem from the way in which the relevant constraints interact with the grammar as a whole and from the substantive nature of the specific faithfulness constraints proposed.

The first set of predictions can be illustrated using the specific faithfulness constraint discussed in this paper: IDENTCORONAL/[+strident]. As alluded to in Section 3, the fact that this specific constraint stands in a stringency relationship with the general IDENTCORONAL constraint ensures that if the coronality of some but not all input segments is to be preserved in the output, it will be the coronality of input [+strident] segments that is preserved. This rules out mappings like those in (37) below. The pattern in (37a) is ruled out because the coronality of the input [-strident] segment is preserved by the

/θ/→[θ] mapping even as the coronality of the input [+strident] segment /s/, which we would expect to also be preserved, is lost. The pattern in (37b) is ruled out for the same reason – i.e., the coronality of the input [-strident] segment /θ/ is preserved in the output through the /θ/→[s] mapping even as the coronality of the input [+strident] segment /s/ is lost.

(37) *Predicted impossible mappings*

a.

/s/	/θ/	/f/
[COR,+stri]	[COR,-stri]	[LAB,-stri]
	[θ]	[f]
	[COR,-stri]	[LAB,-stri]

b.

/θ/	/s/	/f/
[COR,-stri]	[COR,+stri]	[LAB,-stri]
	[s]	[f]
	[COR,+stri]	[LAB,-stri]

The predicted impossible mapping in (37b) is of particular interest given that it is a chain shift which, superficially, closely resembles the well-attested s→θ→f chain shift discussed in Section 5. Unlike the s→θ→f chain shift, however, the *θ→s→f pattern is, to my knowledge, unattested in the child acquisition literature. This is precisely what is expected given the constraints proposed in this paper.

The second set of predictions stems from the substantive claim that only perceptually-prominent input feature combinations are reflected in specific faithfulness constraints. This *rules out* a hypothetical constraint like *IDENTCORONAL/[-strident] which has no basis in perceptual prominence and whose inclusion in the universal constraint set CON would falsely allow unattested chain shift mappings like *θ→s→f (37b) and *t→s→k (i.e., *puddle→puzzle→pickle) to be modeled. The principled preclusion of such mappings stands in stark contrast to their free availability under the local constraint conjunction approach (see the discussion in Section 2).

Even as the faithfulness to input prominence approach advocated here rules out unattested patterns, it also explicitly predicts the possibility of developmental chain shifts that involve the preservation of features which are part of perceptually-prominent input combinations. Beyond those discussed in this paper, examples of such patterns include the nasal→voiced stop→voiceless stop pattern displayed by Joan (Velten 1943) and the s→h→k pattern of Korean-acquiring children (Cho & Lee 2003). These can be analyzed as resulting from the perceptually-grounded IDENTVOICE/[+nasal] and IDENTCONTINUANT/[+strident] constraints, respectively (see Jesney 2005 for further discussion of these and other cases). Unlike previous proposals, then, the approach presented here makes strong and falsifiable claims about the typology of developmental chain shifts.

7. Summary

Chain shift patterns spontaneously arise and then subside in the developing phonological systems of child language learners. This paper has argued that these emergent stages are a consequence of a limited set of perceptually-motivated specific IDENT constraints that demand faithfulness to features whose prominence is enhanced in the input. As has been proposed elsewhere (e.g., Hayes 2004, Prince & Tesar 2004, Smith 2000, Tessier 2007), these specific faithfulness constraints are biased toward high ranking and co-exist with general versions of the IDENT constraints in question. Reranking of constraints on the basis of positive target-language evidence is all that is needed, then, in order for developmental chain shifts to both initially emerge and eventually dissipate. They are thus restrictive intermediate stages that naturally arise and subside through the regular process of phonological acquisition. No special mechanisms are required. Taken together, the contents of the constraint system, the means of constraint interaction, and the types of reranking motivated by the target language are sufficient to derive the developmental paths and typology of child chain shifts.

References

Beckman, Jill N. 1998. *Positional Faithfulness.* PhD Dissertation. Amherst, MA: University of Massachusetts.

Benua, Laura. 1997. *Transderivational Identity: Phonological Relations Between Words.* PhD Dissertation. Amherst, MA: University of Massachusetts.

Cho, Mi-Hui and Shinsook Lee. 2003. The acquisition of fricatives: chain shift cases of English and Korean.

Studies in Phonetics, Phonology and Morphology 9(2): 485-498.

Demuth, Katherine. 1995. Markedness and the development of prosodic structure. In *Proceedings of NELS 25*, edited by Jill Beckman. Amherst, MA: Graduate Linguistic Student Association. [ROA-50]

Dinnsen, Daniel A. and Jessica A. Barlow. 1998. On the characterization of a chain shift in normal and delayed phonological acquisition. *Journal of Child Language*, 25: 61-94.

Dinnsen, Daniel A. and Laura W. McGarrity. 2004. On the nature of alternations in phonological acquisition. *Studies in Phonetics, Phonology and Morphology* 10: 23-41.

