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Phonotactic blocking through structural immunity

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1. Introduction

"Phonotactic blocking" is the failure of phonotactic conditions to apply even though the structural description is apparently present. Three general types of phonotactic blocking have been the focus of work in the past two decades:

(1) a. Strict cycle effects (nonderived environment blocking)
b. Lexical exceptionality
c. Geminate inalterability

These are all phenomena in which phonological generalizations are defied. Quite different approaches have been taken to them in the past. For strict cycle effects, conditions such as the Strict Cycle Condition (Mascaró 1976, Kiparsky 1982) have been proposed; lexical exceptionality has been handled by morphemic exception features (e.g. Chomsky & Halle 1968); geminate inalterability has inspired the Linking Condition (Hayes 1986) and Uniform Applicability Condition (Schein & Steriade 1986). Each of these various theoretical devices is targeted at specific types of phonotactic immunity. None extends to either of the other two types.

By contrast, Structural Immunity is a general approach that has been applied to all three of these phenomena. Structural Immunity is the method of prespecifying (either lexically, or via the grammar) strings with structure that blocks the application of phonological alternations or phonotactic conditions. The idea of handling nonderived environment blocking using structural immunity is due to Kiparsky (1993). It has since been applied to geminate inalterability (Inkelas & Cho 1993) and lexical exceptionality (Inkelas, Orgun & Zoll 1997).

The goal of this paper is to show that Structural Immunity, a time-tested technique, fares better than recent proposals couched within Optimality Theory (OT; Prince & Smolensky 1993) in handling nonderived environment blocking and in connecting that phenomenon to other types of blocking. In addition, we shall see that the structural approach leads to a new perspective on the "Richness of the Base" hypothesis in OT.

1 Nonderived environment blocking: a parade example

In this section we introduce the first of several examples which will inform the subsequent discussion of strict cycle, or derived environment, effects. The term "strict cycle" comes from rule-based cyclic analyses of these and other similar examples, in which it appears that phonological alternations apply only when their environments are morphologically derived on the same cycle of rule application[1] (see e.g. Mascaró 1976, Kiparsky 1982). The term "derived environment effects", or "nonderived environment blocking" (NDEB; Kiparsky 1993), captures in more general terms the generalization that these effects occur only across morpheme boundaries.

In Turkish, intervocalic velars delete (Zimmer & Abbott 1978, Sezer 1981, Inkelas & Orgun 1995, Inkelas, Orgun & Zoll 1997), due to a well-known sound change that has given rise to productive synchronic alternations (2a) [2]. Analyzed in OT, the alternation could be attributed to a constraint against intervocalic velars, as in (2b); ranked above MAX-C but below MAX-V, *VGV would have the desired effect. However, Velar Deletion is subject to nonderived environment blocking. Velars internal to morphemes do *not* delete, as shown in (c):[3]

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[1] I will ignore for purposes of this paper those strict cycle effects which are dependent on a *phonologically* derived environment; see e.g. Mascarô 1976 for discussion.
[2] Deletion does not apply when the preceding vowel is long, e.g. *mera:k-i* 'curious-acc'
[3] Turkish data are given throughout the paper in standard Turkish phonemic transcription. "ˆ" = IPA [ɯ]; "ü" = IPA [y]; "ö" = IPA [ø]; "ç" = IPA [tʃ]; "c" = IPA [dʒ].

(2) Turkish Velar Deletion

a.	bebek	'baby'	katalog	'catalog'
	bebe-i	'baby-acc'	katalo-u	'catalog-acc'
	bebe-e	'baby-dat'	katalo-a	'catalog-dat'
b.	*VGV ("no intervocalic velars")			
c.	sokak	'street'	*soak	
	soka-ˆ	'street-acc'	*soaˆ	

A few of the many other parallel examples from the literature include Polish First Velar Palatalization, Coronal Palatalization, as discussed by Rubach (1984) and Lubowicz (1998); Hausa palatalization (Inkelas & Cho 1993 and references therein); Korean affrication (Kiparsky 1993 and references therein), and Finnish assibilation (e.g. Kiparsky 1982, 1993).

Nonderived environment blocking effects inspired a number of different approaches in the 1970's and 1980's. These fall into two camps:

(3) 1970's and 1980's

a. STRICT CYCLE CONDITIONS. Originating with the (Revised) Alternation Condition of Kiparsky (1973), various extrinsic conditions on rule application have been proposed to prevent alternations from occurring in nonderived environments. Mascaró's well known (1976) modification to Kean's (1974) Strict Cycle Condition stipulated that neutralizing cyclic rules may apply only in derived environments.

b. ELSEWHERE CONDITION. Kiparsky (1982) proposed to make nonderived environment blocking an intrinsic, rather than extrinsic, property of rule application by reducing it to the Elsewhere Condition. Kiparsky's idea was that lexical identity rules (which stipulate the content of roots and of stems that have been created earlier in the derivation) would intrinsically block more general rules imposing phonological alternations. Only stems derived on the current cycle, which would not yet have corresponding lexical identity rules, would fail to block, and thus be subject to, structure-changing cyclic rules.

c. OBJECTION: the generalizations on which these are based are wrong (Kiparsky 1993)

Both of these approaches were rejected by Kiparsky (1993) on empirical grounds. Kiparsky observed that it was neither the case that all rules which are blocked in nonderived environments are cyclic, nor that all such rules are structure-changing. This finding contraindicates approaches like those in (3), which are inherently limited to neutralizing cyclic lexical phonology.

Kiparsky's (1993) suggestion was to replace the conditions in (3) with a Structural Immunity approach to nonderived environment blocking:

(4) The early 1990's

a. STRUCTURAL IMMUNITY (Kiparsky 1993): prespecified structure blocks structure-filling phonological rules

b. OBJECTION: pre/underspecification inconsistent with "Richness of the Base"

Kiparsky's inspiration was to use prespecified structure, including structure assigned by rule, blocks structure-filling rules.[4] Potentially alternating portions of roots would be underspecified, with their surface

[4] It is interesting to note that while Kiparsky (1982) had to assume that only structure-changing rules are blocked in nonderived environments, Kiparsky (1993) assumes that only structure-*filling* rules are blocked. Of course, the senses of "structure" differ somewhat across the two terms. Structure-changing rules are defined by result; they are neutralizing. But the operation used to accomplish the neutralization is free to vary. By contrast, structure-filling rules are defined by

values filled in by contextual rules; only those underspecified segments which find themselves in a variety of surface contexts could potentially alternate. Those which always occur in the same context (i.e. morpheme-internal ones) would never alternate. This is very much the approach defended in the present paper, although Kiparsky (1993) assumes a more restrictive theory of underspecification than the one adopted here.

Kiparsky achieved impressive results in his paper, gracefully handling many of the best-known examples of nonderived environment blocking. However, his approach faced objections within the Optimality Theory world from authors defending the "Richness of the Base" hypothesis of Smolensky (1996). This hypothesis, according to which grammars must be able to assign grammatical outputs to any conceivable lexical representation, has been popularly understood to be inconsistent with the use of underspecification to get analyses to work (see e.g. Burzio 1997).

