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CONSONANT HARMONY IN CHILD LANGUAGE: AN OPTIMALITY-THEORETIC ACCOUNT*

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1. Preliminaries

First language acquisition is commonly characterized by consonant harmony (CH), a process whereby consonants which are not string adjacent assimilate to one another, usually in place features (see e.g. Smith 1973; Ingram 1974; Macken 1976; Cruttenden 1978; Menn 1978; Vihman 1978; Donahue 1986; Stemberger & Stoel-Gammon 1991). What is particularly striking about CH is that while is it common in child language, with the exception of sibilant assimilation, long-distance place assimilation among consonants is virtually unattested in adult language (cf. Drachman 1978; Vihman 1978; Shaw 1991). Representative examples of consonant harmony from four children are in (1).[1] While details vary from child to child, we may conclude from the literature that assimilation applies regardless of the quality of the intervening vowel, and coronals typically assimilate place from labials and velars.

(1) a. *Right-to-Left Labial Harmony:*
Sean at 1;3-1;6 (Donahue 1986):
- ‘soap’ → [pop]
- ‘nipple’ → [mɪpəl]
- ‘Tommy’ → [bami]

b. *Left-to-Right Labial Harmony:*
Child at 1;6-2;2 (Cruttenden 1978):
- ‘spoon’ → [bum]
- ‘pen’ → [pɛm]
- ‘birdie’ → [bəːbi]

c. *Right-to-Left Velar Harmony:*
Jennika at 2;0-2;2 (Ingram 1974):
- ‘dog’ → [gɔk]
- ‘take’ → [kek]
- ‘taco’ → [kako]

d. *Left-to-Right Velar Harmony:*
Amahl at 2.60-2.114 (Smith 1973):
- ‘coach’ → [g̊uːk]
- ‘kitchen’ → [g̊igən]
- ‘curtain’ → [g̊əːg̊ən]

In a derivational account, the observation that CH is often restricted to coronal targets is commonly captured through underspecification (see esp. Spencer 1986; Stemberger & Stoel-Gammon 1991). If coronals are represented as an unadorned place node, CH is then consistent with the view that assimilation is in the unmarked case feature-filling rather than feature-changing. Combined with the idea that early grammars are characterized by CV segregation, that consonants and vowels define independent planes, the asymmetry between adult and child language can be

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[1] The symbols in (1) and throughout this paper are the same as those used by the authors of the respective works. [g̊] represents a voiceless unaspirated lenis stop (Smith 1973:37). Note that in (1d), the final nasals in ‘kitchen’ and ‘curtain’ are not targets for assimilation, as Amahl only tolerates coronal consonants in metrically weak positions.

captured: consonant features can spread long-distance without being blocked by intervening vowels (see Macken 1989, 1992; McDonough & Myers 1991).

Based on data from Smith's (1973) grammar of his son Amahl at Stage 1 (age 2.60-2.114), I argue that an analysis involving Coronal underspecification and planar segregation is untenable. First, while CH does indeed target coronals, there is evidence that it is also *triggered* by coronals, when the targets are liquids. We thus arrive at a paradoxical situation where, as triggers, coronal consonants must bear Coronal and, as targets, they must be unspecified for this feature. As will be seen, in this case, an appeal to temporary underspecification of Coronal is unsatisfactory. Second, planar segregation cannot adequately account for the harmony patterns documented by Smith. In particular, right-to-left application of velar harmony is productive beyond the point when Amahl's grammar satisfies the requirements set forth in McCarthy (1989) for planar segregation.

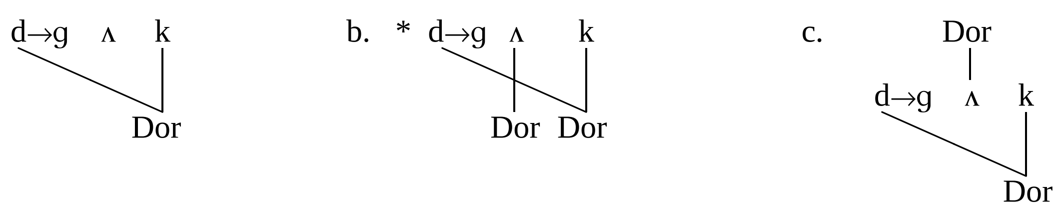
I argue instead for an optimality theoretic account of CH (Prince & Smolensky 1993), one which is motivated by the relative ranking of constraints which "parse" (link) place features and those which "align" place features with the edges of some domain, usually the prosodic word (cf. McCarthy & Prince 1993a). As we will see, the fact that coronals are both targets and triggers can be captured if the constraints responsible for parsing and aligning Labial and Dorsal are ranked higher than those responsible for parsing and aligning Coronal. The latter will only be satisfied in words which contain no other place-bearing consonants, i.e. in words with liquids. Finally, the effect of planar segregation is obtained automatically. The constraint ranking, motivated on the basis of other facts about Amahl's grammar, forces alignment to be satisfied through copying of segmental material, not through spreading (feature sharing). In this respect, consonant harmony in child language formally resembles reduplication rather than, for example, vowel harmony.

The paper is organised as follows. In Section 2, I review the standard analysis of child consonant harmony and discuss the empirical problems posed by Amahl's data for an account involving CV planar segregation. In Section 3, Amahl's consonant harmony patterns at Stage 1 are discussed in some detail. An analysis involving serial derivation (with Coronal underspecification) follows in Section 4, and empirical and conceptual shortcomings are addressed. The basic assumptions of Optimality Theory (OT) are outlined in Section 5, after which an OT analysis of Amahl's consonant harmony patterns is provided; Section 6 focusses on obstruent and nasal targets, and Section 7, on liquids. I conclude in Section 8 with some hypotheses as to why we do not find consonant harmony in adult languages.

2. Planar Segregation

Consonant harmony in child language has typically been treated as spreading; see e.g. Menn (1978); Spencer (1986); Stemberger & Stoel-Gammon (1991). Consistent with these works, the derivation for [gʌk] 'duck' would be along the lines of that in (2a). As is apparent from (2b), however, the problem with (2a) is that the assimilation is applying non-locally.[2] To avoid crossed association lines, consonants and vowels must define separate planes as in (2c). Precisely this analysis has been proposed by Macken (1989, 1992) and by McDonough & Myers (1991).

(2) a.



2 In non-linear phonology, "locality" is a restriction on long-distance assimilation which requires that trigger and target be adjacent on some specified tier at the segmental or prosodic level (see Archangeli & Pulleyblank 1987; Odden 1994; also Archangeli & Pulleyblank 1994).

As CV segregation circumvents locality, there must be limited conditions under which it can be invoked. Toward this goal, McCarthy (1989) restricts it to languages which do not have inherent linear order relations between consonants and vowels: (i) languages such as Semitic where consonants and vowels define separate morphemes; (ii) languages such as Yawelmani where morphological templates determine the order of consonants and vowels; and (iii) languages such as Chinese and Mayan which have restricted root structure constraints. Few adult languages satisfy these requirements which no doubt attests to the rarity of non-coronal CH.

The question which naturally arises is: does child language meet any of these requirements? McDonough & Myers (1991) argue that early grammars satisfy criterion (iii) and, for some children, criterion (ii) as well. For one, child language has a very restricted inventory of syllable types which in effect means that the sequence of consonants and vowels is predictable. Further, some children develop quasi-templatic root constraints which require that consonants be visible to one another across intervening vowels. In a similar vein, Macken (1989, 1992) argues that early grammars are of two types: “harmony grammars” which are characterised by extensive CH, and “melody grammars” which display rigid root- or syllable-structure constraints. She suggests that these properties are best captured through planar segregation.