Dinnsen, Daniel A., Kathleen M. O'Connor and Judith A. Gierut. 2001. The puzzle-puddle-pickle problem and the Duke-of-York gambit in acquisition. *Journal of Linguistics*, 37: 503-525.

Dresher, Bezalel Elan. 1999. Charting the learning path: cues to parameter setting. *Linguistic Inquiry* 30: 27-67.

Fukazawa, Haruka and Viola Miglio. 1998. Restricting conjunction to constraint families. In *Proceedings of WECOL 96*, edited by Vida Samiian, 102-117. Fresno, CA: California State University.

Gnanadesikan, Amalia. 2004. Markedness and faithfulness in child phonology. In *Fixing Priorities: Constraints in Phonological Acquisition*, edited by René Kager, Joe Pater and Wim Zonneveld, 73-108. Cambridge: Cambridge University Press. [ROA-67]

Goad, Heather and Yvan Rose. 2004. Input elaboration, head faithfulness and evidence for representation in the acquisition of left-edge clusters in West Germanic. In *Fixing Priorities: Constraints in Phonological Acquisition*, edited by René Kager, Joe Pater and Wim Zonneveld. Cambridge: Cambridge University Press.

Hayes, Bruce. 2004. Phonological acquisition in Optimality Theory: the early stages. In *Fixing Priorities: Constraints in Phonological Acquisition*, edited by René Kager, Joe Pater and Wim Zonneveld. Cambridge: Cambridge University Press.

Itô, Junko and Armin Mester. 2003. *Japanese Morphophonemics: Markedness and Word Structure*. Cambridge, MA: MIT Press.

Jesney, Karen. 2005. *Chain Shift in Phonological Acquisition*. MA Thesis. Calgary, AB: University of Calgary.

Kirchner, Robert. 1996. Synchronic chain shifts in Optimality Theory. *Linguistic Inquiry,* 27: 341-351.

Ladefoged, Peter and Ian Maddieson. 1996. *The Sounds of the World's Languages*. Oxford: Blackwell.

Lombardi, Linda. 1999. Positional faithfulness and voicing assimilation in Optimality Theory. *Natural Language and Linguistic Theory* 17: 267-302.

Macken, Marlys A. 1980. The child's lexical representation: the '*puzzle-puddle-pickle*' evidence. *Journal of Linguistics* 16: 1-17.

McCarthy, John J. 2006. *Hidden Generalizations: Phonological Opacity in Optimality Theory*. London: Equinox.

McCarthy, John J. and Alan Prince. 1995. Faithfulness and reduplicative identity. In *Papers in Optimality Theory: University of Massachusetts Occasional Papers* 18: 249-384.

Moreton, Elliott. 2000. *Phonological Grammar in Speech Perception*. PhD Dissertation. Amherst, MA: University of Massachusetts.

Pater, Joe. 1997. Minimal violation in phonological development. *Language Acquisition* 6(3): 201-253.

Pater, Joe. 2006. Weighted constraints: typology and acquisition. Paper presented at Generative Approaches to Language Acquisition North America 2. Montréal, PQ: McGill University.

Prince, Alan and Bruce Tesar. 2004. Learning phonotactics distributions. In *Fixing Priorities: Constraints in Phonological Acquisition*, edited by René Kager, Joe Pater and Wim Zonneveld. Cambridge: Cambridge University Press.

Prince, Alan and Paul Smolensky. 2004. *Optimality Theory: Constraint Interaction in Generative Grammar*. Malden, MA: Blackwell.

Rose, Yvan. 2000. *Headedness and Prosodic Licensing in the L1 Acquisition of Phonology*. PhD Dissertation. Montréal, PQ: McGill University.

Smith, Jennifer L. 2000. Positional faithfulness and learnability in Optimality Theory. In *Proceedings of ESCOL 99*, edited by Rebecca Daly and Anastasia Riehl, 203-214. Ithaca, NY: CLC Publications.

Smith, Neilson V. 1973. *The Acquisition of Phonology: A Case Study*. Cambridge: Cambridge University Press.

Smolensky, Paul. 1996. On the comprehension / production dilemma in child language. *Linguistic Inquiry* 21: 720-731.

Steriade, Donca. 2001. Directional asymmetries in place assimilation. In *The Role of Speech Perception in Phonology*, edited by Elizabeth Hume and Keith Johnson, 219-250. San Diego: Academic Press.

Tessier, Anne-Michelle. 2005. Testing for OO-Faithfulness in artificial phonological acquisition. Paper presented at *BUCLD 30*. Boston, MA: Boston University. [ROA-817]

Tessier, Anne-Michelle. 2007. *Biases and Stages in Phonological Acquisition*. PhD Dissertation. Amherst, MA: University of Massachusetts. [ROA-883]

Velleman, Shelley L. 1988. The role of linguistic perception in later phonological development. *Applied Psycholinguistics* 9: 221-236.

Velten, H.V. 1943. The growth of phonemic and lexical patterns in infant language. *Language* 19(4): 281-292.

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