Thus many working in the Optimality Theory framework found themselves bereft of a general account of nonderived environment blocking. Into this vacuum several new approaches have been thrust. I will briefly review them here, comparing each to Optimality Theory instantiations of a modified version of Kiparsky's Structural Immunity account.

2. New approaches in Optimality Theory

The first approach to be considered is that of Itô & Mester (1996), which relies on the notion that adjacency relations on the input must be preserved; segments in nonderived environments derive special protection from neighborhood preservation insofar as they have more input neighbors than segments in derived environments do.

2.1 Neighborhood Protection

Neighborhood, or adjacency, constraints in Optimality Theory are based on McCarthy & Prince's (1994:340) Linearity constraint, which is stated over two strings (their statement refers to R(eduplicant) and B(ase); here we will generalize to S1 and S2):

(5) LINEARITY: S1 reflects the precedence structure of S2, and vice versa
For $r_i, r_j \in$ Dom(f), $r_i < r_j$ iff $f(r_i) < f(r_j)$

In the above statement, *f* is the correspondence function relating strings S1 (the *domain*, or "Dom" or *f*) and S2 (the *range* of *f*).

Itô & Mester (1996:8) define a variant of the LINEARITY constraint, which they term NEIGHBORHOOD. (NEIGHBORHOOD differs slightly from LINEARITY in that it is unidirectional.)

(6) NEIGHBORHOOD:
- The neighborhood of a segment must be preserved
- If α precedes/follows β, then the correspondent of α precedes/follows β.

In order to make use of these constraints, several clarifications/modifications are necessary:

(7) Modifications to LINEARITY/NEIGHBORHOOD
a. **Immediate precedence.** I will assume that the notion of precedence being appealed to is *immediate* precedence. This appears to be the practice of Itô & Mester (1996) as well (on p. 9 of their paper, Itô & Mester say that "segments occupying stem edges ... are input-adjacent to only a single neighbor")
b. **Directionality.** I will assume that the constraints are evaluated only with respect to the one-way mapping from input to output. Doing otherwise would multiply the number of violations

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operation, not result. Structure-filling rules are those which simply add structure and do not delete it. They may or may not be neutralizing.

observed without, I believe, affecting outcomes in tableaux (for example, every affixed candidate would gratuitously violate the constraints by virtue of being one string in output but two nonlinearized strings in input).

c. **Mode of violation.** I will assume that the constraints are evaluated for each pair of adjacent input elements (whether segments, or features on a tier), and that violations are cumulative.

In summary, then, our working version of LINEARITY/NEIGHBORHOOD penalize corresponding strings in which a pair of adjacent input segments does not correspond to an adjacent pair in output. Relativized to a specific phonological tier, the constraints also penalize corresponding strings in which a pair of adjacent features does not correspond to an adjacent pair in output.

To exemplify, consider a Turkish morpheme with intervocalic velar:

(8)

	sok_1ak_2-a	NEIGHBORHOOD
a.	sok_1ak_2-a	
b.	sok_1a-a	*(ak_2)
c.	$soak_2$-a	**(ok_1, k_1a)
d.	soa-a	***(ok_1, k_1a, ak_2)

Deletion of the root-final velar violates NEIGHBORHOOD once, since the velar is a member of only one pair of adjacent input segments. (Crucially, the suffix is not considered adjacent to the root in input, as its linear position is determined only in output, by Alignment constraints.) But deletion of the internal velar contributes *two* NEIGHBORHOOD violations, since it is a member of two adjacent input pairs.

This observation is key to Itô & Mester's insight that two NEIGHBORHOOD violations are categorically worse than one. Internal segments, with larger neighborhoods to be loyal to, should be harder to disturb than peripheral segments, with smaller neighborhoods.

To implement this insight, Itô & Mester appeal to the mechanism of self-conjunction (Smolensky 1997). Conjoining NEIGHBORHOOD with itself yields NEIGHBORHOOD^2, a constraint which penalizes a string once for each pair of input segments that have *two* neighborhood violations.

To illustrate, let us apply the Neighborhood approach to the Turkish velar deletion example already discussed. Given the constraint ranking in (9),

(9) NEIGHBORHOOD^2 >> *VGV >> NEIGHBORHOOD

the correct prediction is that a tautomorphemic VGV sequence will be preserved, while a heteromorphemic one will be deleted:

(10) Deletion of stem-final /k/ violates NEIGHBORHOOD only once, and therefore does not violate NEIGHBORHOOD^2:

	sok_1ak_2-a	NEIGHBORHOOD^2	*VGV	NEIGHBORHOOD
a.	sok_1ak_2-a		**!	
☞ b.	sok_1a-a		*	*(ak_2)
c.	$soak_2$-a	*!(ok_1, k_1a)	*	
d.	soa-a	*!(ok_1, k_1a)		***(ok_1, k_1a, ak_2)

Although it appears to work well for this common kind of example, the Neighborhood account actually suffers a number of serious difficulties. These are summarized below:

(11) Problems for Neighborhood account of nonderived environment blocking:
  a. Predicts equal alterability of stem-final and suffix-initial velars in Turkish
  b. Predicts equal alterability of peripheral sequences generally, not just under affixation
  c. Can't handle NDEB effects involving nonadjacent trigger and target
  d. Can't handle NDEB effects in which there is no phonological alternation

2.1.1 Problem 1: disparate behavior of junctural segments

To illustrate the first point, consider the following data from Turkish (which also, by the way, present a problem for Mascaró-style strict cycle accounts). Both the polygon name-former *-gen* and the relativizer *-ki* begin with velars and can combine with vowel-final stems, yielding the environment for velar deletion. Yet affix-initial velars never delete:

(12)

a.	-gen		
	üç-gen		'3-gon = triangle'
	dört-gen		'4-gon = quadrilateral'
	yedi-gen	*yedien	'7-gon = septagon'
b.	-ki		
	Orhan-ˆn-ki		'Orhan-gen-rel = the one belonging to Orhan'
	ora-da-ki	*oradai	'there-loc-rel = the one over there'

This is contrary to the predictions of the neighborhood approach, which simply counts pairs of adjacent input elements. A CV suffix initial velar belongs to only one such pair; its deletion violates NEIGHBORHOOD but not NEIGHBORHOOD^2, and should thus be permitted:

(13)

	yedi-gen	NEIGHBORHOOD^2	*VGV	NEIGHBORHOOD
(☞) a.	yedi-gen		*!	
💣 b.	yedi-en			*(ge)

It is not obvious how to solve this problem. Stipulating that affix segments are more important to preserve than root segments would work, but runs afoul of the universal tendency (elevated to a universal constraint ranking in Optimality Theory; see e.g. McCarthy & Prince 1995) that root faithfulness outranks affix faithfulness. Another option would be stipulating that NEIGHBORHOOD^2 crucially include a violation of adjacency on the left, so that suffix-initial segments would never qualify.