While I do not dismiss the possibility that early grammars warrant CV segregation, I argue that this explanation cannot adequately account for Amahl’s CH patterns. Specifically, CH is present and productive at stages when planar segregation is no longer possible. While Amahl’s syllable types at Stage 1 are restricted to V(V)C, CV(V) and CV(V)C, one of his consonant harmony rules, right-to-left application of velar harmony, is retained until Stage 14 (age 2.247-2.256) by which point he is producing consonant clusters; see (3a).[3] The presence of clusters precludes the planar segregation account of CH as consonants and vowels are no longer occurring in a predictable order (cf. also Levelt 1994). This is most apparent from the onset and coda clusters in (3b). These facts compel us to find an alternative characterization of the process.

(3) a. *CH within Clusters:*
[g̊lʌk] ‘truck’ (St 10)
[g̊riŋk] ‘drink’ (St 12)

b. *Onset and Coda Clusters:*
[g̊laːt] ‘glass’ (St 10) *vs.* [g̊ɔːld] ‘called’ (St 9)
[g̊luːd]; [kluːd] ‘clothes’ (St 12; 13) *vs.* [kuːld] ‘cold’ (St 12)

3. Amahl’s Stage 1 Data

In order to effectively interpret the consonant harmony data, we begin with some brief discussion of the relevant features of Amahl’s speech at Stage 1. From (4a), it can be seen that voicing is not distinctive. According to Smith (1973:37), stops are voiceless unaspirated lenis word-initially, voiced lenis word-medially, and voiceless fortis in final position. Second, coronal obstruents are (for the most part[4]) realised as anterior stops, (4b). The situation with labials, (4c), is somewhat more complex: while /f/ is realised as a stop in coda position, both /f/ and /v/ surface as [w] in onset position. Finally, consonant clusters are absent altogether; see (4d,e). With the exception of final nasal + voiced stop sequences, only the least sonorous member of the constituent is produced.[5]

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[3] The stages for the data in (3), (6b), (10), and (11) correspond to the following ages:

Stage 2: Age 2.115-2.129	Stage 5: Age 2.139-2.144	Stage 10: Age 2.198-2.203
Stage 3: Age 2.130-2.133	Stage 6: Age 2.148-2.152	Stage 12: Age 2.219-2.227
Stage 4: Age 2.134-2.137	Stage 9: Age 2.189-2.196	Stage 13: Age 2.233-2.242

[4] However, /s/ and /ʃ/ are sometimes deleted in word-initial position, e.g. ‘seat’ [iːt].

[5] In /s/ + stop/nasal clusters, /s/ is always deleted. In keeping with the unique behaviour of initial /s/ in many European languages, I assume that it is not part of the onset and is instead licensed by some higher prosodic constituent (see e.g. Kenstowicz 1994).

(4) *Stage 1 Consonant Reductions:*

a.	*Voicing Neutralisation:*				
	[b̥, d̥, g̊] voiceless unasp lenis	[b̥ɔi]	'boy'	[d̥ai]	'tie'
	[b, d, g] voiced lenis	[ɛbu]	'apple'	[g̊ɛguː]	'Lego'
	[p, t, k] voiceless fortis	[aːt]	'hard'	[g̊ʌk]	'duck'
b.	*Coronal Obstruent Reductions:*				
	/θ, ð, s, z, ʃ, ʒ, tʃ, dʒ/ → [d̥, d, t]	[d̥uːt]	'juice'	[ʌdə]	'other'
c.	*Labial Obstruent Reductions:*				
	Ons /f, v/ → [w]; Coda /f/ → [p]	[wæwə]	'flower'	[maip]	'knife'
d.	*Initial Clusters:*				
	/s/ + stop,nasal → stop,nasal	[g̊ai]	'sky'	[mit]	'Smith'
	obstr + approx → obstr	[b̥æk]	'black'	[g̊eip]	'grape'
e.	*Final Clusters:*				
	liquid + obstr → obstr	[mik]	'milk'	[b̥ɔːt]	'bolt' (N)
	nasal + vclss stop → stop	[d̥ɛt]	'tent'	[d̥æp]	'stamp'
	nasal + voiced stop → nasal	[mɛn]	'mend'	[ɛn]	'hand'

Turning directly to consonant harmony, it can be seen from the data in (5) that CH never applies between labials and velars: 'black', for instance, is neither *[b̥æp] nor *[g̊æk].

(5) *Labials and Velars as Potential Targets:*

Labial + Velar (no assimilation)		*Velar + Labial* (no assimilation)	
[b̥æk]	'black'	[g̊eip]	'grape'
[mik]	'milk'	[g̊eːp]	'escape'
[wiŋ]	'swing'	[g̊ʌm]	'come'

Harmony only applies when coronal consonants are targets. From (6a), we can see that when the targets are obstruents, velar harmony applies obligatorily in both directions: 'cloth' and 'stalk' are virtually homophonous. Labial harmony, however, does not affect final coronals: 'bit' surfaces as [b̥it] and not as *[b̥ip]; and it applies optionally when coronals are in initial position: 'stop' is realised both as [b̥ɔp] and as [d̥ɔp].

(6) a. *Coronal Obstruents as Potential Targets:*

Velar + Coronal (L→R: oblig assim)		*Coronal + Velar* (R→L: oblig assim)		*Labial + Coronal* (L→R: no assim)		*Coronal + Labial* (R→L: opt'l assim)	
[g̊ɔk]	'cloth'	[g̊ɔːk]	'stalk'	[b̥it]	'bit' (N)	[b̥ɔp]	'stop'
[g̊ik]	'kiss'	[g̊ʌk]	'duck'	[wɔt]	'wash'	[d̥ɔp]	'stop'
[g̊uːk]	'coach'	[g̊aːk]	'dark'	[b̥ɔːt]	'bolt' (N)	[b̥eːbu]	'table'
[g̊aːgiː]	'glasses'	[g̊igiː]	'sticky'	[b̥aːt]	'bath'	[d̥ʌm]	'drum'

b. *Coronal Nasals as Potential Targets:*

Vel + Cor Nasal (L→R: no assim)	*Cor Nasal + Vel* (R→L: oblig assim)	*Lab + Cor Nasal* (L→R: no assim)	*Cor Nasal + Lab* (R→L: oblig assim)
[g̊iːn] ‘clean’	[ŋeik] ‘snake’	[b̥əːn] ‘burn’	[maip] ‘knife’
[g̊in] ‘skin’	[ŋʌŋgə] /nʌŋgə/ (St 2) Hindi: ‘naked’	[b̥ɛn] ‘pen’	[mibu] ‘nipple’
[g̊ɔːnə] ‘corner’	[ŋ̣(g̣)ɛk] ‘neck’ (St 4)	[b̥uːn] ‘spoon’	[mɔb̥] ‘knob’ (St 2)

When the targets are nasals, the data for the most part parallel those in (6a). From the first column in (6b), however, it can be seen that harmony does not operate from left-to-right: ‘clean’ surfaces as [g̊iːn] and not as *[g̊iːŋ]. As with obstruent targets, labial harmony does not operate from left-to-right when the targets are nasals, although right-to-left application appears to be obligatory; there is no evidence of optionality until Stage 6 (age 2.148-2.152).

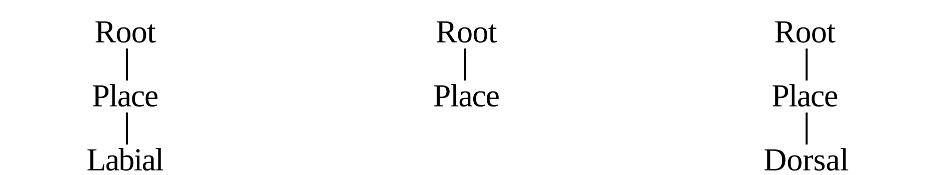
4. A Derivational Account

4.1. Coronal Underspecification

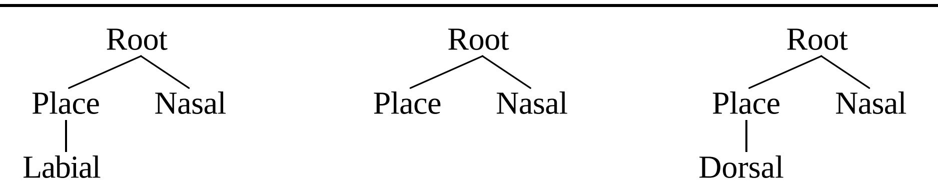
Before turning to the optimality theoretic analysis, I will briefly outline one rule-based account for comparison. In the standard derivational analysis, the asymmetry observed in consonant harmony between the behaviour of coronals on the one hand and labials and velars on the other is captured through Coronal underspecification (see esp. Spencer 1986; Stemberger & Stoel-Gammon 1991). Factoring in Amahl’s consonant reductions from (4), the input to CH would be representations along the lines of those in (7).

(7) *Amahl’s (Underlying) Production Representations:*

Amahl: |B| Adult: /p,b/, coda /f/	Amahl: |D| Adult: /t,d,θ,ð,s,z,ʃ,ʒ,tʃ,dʒ/	Amahl: |G| Adult: /k,g/



Amahl: |m| Adult: /m/	Amahl: |n| Adult: /n/	Amahl: |ŋ| Adult: /ŋ/



The representations in (7) reflect the commonly held view in non-linear phonology that features are hierarchically organised into constituents under a superordinate “Root” node; this theory has come to be known as “feature geometry” (Clements 1985; Sagey 1986). Following Sagey (1986), the articulators with which speech sounds are executed — Labial, Coronal, and Dorsal — are sisters under a common Place node. Underspecification of Coronal formally translates into coronals being represented as a bare Place node.[6]

The representations in (7) reflect only what Amahl can produce rather than the greater number of contrasts he can perceive. Production representations are therefore derived from more fully specified perceptual representations. Whether production representations are themselves stored (one interpretation of the "Dual Lexicon" model; see Menn & Matthei (1992) and references cited therein) or whether they merely reflect an intermediate stage in the derivation is not of issue here. Under either view, production representations, marked by straight brackets in (7), constitute the input to the phonology proper: syllabification, consonant harmony, and the like. For ease of exposition, the following discussion is expressed within the Dual Lexicon model.

In Figure 1 (modified from Spencer 1986:8), underlying representations (URs) are divided into two components, an input lexicon which reflects the child's perceptual abilities and an output lexicon, his or her productive abilities. The relationship between these levels of representation is exemplified in the same derivation provided for Amahl's two surface forms for 'stop'. (R stands for Root node; μ for mora; and σ for syllable.)

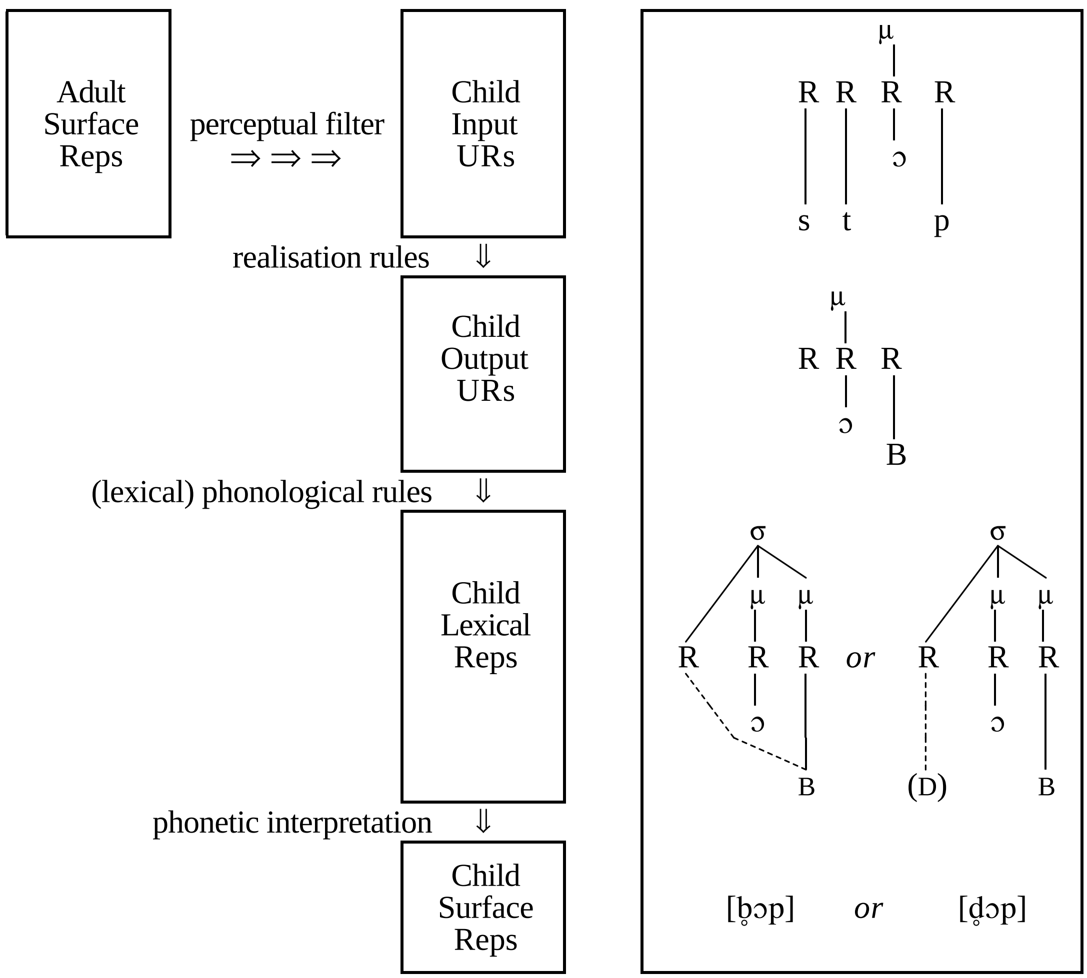


Figure 1. Dual Lexicon

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6 In the literature on underspecification, representing coronals as a Place node with no dependents is what is *minimally* assumed. See the contributions to Paradis & Prunet (1991) for various views on this issue, and McCarthy & Taub (1992) for critical discussion.