2.1.2 Problem 2: disparate behavior of stem-peripheral segments

The second problem for the neighborhood approach, stated in (10b), is that it predicts that a stem-initial segment will be just as vulnerable to alternation conditioned by the following segment as a stem-final segment, which is clearly untrue. To see why, consider the following well-known example from Finnish (e.g. Kiparsky 1973, 1993). In Finnish, /t/ assibilates to /s/ before /i/ (13a). This alternation can be attributed to a constraint against /ti/ sequences (e.g. Burzio 1997:24), as in (b). However, the alternation is limited to derived environments, such that when the underlying form /tilat/ is suffixed with /i/, only the second /ti/ sequence — the one which spans the stem-suffix boundary — undergoes assibilation (c):

(14) Finnish assibilation

a.	Assibiliation turns /ti/ into /si/:		
	halut-a	'to want'	
	halus-i	'wanted'	
b.	*ti		
c.	Assibilation is subject to NDEB:		
	tilat-a	'to order'	*silat-a
	tilas-i	'order-3sg.pret.'	*silas-i

Although the initial /t/ of /tilat/ never assibilates, the neighborhood approach predicts that it should, as shown by the following table. Here, NEIGHBORHOOD and NEIGHBORHOOD^2 should be interpreted as applying to the [continuant] tier; changing /t/ to /s/ changes its value for [cont] and disrupts the underlying adjacency between the [-cont] specification of /t/ and the [cont] specifications of the adjacent segments.

(15) Problem: initial /t/ of /tilas/ has only one neighbor, and is not protected by NEIGHBORHOOD^2

	/tilat, -i/	NEIGHBORHOOD^2	*TI	NEIGHBORHOOD
a.	tilat-i		**!	
(☞) b.	tilas-i		*	*
💣 c.	silas-i			**!

Candidate (c), *silas-i*, does not violate NEIGHBORHOOD^2 because no single pair of adjacent input segments suffers two NEIGHBORHOOD violations. Therefore, since *silas-i* violates *TI the least, it is (incorrectly) predicted to win.

A possible solution would be to make NEIGHBORHOOD (and NEIGHBORHOOD^2) sensitive to boundary symbols (á la Chomsky & Halle 1968), so that the initial word boundary would be counted as one of the neighbors of the word-initial segment. This would correctly protect the /ti/ of /tilat/:

(16) Possible solution: make NEIGHBORHOOD sensitive to boundary symbols:

	/#$t_1$ilat$_2$#, #a#/	NEIGHBORHOOD^2	*TI	NEIGHBORHOOD
☞ a.	#$t_1$ilat$_2$#a#		*	
b.	#$s_1$ilat$_2$#a#	*!(#t_1, t_1i)		**

However, it would incorrectly block assibilation where we *do* want it to apply:

(17) Problem: derived environments are protected too:

	/#$t_1$ilat$_2$#, #i#/	NEIGHBORHOOD^2	*TI	NEIGHBORHOOD
(☞) a.	#$t_1$ilas$_2$#i#		*	
💣 b.	#$s_1$ilas$_2$#i#	**!(#t_1, t_1i; at$_2$, t_2#)		**

In summary, protection by adjacency works only when the target of the alternation is completely morpheme-internal — and not all nonalternating segments meet this condition.

2.1.3 Problem 3: stem-internal targets

The third problem for the Neighborhood account is illustrated by the following example from Uighur, in which the suffixal trigger of a raising alternation is not string-adjacent to its stem-internal target.

As reported by Orgun (1994, 1996), the rightmost vowel of an Uighur stem raises when in a nonfinal open syllable (a). (Note that in the last form in (ii), deletion, which has a similar environment, has applied to the root-final vowel.) The raising process can be attributed to a constraint against a [+high] vowel immediately followed by a syllable, as in (b). However, this constraint does not have any effect on high vowels in which the following syllable belongs to the same morpheme — i.e. to vowels in nonderived environments (c):

(18) a. i. qazan ‘pot’
qazan-ni ‘pot-acc’
qazˆn-i ‘pot-3sgposs’
ii. bala ‘child’
balˆ-lar ‘child-pl’
bal-lˆr-i ‘child-pl-3poss’

iii. ameriqa 'America'
ameriqˆ-lˆq

b. *[-high]σ

c. *qˆzan 'pot'
*bˆlˆ-lar 'child-pl'
*ˆmiriqa 'America'

A Neighborhood account of the immunity of vowels in non-stem-final syllables to Raising would protect two-member neighborhoods of high vowels by self-conjunction, as in (19):

(19) NEIGHBORHOOD[HIGH]^2

The problem for this account is that the trigger and target of Uighur Raising are not string-adjacent. Thus, while NEIGHBORHOOD[HIGH]^2 correctly protects the vowel in stem-initial or stem-medial syllables from raising, it also incorrectly protects even those vowels in stem-final syllables, as long as a consonant follows in the stem. The reason is that any vowel surrounded by other segments in the stem is automatically protected by NEIGHBORHOOD^2, as shown below:

(20)

	qazan, -i	NEIGHBORHOOD[HIGH]^2	*[-high]σ	NEIGHBORHOOD[HIGH]
💣 a.	qazani		**	
(☞) b.	qazˆni	*!(za, an)	*	**
c.	qˆzˆni	*!*(qa, az; za, an)		****

One might try to find a way around the problem of stem-internal target by appealing to a more sensitive definition of adjacency. Perhaps only vowels project the [high] feature and comprise the neighborhoods in which faithfulness is computed (abbreviated below as V-NEIGHBORHOOD[HIGH]). But this does not work either. As (21) shows, in a stem with two input vowels, both have only one vowel neighbor. Thus neither is protected by V-NEIGHBORHOOD[HIGH]^2, which is irrelevant to the outcome. As a result, the candidate which best satisfies *[-high]σ incorrectly wins (c).

(21)

	qazan, -i	V-NEIGHBORHOOD[HIGH]^2	*[-HIGH]σ	V-NEIGHBORHOOD[HIGH]
a.	qazani		*!*	
(☞) b.	qazˆni		*!	*(aa)
💣 c.	qˆzˆni			*(aa)

In summary, stem-internal undergoers of derived environment rules pose a challenge for the Neighborhood account because such undergoers have the same number of neighbors as the nonundergoers.

2.1.4 Problem #4: phonotactic requirements which induce no alternation

A different kind of problem for the Neighborhood account is posed by phonotactic requirements that happen not to result in alternations. Such a case is found in Turkish and has been the focus of much work by Inkelas & Orgun (1995), Orgun (1996) and Orgun & Sprouse (1997). As first documented by Itô & Hankamer (1989), some speakers of Turkish impose a disyllabic minimal size requirement on derived words. (22a) shows that these speakers judge suffixed monosyllabic words as ungrammatical. This is modeled by a constraint requiring words to be minimally disyllabic (b):

(22) Turkish Disyllabic Minimality

a. *fa-m 'musical note *fa*-1sg.poss = my *fa*' (cf. sol-üm 'my note *sol*)
*be-n 'letter *b*-2sg.poss = your *b*' (cf. abece-n 'your *abc*')
*ye-n 'eat-pass = be eaten!' (cf. yut-ul 'be swallowed!)

b. [σσ]ω

c. fa ‘musical note *fa*’
be ‘letter *b*’
ye ‘eat!’