The child's input underlying representations reflect the level at which words are distinguished from one another. As such, they are not fully specified, but only encode information that is required to minimally contrast lexical items (cf. Spencer 1986). Output representations are derived from input representations through a set of realisation rules which eliminate structure. The output lexicon is therefore the product of segmental neutralisations and of rules which eliminate clusters (cf. (4)). In the example provided, voicing contrasts are neutralised (/p/→|B|), contrasts among coronals are lost (cf. (7)), and the /st/ cluster is reduced. Consonant harmony rules and syllabification apply in the (lexical) phonological component, and default material (e.g. ØPlace → Coronal) is inserted at the end of this component. When consonant harmony applies, Labial spreads to the unadorned Place node of the initial consonant yielding |BɔB|. If there is no harmony, Coronal is filled in by default: |DɔB|. Amahl's voicing spell out rules apply in the phonetic component, yielding [b̥ɔp] and [d̥ɔp] respectively.

4.2. Conceptual and Empirical Shortcomings

There are two problems, I argue, with the rule-based analysis briefly outlined above, one conceptual and the other empirical. The conceptual problem stems from the fact that in rule-based approaches, the set of rules cannot be formally reconciled with the set of independently needed constraints on representation (cf. Kisseberth 1970). In Amahl's grammar, it appears that the presence of consonant harmony is as much a consequence of production (output) constraints as is the reduction of contrasts among coronal stops and fricatives. Yet, in a model such as that in Figure 1, these two facts are not related, regardless of whether production representations are stored or derived. Contrasts that the child can perceive but not produce are first neutralised; the output of this level of representation is then the input to the consonant harmony rules. It is thus formally arbitrary that the reduction (underspecification) of coronals to bare Place in one component is what in some sense "triggers" CH in a later component. This problem does not arise in a framework such as Optimality Theory, as representations are assessed for their adherence to all types of well-formedness simultaneously.

The thrust of the argument becomes clearer when we consider the empirical problem that Amahl's Stage 1 data cause for a rule-based account involving underspecification. However, we must first consider some relevant axioms of underspecification theory. One, in the unmarked case, harmony is assumed to be feature-filling rather than feature-changing. It therefore applies to segments unspecified for the feature which spreads. Two, in approaches to underspecification known as Contrastive or Restricted Underspecification, the degree to which segments are specified is determined by the particular contrasts present in an inventory (Steriade 1987; Avery & Rice 1989; Mester & Itô 1989; inter alia). If a language contains only one series of coronals, these segments are generally assumed not to bear a Coronal node. If, on the other hand, some coronals in a language minimally contrast for sub-coronal place features, they are specified both for a Coronal node and for the relevant dependent(s). In Avery & Rice (1989), this is achieved through the Node Activation Condition in (8):

(8) *Node Activation Condition (NAC)* (Avery & Rice 1989:183):

> If a secondary content node is the sole distinguishing feature between two segments, then the primary feature is activated for the segments distinguished. Active nodes must be present in underlying representation.

In a language with anterior coronals only, specifications for obstruents are as in (9a). In another language where /t/ and /tʃ/ minimally contrast, both segments bear a Coronal node as per the NAC, and /tʃ/ also bears Post(erior); see (9b).[7]

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[7] In Avery & Rice (1989), features are assumed to be monovalent. As "-" is arguably the marked value of the traditional binary feature [anterior], it is replaced by monovalent Posterior.

(9) a.

p	t	k
|	|	|
Pl	Pl	Pl
|		|
Lab		Dor

b.

p	t	tʃ	k
|	|	|	|
Pl	Pl	Pl	Pl
|	|	|	|
Lab	Cor	Cor	Dor
			|
			Post

If this view of underspecification is on the right track, the consonant reduction facts in (7) would suggest that Amahl's perceptual representations resemble those in (9b) and his production representations, those in (9a). CH would then target coronals precisely because it operates on production representations when coronals are unspecified for Place dependents. There is evidence, however, that CH is also triggered by coronals, in words where the targets are liquids. It would thus seem that, as triggers, coronal consonants must bear Coronal yet, as targets, they must be unspecified for this feature. An appeal to temporary underspecification is less than satisfactory. There is no independent evidence that CH applies to non-liquid targets early in the derivation when Coronal is unspecified and to liquids only after this feature has been supplied by default rule. There ia also no independent evidence for the alternative, that CH is triggered by labials and velars early in the derivation and by coronals after Coronal has been supplied by default (cf. also McCarthy & Taub 1992; Itô, Mester & Padgett 1995).

4.3. Liquids

Let us turn directly to the data on liquids. A cursory look at Amahl's Stage 1 data in the Appendix to Smith's (1973) grammar would lead to the conclusion that /l, r/ surface as [d̥] in onset position, except in words which contain other liquids where they are instead realised as [l].[8] 'light', for instance, surfaces as [d̥ait] while 'lorry' surfaces as [lɔliː]. This, however, is contradicted by words such as 'hello' which is realised as [ɛluː]. A plausible account for all of these forms is that Lateral is a property of the morpheme in the output lexicon (cf. Spencer 1986) and, perhaps for articulatory reasons, is only licensed where it is flanked by vowels; see (10a). If Lateral were then to spread to all liquids in the word, 'lorry' and 'trolly' would surface correctly, (10b).[9] However, under this analysis, 'telephone', 'along' and 'balance' should surface with medial [l]; cf. (10c).

(10) a. 'light' dait (Lat, unlinked); 'hello' ɛluː | Lat

b. 'lorry' l ɔ l iː — Lat (linked to second l, dotted to first l); 'trolly' l ɔ l iː — Lat (linked to second l, dotted to first l)

c. 'telephone' d̯ɛwiːbuː(n) (Lat, unlinked) — *d̥ɛliːbuː(n) | Lat

'along' (St 4) əgɔŋ (Lat, unlinked) — *əlɔŋ | Lat

'balance' (St 6) b̥ætən (Lat, unlinked) — *b̥ælən | Lat

The problem in (10), I argue, is that the presence or absence of surface Lateral is being confounded by the operation of consonant harmony. Consider the data in (11). The forms in (11a,c) exhibit the

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8 Here we are concerned only with the realisation of /l, r/ in onset position. Amahl speaks standard Southern British English, so /r/ is in fact restricted to onset position. When /l/ is syllabic, it vocalises to [u]; in coda position, it is deleted altogether.

9 There is some evidence to suggest that initial /l/ is difficult to produce. Stemberger (1992:184) reports on a child who produced initial /l/ correctly only when there was an intervocalic /l/ (also produced correctly) later in the word; otherwise initial /l/ was replaced by [ɮ]. Thanks to an anonymous reviewer for pointing this out.

behaviour of /l/ and /r/ in harmonising contexts where it can be seen that they pattern as do the coronal obstruents: they are realised as [w][10] in labial contexts and as [g̊] in velar contexts.

(11) *Liquids:*

Before Labials			*Before Coronals*			*Before Velars*		
a.	[wɛpt]	‘left’ (St 3)	b.	[d̥ait]	‘light’	c.	[g̊ɔk]	‘lock’
	[wæp]	‘lamp’ (St 5)		[d̥æt]	‘lash’		[g̊ɛk]	‘leg’
	[wum]	‘room’		[d̥ein]	‘rain’		[g̊iŋ]	‘ring’
	[wɔbiː]	‘Robbie’		[d̥ɛt]	‘red’		[g̊ʌk]	‘rug’ (St 2)
d.	[d̥ɛwiːbuː(n)]	‘telephone’	e.	[b̥ætən]	‘balance’ (St 6)	f.	[əgɔŋ]	‘along’ (St 4)
	[əwiːp]	‘asleep’ (St 8)						
	[g̊æwəwæn]	‘caravan’						

With other Liquids			*[l] in Isolation*		
g.	[lɔliː]	‘lorry’	h.	[ɛluː]	‘hello’
	[lɔliː]	‘trolly’		[uːliː]	‘only’ (St 6)
	[lɔlə]	‘troddler’			

What is striking about these data is that, without exception, [d̥] occurs before a coronal obstruent or nasal. The data in (11b), I argue, like those in (11a,c), are due to CH. In [d̥ait] ‘light’ and [d̥ein] ‘rain’, for example, coronal place structure is occupying the onset position; however, since Coronal and the feature Approximant cannot be licensed on a single segment in English, the result is [d̥] (due to constraint ranking; see Section 7). In combination with Lateral Harmony, /l/ can surface in (11g,h) precisely because these words contain no place-bearing consonants.[11]

As an alternative to the consonant harmony analysis, one might argue that /l/ surfaces as [l] in (11g,h) because of some property of laterals that favours intervocalic position. In languages like Luganda, for example, /d/ is realised as [l] between vowels (Hyman 1975:167). This analysis, however, would incorrectly predict that the forms in (11d-f) would surface with liquids. Instead, /l, r/ surface as Labial, Coronal, and Dorsal respectively, as would be expected is they were acquiring place from the following consonant. Alternatively, one might argue that consonant harmony is triggered only by labials and dorsals, and that in non-harmonic contexts, /l, r/ are neutralised to [d̥] (cf. Smith 1973:19). This analysis, however, cannot account for the differences observed in ‘hello’ and ‘only’ on the one hand versus ‘balance’ on the other. Finally, one might argue that the pattern observed in (11b) is not due to place assimilation but, instead, to manner assimilation (cf. Spencer 1986:12). The relevant feature would be [-continuant]. Notice, however, that the assimilation is taking place before both obstruents and nasals. Nasals are not typically assumed to bear a specification for [-cont]. If the rule were to operate after nasals had been supplied [-cont] by default rule, /l/ would also receive a specification for this feature and would thereby not be predicted to exhibit any change in the harmony process. Second, the manner assimilation would have to be restricted to coronals and velars, to the data in (11b,c). In other words, it would not be obvious why the harmonised labial consonants in (11a) are realised as [w] and not as [b̥].

I thus conclude that alternative analyses cannot account for all of the data in a unified way, and return to the hypothesis that the patterns in (11a-f) are due to consonant harmony involving place features. Under this analysis, coronal consonants can both trigger and be targets for CH.

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10 Liquids are realised as [w] and not as [b̥] in labial contexts because the manner features of the liquid in the input are compatible with labiality in the output (see Section 7). There is one exception: [b̥ʌbə] ‘rubber’.

11 Due to space considerations, no account of Lateral Harmony is provided here. Note that Amahl has no words such as ‘low’ or ‘ray’ at Stage 1 which have a liquid in initial position and contain no place-bearing consonants. Also, intervocalic [r] is often subject to deletion, e.g. [g̊ɔiːdɔː].

They thus appear to be both specified and unspecified for Coronal. While this causes problems for a rule-based analysis involving underspecification, we will see shortly that in Optimality Theory, the effects of coronal underspecification and coronal specification can be simultaneously obtained through constraint ranking. Let us now turn to a more systematic examination of the premises of this theory.

5. Optimality Theory

Rule-based approaches to phonology have primarily been concerned with constructing a theory in which there is a direct correlation between the simplicity of the formal expression of a process and its frequency across languages; and with restricting the available primitives and operations to allow only for the formalisation of attested processes. With the development of nonlinear phonology, significant progress has been made toward these goals: a concomitant shift in focus from rules to representations has resulted in a highly constrained theory of the nature of underlying representations and of the types of operations permitted to derive surface representations. Nevertheless, rule-based nonlinear phonology continues to suffer from the problem that the set of rules cannot be formally reconciled with the set of independently needed constraints on representation. The solution to this problem proposed within Optimality Theory (OT) is to deny that rules exist (see Prince & Smolensky 1993; McCarthy & Prince 1993a,b).

OT replaces the theory of operations entirely with a theory of well-formedness where well-formedness is assessed across representations, not derivations. Inputs (underlying representations) and outputs (surface representations) are related through a set of universal, violable constraints. Individual grammars are constructed from this set of constraints only. In this way, OT contrasts with rule-based approaches where Universal Grammar (UG) contains the set of primitives and the conditions on their combination and interaction, but the rules themselves are language-specific.

As all constraints are part of the grammar of every language in OT, every grammar will contain constraints that are in conflict with one another. Some constraints will therefore be violated in order to satisfy higher ranked constraints. In this way, OT represents a shift in focus from a theory of absolute well-formedness to a theory of relative or "optimal" well-formedness. Different languages represent different ways of resolving the conflict among competing constraints; in fact, cross-linguistic variation results primarily from variation in constraint ranking.

To illustrate the relationship between ranking and violability, let us assume that UG contains only three constraints, X, Y and Z. Suppose further that "Gen" (the component which freely generates outputs so long as they conform to the principles of UG) provides as outputs the set of candidates {$cand_1$, $cand_2$} for a given input /I/. If $cand_1$ satisfies X, Y and Z while $cand_2$ violates one or more of these constraints, then $cand_1$ is clearly the optimal output, i.e., the output assigned to /I/ by the grammar. If, on the other hand, $cand_1$ satisfies X and Z only while $cand_2$ satisfies Y and Z and $cand_1$ is in fact the correct ouput, then constraint X must be ranked over constraint Y: X >> Y. This situation is displayed in the tableau in (12a) for an input /I_A/ and two candidates $cand_{A1}$ and $cand_{A2}$. If for an input /I_B/ in (12b), $cand_{B1}$ violates the lowest ranked constraint Z in addition to Y, the fact that $cand_{B1}$ violates more constraints than $cand_{B2}$ does not affect the well-formedness of $cand_{B1}$: constraints are ranked in a strict dominance hierarchy such that each constraint has absolute priority over all lower-ranked constraints.

(12) a. Input /I_A/:

	X	Y	Z
☞ $cand_{A1}$		*	
$cand_{A2}$	*!		

b. Input /I_B/:

	X	Y	Z
☞ $cand_{B1}$		*	*
$cand_{B2}$	*!		

Following the conventions of Optimality Theory, constraint ranking is indicated by right-to-left order within tableaux. ☞ marks the optimal candidate, and constraint violation is marked by an asterisk. An exclamation mark indicates a fatal violation, the point where a particular candidate loses out to at least one other candidate. Since evaluation is done in parallel — the grammar rates alternative analyses according to how well they satisfy the whole constraint set — all outputs continue to be marked for the violations they incur, even after they incur fatal violations. After the point where a non-optimal candidate acquires a fatal violation mark, its cells are shaded; the cells of optimal candidates are shaded after the point where there are no longer any competing candidates.

We turn now to the optimality-theoretic account of Amahl's consonant harmony patterns. As will be seen, the bulk of the alternations exhibited can be captured through the interaction of a small number of independently needed constraints. The fact that these constraints are independently needed locates this work within a growing body of literature on acquisition within Optimality Theory which attempts to account for children's patterns with the same constraints as are required for adult languages (e.g. Demuth 1995, Gnanadesikan 1995, Pater & Paradis 1995, Stemberger 1995, Velleman 1995). Differences between child and adult grammars are due to differences in constraint ranking; other extralinguistic factors may play a role as well (see further Section 8).