However, as (22c) shows, monosyllabicity is tolerated and even common among nonderived words. Thus, although the Disyllabic Minimality condition causes no alternations, it nonetheless is subject to nonderived environment blocking. A neighborhood account is entirely inappropriate here. When the phonotactic condition [σσ]ω is imposed on illformed derived inputs, there is no output, hence no NEIGHBORHOOD^2 (or even NEIGHBORHOOD) violation.

2.1.5 Summary

To summarize, the neighborhood approach works only for stem-peripheral segments which are the target of an alternation conditioned by a trigger outside the stem. This is true of some cases of nonderived environment blocking, but it is by no means true of all.

2.2 Sequence Protection

A second type of approach to nonderived environment blocking is taken by Burzio (1997), who proposes faithfulness constraints on specified phonological *sequences*. The reason this approach can achieve nonderived environment blocking is that bases and affixes are not linearized in the input. Only morphologically derived tokens of such sequences escape sequence faithfulness and are permitted to alternate.

Burzio (1997) specifically discusses the case of Finnish assibilation, proposing that input *ti* sequences are the target of special faithfulness constraints (24a). The same approach extended to Turkish velar deletion would involve faithfulness to the sequence VGV (24b).

(23) a. Finnish: Faith_{ti} >> *ti (Burzio 1997)
b. Turkish: $\text{Faith}_{\text{VGV}}$ >> *VGV

These sequence faithfulness constraints would outrank the constraints responsible for the alternation (assibilation or velar deletion). The following table illustrates the approach applied to Turkish:

(24)

	sokak, -a	FAITH$_{\text{VGV}}$	*VGV
a.	sokaka		**!
☞ b.	sokaa		*
c.	soaa	*!	

Perhaps the most straightforward objection to the Sequence Protection approach is its redundancy; the phonotactic constraint causing the alternation from which nonderived sequences must be protected is repeated verbatim in the protection constraint. There is clearly no generalization being captured here. Burzio’s insight that those sequences which are immune are the sequences which are present in input is potentially valuable. But the analysis must stipulate this insight afresh for each invididual alternation.

2.2.1 Problem: “overlapping” protected sequences

The Sequence Protection approach fares better than the Neighborhood approach in handling the examples we have introduced thus far. However, at least one type of phenomenon does pose an empirical challenge. This is the Uighur raising example. Recall that in Uighur, syllable-final low vowels in stem-final syllables raise under affixation. Vowels followed by another vowel in the same morpheme do *not* raise. Under the Sequence Protection approach, this nonderived environment blocking effect would be attributed to a faithfulness constraint protecting [-high]σ sequences (abbreviated below as Vσ). However, as shown in the following table, the approach breaks down whenever the syllable in the relevant Vσ sequence itself contains a vowel that *does* undergo raising:

(25)		/ba$_1$la$_2$, -lar/	FAITH$_{V\sigma}$	*[-high]σ
	💣 a.	balalar		**
	(☞) b.	balˆlar	*!(a$_1$a$_2$)	*
	c.	bˆlˆlar	*!(a$_1$a$_2$)	

No matter whether candidate (c) is considered to violate the sequence faithfulness constraint once (as in the above table) or twice (since two segments in the sequence are altered), the fact remains that both candidates (b) and (c) violate the constraint while (a) does not. Thus, the candidate in which no raising occurs at all incorrectly wins. Note that not only does the intended winning candidate (b) *not* win; it actually does the worst of the three candidates in (26)!

Why does Sequence Protection fail to correctly identify candidate (b) as the winner? Because the second /a/ in candidate (b) is both the raising trigger for the first /a/ -- which should *not* alternate – *and* the target of raising by the third (suffixal) /a/. Once the second /a/ raises, the sequence containing it and the first vowel is no longer intact. Once the sequence is altered, there is nothing to be gained by keeping the first vowel intact, and so candidate (c), which better satisfies *[-high]σ, outdoes (b). Candidate (a) does even better by keeping the sequence so intact that not even the second vowel raises.

In sum, Sequence Protection works only if no other alternation (or even the same one, conditioned by a different trigger) affects any part of the sequence. This is unrealistic, as the Uighur example illustrates.

It is conceivable that the Uighur account could be rescued by self-conjunction. Depending on exactly how violations of sequence faithfulness are computed, the ranking FAITH$_{V\sigma}^2$ >> *[-high]σ >> FAITH$_{V\sigma}$ could correctly select candidate (b), balˆlar, as the winner in (26). This modification would, however, fail to capture the insight that the *second* /a/ in a tautomorphemic Vσ sequence is alterable, while the first is not. The account would simply count violations without identifying them. Moreover, the self-conjunction modification would not work even for the Finnish example discussed by Burzio. A variety of rankings and degrees of sequence faithfulness would therefore have to be utilized, reducing the insight and generality of the analysis.

2.3 Parasitic alternations, or local conjunction

The Parasitic Alternations approach of Lubowicz (1998) can in some ways be seen as a more sophisticated version of Sequence Protection. Lubowicz proposes that local conjunction of faithfulness and markedness constraints can generate both phonological and morphological derived environment effects. The essential idea is that one alternation may be parasitic on another. The bulk of Lubowicz's discussion is devoted to phonologically derived environments, not a focus of the present paper, but she addresses morphologically derived environments as well. Noting that many such cases involve stem-final segments under affixation, Lubowicz's insight is that resyllabification across a morpheme boundary "licenses" an alternation at the morphological juncture which otherwise could not occur:

(26) "By means of local conjunction, violation of stem:syllable anchoring activates a markedness constraint, causing a phonological process. In case when there is no violation of anchoring the phonological process is blocked" [Lubowicz 1998:26-27]

In other words, only if the syllable structure of a stem-final segment is being disturbed *anyway* is it all right to alter the segment in other ways.