6. Consonant Harmony: Obstruent and Nasal Targets

6.1. Constraint Ranking

Consonant harmony falls out of the relative ranking of constraints which "parse" place features and those which "align" place features with the edges of some domain, usually the prosodic word. Parse is a family of faithfulness constraints which requires material present in the input to be parsed (or linked) in the output. It thus prefers candidates where underlying material has not been deleted. Alignment refers to a family of constraints which captures the fact that reference to the edges of morphological and prosodic constituents is commonly required in phonological operations. As defined in (13a), Generalized Alignment requires that the specified edge of every prosodic or grammatical category, Cat1, coincide with the specified edge of some prosodic or grammatical category, Cat2. Alignment can designate either the left or right edge, and opposite or corresponding edges can be aligned.

(13) a. *Generalized Alignment* (McCarthy & Prince 1993a:80):
Align (Cat1, Edge1, Cat2, Edge2) = def
$\forall$ Cat1 $\exists$ Cat2 such that Edge1 of Cat1 and Edge2 of Cat2 coincide
Where
Cat1, Cat2 $\in$ PCat $\cup$ GCat
Edge1, Edge2 $\in$ {Right, Left}

b. ALIGN (Artic, L, ArticDomain, L)

c. *Harmonic Domain* (Pulleyblank 1994):
The edge of a harmonic domain is established by a link to a harmonic feature, else, by a word-boundary

The particular alignment constraints required here are those which are expansions of the template in (13b). "Artic" refers to any member of the class Labial, Coronal, Dorsal. While Amahl's grammar exhibits harmony in both directions, the discussion will focus on the more productive right-to-left pattern only, as indicated by reference to the left edge in (13b). Finally, I adopt Pulleyblank's (1994) definition of harmonic domain, (13c). The significance of this will become clear shortly.

Since Optimality Theory maintains that all constraints are universal, there will always be constraints that are in conflict with one another, and language-particular orderings will determine for each input which constraints are satisfied at the expense of others. We can obtain the effects both of Coronal underspecification and of Coronal specification with the constraint ranking in (14). (A comma separates two constraints which are unranked with respect to one another.)

(14) PARSELAB, PARSEDOR >> ALIGNLAB, ALIGNDOR >> PARSECOR >> ALIGNCOR

The ranking of PARSELAB and PARSEDOR above PARSECOR in (14) may be universally fixed, as it captures the cross-linguistic observation that labials and velars dominate coronals in assimilation processes (Kiparsky 1994). Regarding the relative ranking of PARSE and ALIGN, in order to obtain the effect of harmony, PARSE must be ranked above the alignment constraint which refers to the same feature. Otherwise, harmony would not result, as alignment could be satisfied through underparsing of the relevant feature (see Piggott 1995 for discussion). Putting these two observations together, (14) indicates that it is more important to align Labial and Dorsal (with the left edge) than it is to parse Coronal. As a result, coronals will be targets for harmony in words which contain place-bearing consonants. Given the relatively low ranking of ALIGNCOR, harmony will only be triggered by coronals in words which contain no other place-bearing consonants, i.e. in words with liquids (see Section 7).

To illustrate the interaction between align and parse, we begin with a comparison of Amahl's 'black' which is not subject to CH and 'stalk' which undergoes harmony to yield [g̊ɔːk]. (The non-effects of intervening vowels will be discussed shortly.) Since 'black' contains no coronals, any attempt to align Dorsal with the left edge — whether through spreading, (15a.i), or through melody copy, (15a.ii) — will violate the higher ranked PARSELAB. (Material in angle brackets is not parsed in the output; inserted material is underlined.) For 'stalk' in (15b), on the other hand, high ranking of ALIGNDOR guarantees that alignment will be favoured at the expense of incurring violations of the lower ranked PARSECOR. Thus, the candidate in (15b.iii) loses out either to (15b.i) or to (15b.ii). (As we will see, (15b.ii) is in fact the optimal candidate; cf. (16e).)

(15) a. No Harmony: [b̥æk] 'black'

	PARSE LAB	ALIGN DOR
i. g æ k <Lab> Dor	*!	
ii. g æ k Dor Dor <Lab>	*!	
☞ iii. b æ k Lab Dor		*

b. Harmony: [g̊ɔːk] 'stalk'

	ALIGN DOR	PARSE COR
i. g ɔː k <Cor> Dor		*
ii. g ɔː k Dor Dor <Cor>		*
✘ iii. d ɔː k Cor Dor	*!	

6.2. Melody Copy

With the constraint ranking in (14), we capture the asymmetry in consonant harmony between labials and velars on the one hand and coronals on the other. However, we have yet to address the question of the intervening vowels. As discussed in Section 2, without planar segregation, CH must be analysed as melody copy. This analysis follows directly from high ranking of PARSELAB/DOR and of two independently needed constraints, NOGAP and *COMPLEX. NOGAP is arguably a universally undominated constraint which rules out configurations where potential targets are skipped. It is thus the OT analogue of locality. *COMPLEX, an undominated constraint in Amahl's grammar, captures the fact that configurations where an "organizing node" (e.g. Place) branches are marked (see also Kawasaki 1995). For example, with two Place node dependents, labio-velar /kp/ is more marked than either /p/ or /k/.

A more comprehensive tableau for 'stalk' is given in (16).[12] The first candidate, that which is most faithful to the input, violates the highly ranked ALIGNDOR twice: Dorsal misses the left edge

[12] Due to space limitations, undominated NOGAP, *COMPLEX, *V-TO-C and OCP (see below for discussion of the latter two) are assigned to the same cell. Elsewhere in the tableau, dotted lines between constraints indicate

by two segments. The second candidate, (16b), satisfies ALIGNDOR by skipping the medial vowel. This violates the undominated NOGAP. (16c) and (16d) avoid this problem by treating the vowel as a target. If the vowel's Labial feature is parsed, (16c), the result violates the undominated *COMPLEX. If it is unparsed, (16d), the output violates the highly ranked PARSELAB.

The last alternative is to copy the Dorsal specification onto the initial consonant, as in the optimal candidate in (16e). Thus, while CH results from satisfying the requirements of alignment, it involves the equivalent of melody copy, not spreading. Since melody copy requires feature insertion (indicated by the underlining), FILLFEAT must be ranked low in Amahl's grammar. FILLFEAT is a member of the constraint family FILL which militates against the addition of material not present in the input.

While (16e) is in fact optimal, to a large extent, it resembles the unsuccessful candidate in (16a). Since the final Dorsal is not left-aligned in either candidate, it might appear that both candidates violate ALIGNDOR twice. If, however, we adopt Pulleyblank's (1994) definition of harmonic domain, (13c), the domain of the rightmost Dorsal specification in (16e) extends only as far as the initial Dorsal. As a result, there is only one violation of ALIGNDOR, the position occupied by the Labial vowel. In (16a), on the other hand, the domain of the rightmost Dorsal extends to the left word edge. Thus, there are two violations of ALIGNDOR, the positions occupied by the vowel and by the initial Coronal.

Let us turn finally to the candidates in (16f) and (16g). At the expense of violating ALIGNDOR, these candidates satisfy the equally highly ranked ALIGNLAB but, in so doing, violate *V-TO-C and OCP respectively, two undominated constraints in Amahl's grammar. *V-TO-C captures the fact that spreading of place features from vowels to yield primary place in consonants is, at best, highly marked (cf. Ní Chiosáin & Padgett 1993); for example, spreading of Labial from /u/ to /t/ in /tun/ yields secondarily-articulated [tʷun] and not primarily-articulated *[pun].[13] The candidate in (16f), where Labial has spread from the vowel to the initial consonant, violates this constraint. (16g) avoids this problem by copying the the vowel's Labial specification onto the initial consonant. It thereby violates OCP (Obligatory Contour Principle), a constraint which militates against representations where adjacent identical elements reside on the same tier (Leben 1973; McCarthy 1986).

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that their ranking is indeterminate, while solid lines mark strict dominance. As can be determined from (16), PARSELAB and PARSEDOR are highly ranked, but they are not undominated. Recall from note 1 that they can be violated in metrically weak positions where Amahl does not tolerate labial and velar consonants (with one exception): 'bottom' → [b̥ɔdin], *[b̥ɔdim] (cf. [d̥ɛm] 'jam'); 'working' → [wəːgin], *[wəːgiŋ] (cf. [wiŋ] 'swing'). I assume that these final nasals are unadorned Place nodes which are phonetically interpreted as coronal.

[13] Early child language *does* exhibit something akin to this process. Levelt (1994) provides examples from Dutch such as: /sχun/ → [pum] 'shoe' (Elke 1;9.24). However, the question arises whether, at this stage, Labial is underlyingly linked to the vowel or is instead a property of the morpheme.

(16) [g̊ɔːk] ‘stalk’

	NOGAP, *COMPLEX, *V-TO-C, OCP	PARSE DOR	PARSE LAB	ALIGN DOR	ALIGN LAB	PARSE COR	ALIGN COR	FILL FEAT
a. d ɔː k Cor Lab Dor				**!	*			
b. g ɔː k Lab <Cor> Dor	*! (NOGAP)				*	*		
c. g ɔː k Lab <Cor> Dor	*! (*COMP)				*	*		
d. g ʌː k <Lab> <Cor> Dor			*!			*		
☞ e. g ɔː k Dor Lab Dor <Cor>				*	*	*		*
f. b ɔː k <Cor> Lab Dor	*! (*V-TO-C)			**		*		
g. b ɔː k Lab Lab Dor <Cor>	*! (OCP)			**		*		*

We have seen that in cases like [g̊ɔːk] ‘stalk’, consonant harmony is satisfied through melody copy, (16e). This, however, is not necessary for words such as [g̊ʌk] ‘duck’ where the vowel and triggering consonant share the same place of articulation in the input. As can be seen in (17b), if Dorsal is copied, the output violates OCP. The optimal candidate, (17c), will therefore involve the equivalent of spreading. This form will not fail on *V-TO-C if the feature to be aligned, Dorsal, originates as a property of both the final consonant and the vowel in the input.

(17) [g̊ʌk] ‘duck’

	*V-TO-C, OCP	PARSE DOR	PARSE LAB	ALIGN DOR	ALIGN LAB	PARSE COR	ALIGN COR	FILL FEAT
a. d ʌ k Cor Dor				*!				
b. g ʌ k <u>Dor</u> Dor <Cor>	*! (OCP)					*		*
c. g ʌ k Dor <Cor>						*		

6.3. *Front Vowels as Dorsal*

From the discussion of ‘stalk’ in Section 6.2, we observed that the candidate in (16d), where Dorsal had spread throughout the entire word, was illicit as it left the vowel’s Labial feature unparsed. Thus, without violating *COMPLEX, the ranking of PARSELAB over ALIGNDOR guarantees that harmony cannot target the medial vowel in a word such as ‘stalk’. Recall from (14), however, that there is one place feature for which parse is ranked lower than the alignment constraints, Coronal. The effect of this ranking is to guarantee that the only possible targets for place harmony are segments which are specified for Coronal. If we adopt the traditional position that this feature is *not* available to vowels (following Sagey 1986; pace Clements & Hume 1995), front vowels will not incorrectly be targetted on the way to satisfying Labial or Dorsal alignment.

To exemplify, two analyses are provided for [g̊ægiː] ‘taxi’ in (18) and (19). (Irrelevant information has been omitted.) Dorsal alignment must be satisfied in this word, but if front vowels are Coronal as in (18), the ranking of ALIGNDOR over PARSECOR will incorrectly select (18a) as optimal; the front vowel has acquired Dorsal from the consonant to its right yielding *[g̊agiː]. The check mark indicates that (18b) should have been selected as optimal. If front vowels are instead analysed as Dorsal—Front, the correct output obtains as in (19). PARSEFRONT is undominated in Amahl’s grammar; and, as a result, the candidate in (19b) is favoured over that in (19a).

(18) *Front Vowels as Coronal:*

[g̊ægiː] ‘taxi’	ALIGN DOR	PARSE COR
☞ a. g a g <Cor> <Cor> Dor		**
✔ b. g æ g <u>Dor</u> Cor Dor <Cor>	*!	*

(19) *Front Vowels as Dorsal—Front:*

[g̊ægiː] ‘taxi’	PARSE FRONT	ALIGN DOR	PARSE COR
a. g a g <Fr> <Cor> Dor	*!		*
☞ b. g æ g <u>Dor</u> Dor Dor <Cor> Fr			*

To summarise, we have seen that consonant harmony involves left-alignment of Labial and Dorsal. The relatively low ranking of PARSECOR ensures that coronals are the only consonants which are targets for assimilation. If Coronal is a feature which is only available to consonants, any attempt to target intervening vowels in consonant harmony will violate the highly ranked PARSELAB, PARSEDOR, and/or PARSEFRONT.

7. Consonant Harmony: Liquid Targets

We turn finally to consonant harmony which targets liquids. Recall from the data in (11), a subset of which is reproduced in (20), that liquids only surface in words which contain no place-bearing consonants: e.g. [lɔliː], [ɛluː].

(20) *Liquids* (abbreviated from (11)):

Before Labials			*Before Coronals*			*Before Velars*		
a.	[wum]	'room'	b.	[d̥ein]	'rain'	c.	[g̊iŋ]	'ring'
	[wæp]	'lamp' (St 5)		[d̥ait]	'light'		[g̊ɔk]	'lock'
With other Liquids				*[l] in Isolation*				
d.	[lɔliː]	'lorry'		e.	[ɛluː]	'hello'		

In (20a,c), Labial and Dorsal occupy the onset position, yielding [w] and [g̊] respectively. Given that /l,r/ only surface as [d̥] in words which contain coronal obstruents and nasals, we can conclude that in (20b), Coronal place is similarly occupying the onset.

Since liquids do not contrast for place in English, I assume that they do not bear a Place node; they are instead distinguished through manner features, in particular through the structure they bear under the SV node (following Rice 1995). See (21).[14]

(21) *Liquids in English* (Rice 1995):

/l/: Root
|
SV
|
Approx
|
Lat

/r/: Root
|
SV
|
Approx

SV abbreviates "Spontaneous Voice" or "Sonorant Voice", a constituent initially proposed by Rice & Avery (1989) and Piggott (1992) to organise sonorant features. Its immediate dependent "Approximant" groups together liquids, glides and possibly vowels (cf. Ladefoged 1975; Clements 1990; Piggott 1993). It is thus equivalent to the class of segments defined by the intersection of the traditional [+continuant, +sonorant].