Lubowicz implements the stem-syllable anchoring insight with the following constraint schema:

(27) [Markedness$_i$ × Anchor-R(stem, σ)]$_{Dom}$ >> Faithfulness >> Markedness$_i$

Markedness$_i$: constraint responsible for alternation at issue

Anchor-R(Stem, σ): "the rightmost segment of a stem in the input has a correspondent at the right edge of a syllable in the output" [Lubowicz 1998:25]

Dom(ain): "the smallest domain within which both of the locally-conjoined constraints can be evaluated" [Lubowicz 1998:33]

Markedness_i is the constraint responsible for the alternation in question. In its single state, it is ranked below Faithfulness, so that no alternations are expected to occur. However, Markedness_i is also locally conjoined with an Anchoring constraint. The conjunction is ranked *above* Faithfulness. Conjoined constraints, by convention (Smolensky 1997), are violated only when both conjuncts are violated (by the same portion of the string). Therefore the conjunction in (27) is violated only by those candidates in which a stem-final consonant surfaces as an onset *and* fails to conform to Markedness_i. Otherwise, the conjunction is satisfied. Therefore, the conjunction is satisfied by all candidates which satisfy Markedness_i and by all candidates in which stem-final consonants surface as codas. On the assumption that a consonant must surface as an onset when followed by a vowel-initial suffix, the relevant candidates are only those whose stem-final consonants surface as onsets and which satisfy Markedness_i. This is Lubowicz's insight exactly: only those consonants which resyllabify may alternate.

Lubowicz shows how the analysis works for Polish First Velar Palatatization; here, we illustrate using Turkish velar deletion data. In both Polish and Turkish, a stem-final consonant alternates before a vowel-initial suffix. In the Turkish example, Markedness_i is instantiated by *VGV. Recall that a conjoined constraint is violated only if both components are violated within a given domain. Light shading is provided for columns which clarify how violations are computed for the conjoined constraint as a reminder that only the "product" column is relevant to determining overall constraint satisfaction/violation. The domain for the conjoined constraint is assumed to be an input VGV sequence, the minimal domain within which violations of *VGV are computed.

(28)

	/sok$_1$ak$_2$, -a/	[*VGV × Anchor-R]$_{VGV}$				Faith	*VGV
		Relevant domains	*VGV	Anchor	Product		
a.	so.ka.k-a	/oka/	*		*!		**oka, aka
		/ak-a/	*	*			
☞ b.	so.ka.-a	/oka/	*			*k$_2$	*oka
		/ak-a/		*			
c.	so.a.-a	/oka/				**!k$_1$, k$_2$	
		/ak-a/		*			

2.3.1 Problem #1: stipulative

As formulated above, the Parasitic Alternations account is stipulative; Anchor-R stipulates that the stem-final segment is special, rather than deriving its special ability to alternate in some general way. Lubowicz's valuable insight might be captured better by making alternations parasitic on resyllabification generally, rather than on violations of Anchor-R specifically; we will not do this below, but it might be advantageous and would bring her analyses of morphologically derived environments even more closely in line with her analyses of phonologically derived environments.

2.3.2 Problem #2: Prefixal targets

An obvious sort of problem for the stem-anchoring account of nonderived environment blocking characterized by the quote in (26) is presented by targets of alternation which are not part of a stem. In Chumash, for example, an alternation which applies only in derived environments targets segments in a variety of *prefixes*.

As documented by Applegate 1972, a rule of Pre-Coronal Laminalization turns [s] into [S] before another coronal (see Poser 1982, 1993; Kiparsky 1993 for further analysis and discussion): [5]

(29) Pre-Coronal Laminalization (PCL): s → S / __ [cor]

s-lok'in	→	S-lok'in	'he cuts it'	p. 117
s-tepu/	→	S-tepu/	'he gambles'	p. 117
pil=c=nunux	→	picnunux	'to fall and blunt tip'	p. 118
ka-s-tepet	→	kaStepet	'name of a hill, a long hogback; it rolls'	p. 203
ma-l-is-tˆk-Vn	→	maliStˆkHˆn	'the first one; that which goes first, which goes in'	p. 206
s-liyo/	→	Sliyo/	'pool, pond' (cf. liyon 'to be deep')	p. 218
is-tˆk-Vn	→	iStˆkHˆn	'to precede, go first'	p. 243

Following Poser and Kiparsky, we assume that the feature in question is [-dist]; the constraint ranking in (30) represents the OT implementation of the alternation.

(30) *[-dist][cor] >> Faith[dist]

Like other alternations we have seen thus far, PCL is subject to nonderived environment blocking, as illustrated below:

(31) PCL is subject to nonderived environment blocking (data from Applegate, via Poser 1993:391):

stumukun	'mistletoe'	*Stumukun
wastu/	'pleat'	*waStu/
slow/	'eagle'	*Slow/

PCL applies only when the intended target is morpheme-final. In this respect Chumash is just like Finnish Assibilation and Turkish Velar Deletion. The big difference is that the morpheme-final consonant in Chumash belongs to a prefix, not a stem. (32) shows the result of plugging the relevant markedness constraint, *[-dist][cor], into the conjoined constraint schema:

(32) *[-dist][cor] $\times$ AlignR(Stem, σ)

No tableau should be necessary to reach the conclusion that AlignR(Stem, σ) will always be vacuously satisfied by a segment which is not stem-final in the input. Thus, no prefix-final /s/ can ever violate AlignR(stem, σ) and, therefore, no prefix-final /s/ can ever violate the conjunction in (32).

It might be possible to avoid the Chumash problem altogether by stipulating that PCL affects only affixes (ranking Root faithfulness sufficiently high would accomplish this). Counterevidence would be a prefix containing an /sn/, /sl/ or /st/ sequence (but even in such a case, one could point to the prefix as a lexical exception).

2.3.3 Problem #3: Alternation under perfect alignment

A related challenge for the theory that "derived environment" alternations apply exactly when anchoring is violated is presented by Basque. As documented by Hualde (1989) (see Orgun 1996 for discussion), final vowel raising applies only in suffixes — and only when those suffixes are word-final. In the data shown below, the underlying /a/ quality of the suffix vowel surfaces only when the vowel is "protected" from the end of the word by another suffix (a-c). Crucially, final vowel raising does *not* apply to stems, as shown in (d):

[5]Page numbers refer to Applegate 1972. Applegate does not provide morpheme glosses, and I have not ventured to create them myself. The s-final morphemes observed in these examples mark such functions as third person subject, possessive, and nominalization.

(33) Challenge: Basque final vowel raising (Hualde 1989)

a.	muti¥-a-k	'boy-def-erg'	
	muti¥-e	'boy-def'	*Raising applies*
b.	ondaru-Ra-ko	'bound for Ondarroa'	
	ondaru-Re	'to Ondarroa'	*Raising applies*
c.	ari-ka-Ra	'throwing of a stone'	
	ari-ke	'throwing a stone'	*Raising applies*
d.	fabrika	'factory'	

In Basque, the vowels that undergo the alternation are the ones which are word-final (and, of course, syllable-final). They are perfectly right-anchored in every way.

The Basque example, like Chumash, might be handled in an entirely different manner. Rather than trying to make Raising parasitic on an Anchoring violation, it might be possible to characterize Raising as a condition on word-final vowels which is ranked below Root-faithfulness:

(34) Faith-Root >> $*[\text{-high}]]_{\omega}$

This would account for the data, but weakens the theory of Parasitic Alternations. Based on the Chumash and Basque examples, nonderived environment blocking effects in affixes would have to be handled differently from those in stems. Affixes would fall outside the generalization that derived environment alternations occur under anchoring violations.

2.3.4 Problem #4: Stem targets which are not resyllabified

Even when affixes are set aside, however, the Parasitic Alternation theory does not account for all nonderived environment blocking effects within stems. In particular, tying the application of alternations to violations of stem anchoring fails to account for nonderived environment blocking effects which involve no concomitant resyllabification. A striking example is presented by Uighur Raising, in which the intended target is a vowel. It never resyllabifies under suffixation. Although a following consonant may resyllabify with the suffix, resyllabification is coincidental and not necessary.

Recall that Uighur Raising applies to the rightmost vowel in a stem when in an open syllable that is not word-final (i.e. which is followed by a suffix). As seen in the data below, repeated from (18), the event of a stem-final consonant resyllabifying with the suffix is irrelevant to the application of raising in the stem. The second example in (35) *has* no stem-final consonant:

(35)	a.	qazan + i	→	qazˆni	Raising of /a/ in stem-final syllable; resyllabification of stem-final C
	b.	bala + lar	→	balˆlar	Raising of /a/ in stem-final syllable; *no* resyllabification of stem-final C

No tableau is needed to make the point that there is no consistently concomitant phonological alternation on which to make Raising parasitic. The only event that accompanies Raising in (35b) is suffixation itself.

The fact that Raising applies only in suffixed forms might suggest the possibility of reparameterizing Anchor to be sensitive to the prosodic word:

(36) $[*[\text{-high}]\sigma \times \text{Anchor-R(stem, } \omega)]_{a\sigma}$ >> FAITH[-high] >> $*[\text{-high}]\sigma$

This constraint would be violated by any *aσ* sequence containing a stem-final segment which is nonfinal in a word. By definition (outside of metathesis and suffix deletion), suffixation renders a stem-final segment nonfinal in the word.

The problem here is that in words like *bala-lar*, whose stem contains *two* /a/ vowels, *both* vowels violate the conjoined constraint in (36). The sequence *...la-lar*, whose first vowel should raise, violates (36) by virtue of containing (double-underlined) stem-final /a/. But (36) is also violated by the sequence *...bala*, whose first vowel should *not* raise. The following tableau illustrates the problem just described:[6]

(37)

	/ba_1la_2, -lar/	*[-high]σ × Anchor-R(stem, ω)$_{[-high]σ}$ Domain	*[-high]σ	Anchor-R	Product	Faith	*[-high]σ
a.	ba.la.-lar	/a.la/	*	*	*!		**
		/a.-lar/	*	*	*		
(☞) b.	ba.lˆ.-lar	/a.la/	*	*	*!	*	*
		/a.-lar/		*			
💣 c.	bˆ.lˆ.-lar	/a.la/		*		**	
		/a.-lar/		*			

It is conceivable that a more sophisticated theory of domains could make this analysis work, but I am doubtful. The intuition that certain alternations apply only under affixation is promising (and resurfaces in section 4), but implementing it by focusing on the stem-final segment seems the wrong way to go. The stem-final segment is not a factor in Uighur Raising.

3. The proposal

The goal of this paper is to present a theory of morphological nonderived environment blocking effects which covers the full range of examples considered. In this section we sketch the desired proposal.

Two of the three proposals we discussed in the previous section share the intuition that alternating and nonalternating segments are distinguished by their context. For example, stem-final /t/ assibilates in Finnish, while stem-internal /t/ does not, because it is underlyingly adjacent to fewer segments (the Neighborhood account of Itô & Mester), or because it is not underlyingly adjacent to the trigger /i/ (the Protected Sequence account of Burzio).

The intuition which I would like to exploit in this section is somewhat different. Drawing on Kiparsky (1993), I propose that material which fits the structural description of an alternation yet fails to undergo the alternation is structurally immune, either phonologically or morphologically.

(38) Intuition: Structural immunity is conferred via input prespecification.

In his paper, Kiparsky assumes a strict version of radical underspecification which I will not adhere to here. Rather, I will assume the "archiphonemic" theory of underspecification put forth in Inkelas (1994). I will not go into the full details here, but roughly, the theory uses Lexicon Optimization (Prince and Smolensky 1993) to derive lexical underspecification in case of alternating segments whose surface values are

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[6]These analyses are highly dependent on the correct choice of domain in which to evaluate the conjoined constraint. Lubowicz (1998:31) explains that "the domain for LC is the smallest domain within which both of the locally-conjoined constraints can be evaluated. … In cases of morphologically-derived environments ... the ANCHORING constraint is still evaluated within a segment, but the markedness constraint requires two adjacent segments to be evaluated, and so the domain for LC is the window of two adjacent segments." In the one example of morphological nonderived environment blocking that Lubowicz analyzes, from Polish, the two-segment window appears to come from the statement of the palatalization constraint, which mentions adjacent segments: *[DORSAL][CORONAL, DORSAL] [fn. 17]. In Uighur I am therefore assuming that because the markedness constraint mentions a vowel and following syllable, that entire string is included in the domain in which the local conjunction constraint is evaluated. If both components of the conjunction are violated anywhere within that domain, I am considering the constraint to be violated. I hope that this is a correct extrapolation of Lubowicz's practice.

completely predictable from context. Nonalternating features, no matter how predictable, are lexically prespecified (except where that would cause trouble in the grammar). The account is very much in the spirit of Optimality Theory; underspecification is used when it would optimize input-output mappings, and not otherwise.

3.1 Prespecified structure doesn't alternate: Kiparsky (1993)

As an illustration of structural immunity to structure-filling alternations by means of prespecification, consider the example of Finnish Assibilation, discussed by Kiparsky. Assibilation is due to a structure-filling alternation which supplies values of [cont] to segments which lack them. The final segment in /tilaT/ is lexically underspecified for [cont], acquiring the value [+cont] when preceding /i/ ("assibilation") and [-cont] elsewhere. The initial segment in /tilaT/ is fully specified for [-cont] lexically, and resists the structure-filling alternation:

(39) Archiphoneme /T/ realized as /s/ before /i/, as /t/ elsewhere:
/tilaT-a/ → [tilata]
/tilaT-i/ → [tilasi]

Kiparsky provides a similar analysis for Chumash (see pp. 297-99).