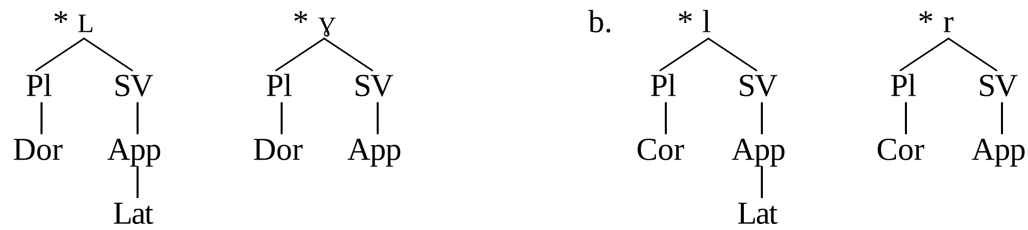
In words which contain place-bearing consonants, alignment must be satisfied. The harmonized consonants in (20b,c) surface as obstruents, [d̥] and [g̊] respectively, because Coronal and unadorned Dorsal cannot be licensed on a consonant which bears Approx in English. Thus, the structures in (22) are illicit in Amahl's grammar. Velar approximants, /ʟ/ and /ɣ/, do not occur in English;[15] and /l, r/ could only have the structures in (22b) if English had minimal contrasts among coronal liquids, /l/ vs. /ḷ/ and /r/ vs. /ṛ/ for example.

---

14 Appealing to the notion of "contrast" may not be the optimal solution for determining the representation of liquids. Nevertheless, we need some way to express the intuition that coronality in liquids is different from coronality in obstruents and nasals. In the former, coronality seems to act as an enhancement feature (in the sense of Stevens, Keyser & Kawasaki 1986) while in the latter, it is an inherent property of the segment.

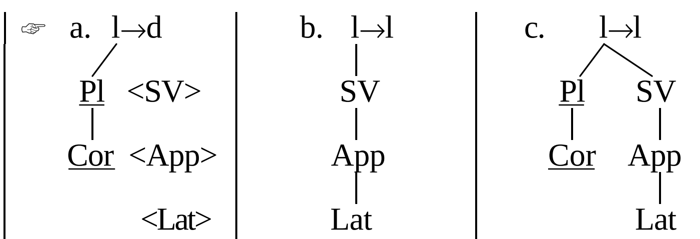
15 /w/ does not function as a velar approximant in English. The phonotactic constraint which forbids place identity within onset clusters indicates that /w/ patterns as Labial: *[pw] is illicit while [kw] is well-formed.

(22) a. b.



To prevent the selection of candidates which contain structures such as those in (22), I assume that UG contains a family of constraints with a similar function to that of Structure Preservation in Lexical Phonology (cf. Kiparsky 1985). This family of constraints, which I will call NOCONTRAST, militates against configurations of features that do not conform to the inventory of segments found lexically in a language. All of the structures in (22) thus violate NOCONTRAST.[16] To satisfy alignment and avoid violations of NOCONTRAST, SV features must be underparsed in examples such as those in (20b,c). The alignment constraints must therefore be ranked above PARSESV or above PARSEAPP. (The ranking among PARSESV, PARSEAPP, and PARSELAT is indeterminate.) Several candidates for the initial consonant in 'light' are compared in (23). The candidate in (23a) is optimal, that in (23b) is faithful to the input and thereby violates ALIGNCOR, and that in (23c) violates NOCONTRAST.

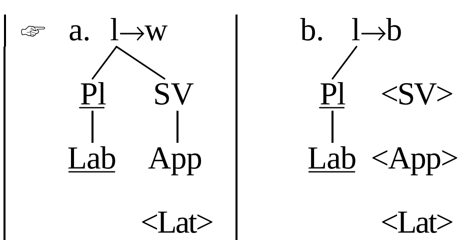
(23) /lait/ → [d̥ait]
Outputs:



	☞ a. l→d	b. l→l	c. l→l
NOCONTRAST	✔	✔	*!
ALIGNCOR	✔	*!	✔
PARSESV,APP,LAT	***	✔	✔

As the data in (20a) reveal, however, Labial and Approximant (without Lateral) can be licensed on a single segment; the result is [w]. Thus, 'lamp' is realised as [wæp], and not as *[b̥æp]; see (24).

(24) /læmp / → [wæp]
Outputs:



	☞ a. l→w	b. l→b
NOCONTRAST	✔	✔
ALIGNLAB	✔	✔
PARSESV,APP,LAT	*	**!*

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[16] If NOCONTRAST is conceived of as is Structure Preservation, it must know what the entire set of *inputs* looks like. Given that Optimality Theory is not concerned with the well-formedness of inputs, I suggest instead that candidates are assessed for their adherance to NOCONTRAST through a comparison with other *outputs*. However, NOCONTRAST not only requires that candidates for some input be compared with each other; they must also be compared with all other optimal outputs in the grammar. As such, NOCONTRAST increases the computational complexity of the theory, a problem which I leave to future research.

For completeness, a tableau for ‘ring’ is provided in (25). The candidate in (25a) is true to the input and thereby fails on ALIGNDOR. The remaining candidates all satisfy alignment, but (25b,c) violate NOCONTRAST: there is no velar fricative in Amahl’s grammar, nor is there a non-nasal sonorant stop, represented by [G] in (25c) (see Piggott 1995). The optimal candidate is that in (25d) where neither SV nor Approx is parsed. However, we have yet to discuss the more serious contender in (25e) where Nasal is inserted yielding [ŋ], a segment which is licit in onset position in Amahl’s grammar (cf. (6b) above) and which bears specifications both for Dorsal and for SV structure. As this is not the optimal candidate, it is crucial that FILLFEAT be ranked above the constraints which parse SV features.

(25) [g̊iŋ] ‘ring’

	NO CONTRAST	ALIGN DOR	FILL FEAT	PARSE SV	PARSE APPROX
a. r i ŋ SV Pl App Dor		*!*			
b. ɣ̊ i ŋ Pl SV Pl Dor App Dor	*!		**		
c. G i ŋ Pl SV Pl Dor <App> Dor	*!		**		*
☞ d. g̊ i ŋ Pl <SV> Pl Dor <App> Dor			**	*	*
e. ŋ i ŋ Pl SV Pl <App> Dor Nas Dor			***!		*

8. Conclusion

In conclusion, we have seen that a small number of constraints are responsible for Amahl’s consonant harmony patterns. CH is motivated by the need to satisfy alignment; no separate constraint guaranteeing place identity among consonants in a word is required. Since consonant harmony of the type commonly found in child language is rarely if ever attested in adult languages, a CH place identity constraint would have been limited to developing grammars, thereby weakening the OT premise that all constraints are universal. Nevertheless, we are left with the question as to why CH is not found in adult grammars. The explanation for this gap cannot follow entirely from the principle of locality, as CH is also absent from languages for which locality can be circumvented, languages for which planar CV segregation can be motivated. Interestingly, these languages do display other effects which indicate that consonants can “see” one another (e.g. root constraints), making the absence of CH is even more puzzling.

The absence of CH from adult languages suggests that the explanation for its presence in child language must lie outside the formal devices provided by the theory. If this is the case, phonological theory must provide the tools with which CH can be expressed, but the motivation for the process must be functional, i.e. independent of the grammar. In child language, a functional explanation for CH would include the fact that it decreases the number of articulatory instructions required to produce the word. As the child’s vocabulary increases in size, however, this functional constraint will compete with another — avoid homonyms — forcing CH to give way to the need to be communicatively effective.

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