Feature-filling alternations are quite familiar from the rule-ordering literature (see e.g. Kiparsky 1982, Archangeli 1984, Pulleyblank 1986), and easily modeled in Optimality Theory as well. The constraint ranking in (40) does the job:

(40) MAX[cont] >> ASSIBILATION >> DEP[cont]

where ASSIBILATION = *[-cont, cor][+high, -back]

Ranked below MAX[cont], ASSIBILATION can be satisfied only by supplying [+cont] to an underspecified segment. Replacing the [-cont] specification of a fully specified /t/ with [+cont] in satisfaction of ASSIBILATION would fatally violate MAX[cont], as the following tableau shows:

(41)

	/tilaT-i/	MAX[cont]	ASSIBILATION	DEP[cont]
a.	tilat-i		*!	*[-cont]
☞ b.	tilas-i			*[+cont]
c.	silas-i	*![-cont]		**[+cont], [+cont]

The Structural Immunity account handles the more challenging Uighur Raising example with equal ease. Consider the inputs in (41), each with underspecified vowels in the positions of potential alternation:

(42) /balA-lAr/ 'child-pl'
/amerikA/ 'America'

The constraint ranking in (43) treats Raising as a purely feature-filling alternation, restricting the insertion of [+high] to those vowels not already specified for [high] in input:

(43) MAX[-high] >> RAISING >> DEP[+high]

where RAISING = *[-high]σ

The following tableau illustrates the success of this analysis in deriving [balˆlar] 'child-pl', the form that stumped all three of the Optimality Theory approaches to nonderived environment blocking discussed in the previous section:

(44) Challenge for Neighborhood, Protected Sequences, Parasitic Alternations: [balˆlar]

	/balA, -lAr/	MAX[-high]	RAISING	DEP[+high]
a.	balalar		**!	**
☞ b.	balˆlar		*	*
c.	bˆlˆlar	*!		**

Candidate (c) loses because its first vowel violates MAX. By raising to [ˆ] it loses its input [-high] specification, a fatal violation. Candidate (a) loses to candidate (b) by incurring more RAISING violations. Both vowels in /balA/ are targets of RAISING. When neither raises, two violations are incurred. This leaves candidate (b) as the winner. Its final vowel raises; its initial vowel does not.

Of course, both this and the Finnish Assibilation analysis depend heavily on the input representations. We will discuss this issue at length in a subsequent section. For now we are simply demonstrating the descriptive adequacy of the Structural Immunity approach with respect to the case studies seen earlier in the paper.

3.2 Prespecified structure licenses dominated string

The analyses just presented of Finnish Assibilation and Uighur Raising work because the alternations in question are construable as purely feature-filling. The nonalternating material can simply be prespecified. But not all alternations which exhibit nonderived environment blocking effects are feature-filling. One such example is Turkish Velar Deletion. How can Structural Immunity be extended to examples such as the ones in (45)?

(45)	sokak, soka-a	'street(-dat)'	*soak, soa-a
	guguk, gugu-u	'cuckoo, cry of derision'	*guuk, guu-u

Velar Deletion deletes whole segments. One might attempt various strategies for featural prespecification of nonalternating /k, g/ and underspecification of alternating /k, g/, but since the alternation itself is not featural, these attempts would be far-fetched and uninsightful.

Structural Immunity, however, is not limited to feature structure. Inkelas & Orgun (1995) and Orgun (1997) develop a cyclic account of the data in (45) which attributes the immunity of root-internal velars to *syllable* structure. The gist of their account is that cyclic syllabification groups all segments except for stem-final consonants into syllables. Once syllabified, a segment is protected from deletion on subsequent cycles by a faithfulness constraint specific to input-syllabified material. Following Rice (1990) and motivated by completely independent considerations, Inkelas & Orgun propose that final consonants are extrametrical, thus immune to syllabification on each cycle. Velar Deletion applies on suffix cycles, but not on the root cycle. Thus it is in effect on only those cycles on which the input is presyllabified. This accounts for the mutability of stem-final intervocalic velars in derived environments.

The account is synopsized below, with an Optimality Theory implementation provided:

(46) Root cycle: Final consonant extrametricality, syllabification of all other segments. No velar deletion.

OT implementation: FINAL-V >> PARSE[σ]
MAX-SYL-C >> MAX-C >> *VGV

Suffix cycles: Same syllabification as on root cycle, but with velar deletion added.

OT implementation: FINAL-V >> PARSE[σ]
MAX-SYL-C >> *VGV >> MAX-C

MAX-SYL-C is the constraint used by Orgun (1997) to protect consonants which are syllabified in the input.

The following tableaus illustrate this method applied to the example *sokak*, given in the dative case. Square brackets represent syllables:

(47) Cycle 1: the root cycle

		Syllabification		*No velar deletion*		
	/sokak/	FINAL-V	PARSE-σ	MAX-SYL-C	MAX-C	*VGV
a.	[so][kak]	*!				*
b.	[so][ka]k		*(k)			*
c.	[so][ak]	*!			*	
☞ d.	[so][a]k		*(k)		*!	

Cycle 2: the (dative) suffix cycle

		Syllabification		*No velar deletion*		
	[so][ka]k, -a	FINAL-V	PARSE-σ	MAX-SYL-C	*VGV	*MAX-C
a.	[so][ka][ka]				**!	
☞ b.	[so][ka][a]				*	*
c.	[so][a][ka]			*!		*
d.	[so][a][a]			*!		**

The effect of ranking MAX-SYL-C over *VGV is that material which is syllabified in the input to the suffix cycle — i.e. material which is syllabified on the root cycle — is immune to velar deletion. Only consonants which are extrametrical on the root cycle succumb to velar deletion when rendered intervocalic on the suffix cycle, as is illustrated in the above tableaux.

In summary, features are not the only kind of structure which can be prespecified on segments which are immune from a particular alternation. In general, *any* structure which is independently attested as part of the nonalternating structure in question can be prespecified in the input to the cycle on which the alternation occurs.

4. Independent motivation for structural immunity account

Structural Immunity is motivated outside of strict cycle effects. I will illustrate this first by making a specific point about Turkish, and then more generally in a discussion of the Structural Immunity approach to lexical exceptionality.

4.1 Structural Immunity extends to systematic exceptionality in Turkish

We have seen above that Velar Deletion targets intervocalic velars in derived environments with regularity. There is one systematic exception to this, however, noted by Zimmer & Abbott (1978).[7] As shown in (48a), Velar Deletion fails systematically to apply to velars at the end of monosyllabic roots. The numbers refer to the Turkish Electronic Living Lexicon (TELL) database, developed at UC Berkeley, which contains phonemic transcriptions of 17,500 lexemes, each elicited in a variety of morphological contexts from a single native speaker.[8]

[7] Zimmer & Abbott (1978) tested the psycholinguistic reality of the polysyllable condition on Velar deletion by asking speakers to use two suffixes as words in carrier sentences. One suffix, the future *–ecek*, was disyllabic; the other, participial *–dik*, was monosyllabic. Both end in velars. In the carrier sentences, the suffixes occupied the position of an accusative NP and were thus suffixed with the vocalic accusative suffix. The future suffix was pronunced *ece-i*, with velar deletion; the participial suffix was pronounced *dik-i*, with *no* deletion.

[8] TELL can be accessed at http://socrates.berkeley.edu:7037/TELLhome.html

(48) Monosyllabic bases do not undergo Velar Deletion (47 nonalternating velars in TELL database, vs. only 1 or 2 that do alternate):

Nominative	Accusative/ 3sg possessive	Dative	Gloss
ek	ek-i	ek-e	‘affix’
lig	lig-i	lig-e	‘league’
sek	sek-i	sek-e	‘(dry) wine’

Why do the final consonants of monosyllabic roots not alternate when rendered intervocalic by suffixation? The answer is provided by Inkelas & Orgun (1995), in a discussion of minimal size constraints in Turkish. Building on earlier work by Itô & Hankamer (1989), Inkelas & Orgun propose that Turkish stems respect a bimoraic minimal size condition. This condition is independently motivated by vowel length alternations in CV roots. Its relevance to Velar Deletion is that it prohibits final consonant extrametricality in (C)VC roots, since failure to syllabify the final consonant would leave only one mora, in violation of minimal size.

(49) Minimal size condition, output of root cycle: [μμ]

Ranking: [μμ] >> FINALV (extrametricality blocked by minimality)

The tableau in (50) shows how root cycle blockage of minimality in a monosyllabic root leads to structural immunity for its final velar on the suffix cycle. (In these tableaux, only constraints of immediate relevance are shown; thus, minimality is not depicted for the suffix cycle, where suffixation renders all forms uninterestingly bimoraic anyway.)

(50) Root cycle: no final extrametricality for (C)VC monosyllable:

	/lig/	[μμ]	FINALV	PARSE[σ]
☞ a.	[lig]		*	
b.	[li]g	*!		*

(Dative) suffix cycle: velar deletion is blocked

	[lig], -e	MAX-SYL-C	*VGV	MAX-C
☞ a.	[li][ge]		*	
b.	[li][e]	*!		*

A parallel account is offered by Inkelas & Orgun (1995) for the failure of monosyllable-final plosives to devoice in coda position, a phenomenon noted in previous literature (e.g. Lewis 1967) but never explained.

In summary, Structural Immunity extends readily from nonderived environment blocking effects to the special behavior of monosyllables. There is a principled reason why monosyllable-final consonants should be prespecified in the input to the suffix cycle; Structural Immunity is thus a principled account of nonalternating velars in Turkish.

By contrast, neither the Neighborhood, Sequence Protection nor Parasitic Alternations approaches can possibly extend to the monosyllables. The local environment of a final velar is the same regardless of the number of preceding moras in the stem. Since all three of these approaches are local in character, none can distinguish a short from long stem.

4.2 Lexical exceptionality

Structural Immunity extends not only to systematic exceptionality, as in the case of Turkish Velar Deletion, but also to lexical exceptionality. This has been the topic of extensive discussion by Inkelas (1994) and

Inkelas, Orgun & Zoll (1997), who argue that prespecification is the ideal method for identifying the exceptional portions of phonologically irregular morphemes.

Many of the alternations we have looked at thus far in the paper which exhibit nonderived environment blocking effects also admit lexical exceptions. Ideally, the account of the former should be able to extend, on a lexical basis, to the latter, and this is indeed the case. For illustration we turn yet again to Turkish Velar Deletion. As shown in (51), the alternation is flouted by a number of exceptional forms. For the speaker represented in the TELL database, of some 1200 polysyllabic velar final forms in which the velar would be expected to alternate, it *fails* to delete in around 100.[9]

(51) Representative examples of the 8% of velar-final polysyllabic roots whose final velar fails to delete intervocalically in derived environments:

isolation	1sg possessive	gloss
antartik	antartik-ˆm	'Antarctic'
(cf. matematik	matemati-im	mathematics')
orak	orak-im	'sickle'
(cf. kurak	kurak-ˆm	'dry, arid')
salacak	salacak-ˆm	'slab for corpse'
(cf. olacak	olaca-ˆm	'ppl of olmak, to become, happen')
sitreptokok	sitreptokok-um	'streptococcus'
(cf. barok	baro-um	'baroque')
sinagog	sinagog-um	'synagogue'
(filolog	filolo-um	'philologist')

How can Structural Immunity protect the final velars of these roots? By presyllabifying them in underlying representation:

(52) [la][yik]

Just like final velars of monosyllables which are syllabified by rule on the root cycle, these underlyingly syllabified velars will resist Velar Deletion, thanks to MAX-SYL-C. (Whether the whole form is underlyingly syllabified, as shown in (50), or just its final syllable or even final mora, is immaterial; the issue is only that the final velar be part of a syllable.)

Chumash Pre-Coronal Laminalization also exhibits lexical exceptionality; as in Turkish, Structural Immunity provides a ready solution. Several forms cited by Poser (1993) (via Applegate 1972) are given in (53); the /s/ prefixes in these lexical items mysteriously fail to laminalize when preceding coronals in derived environments.

(53) Exceptions to Chumash Pre-Coronal Laminalization

s-netus	'he does it to him'
s-lu-skumu	'it branches into four'

Although Structural Immunity cannot explain *why* these prefixes fail to alternate in just these words — no theory of lexical exceptions can do that — it *can* provide a descriptive account. The 3d singular prefix /s/ has two allomorphs, one the underspecified /S/ which alternates between /s/ and /S/, as seen earlier, and another, /s/, which is prespecified as [-dist] and does not alternate. The latter allomorph is selected in words like those in (53).

[9] While it is true that many such forms are borrowings, it is also true that many borrowings fall into the "deleting" class. Some of these borrowings (e.g. sinagog) are quite old, and all are fully intergrated into the morphology of the language. Excluding borrowings is not an appropriate way to analyze Turkish, which has had centuries of sustained contact with other languages.

In summary, the use of relative prespecification to handle nonderived environment blocking is supported by the ease with which the same device can be used to handle systematic and lexical exceptionality to the very same alternations. No other approach to nonderived environment blocking effects can extend to exceptionality.

5. Two apparent problems for Structural Immunity

In this section we face two apparent challenges to the Kiparskyan Structural Immunity approach to nonderived environment blocking. The first of these is what I term "false blocking", or the illusion of nonderived environment blocking.

5.1 False blocking

Catalan and Turkish provide examples of apparent nonderived environment blocking effects which do not yield to prespecification. In Catalan, as documented by Mascaró (1976) and Wheeler (1975) and discussed in Kiparsky (1993), unstressed vowels reduce, leading to alternations when stress shifts (54a). Certain items, however, are exceptions to unstressed vowel reduction (b):

(54) Catalan Vowel Reduction
- a. Reduction of unstressed [o, e] to [u, ´]:
  - i. menjo [ménZu] 'I eat' [Wheeler 1975:33]
    mengem [m´nZEm] 'we eat'
  - ii. pesco [pEsku] 'I fish'
    pesquem [p´skEm] 'we fish'
- b. Failure of vowel reduction in certain lexical items:
  [bóston] 'Boston' [Kiparsky 1993:294, via Mascaró 1976]
  [kátedr´] '(academic) chair'
  [sopráno] 'soprano'

Interestingly, however, those lexical items which resist Vowel Reduction when unaffixed (54b) *do* undergo the rule when a suffix is attached (Kiparsky 1993:294, via Mascaró 1976):

(55) [bustun-yá] 'Bostonian'
[k´t´drá-tik] 'holder of an academic chair'

The second vowel in *Boston* is unstressed both in isolation and under affixation. There is no phonological reason why the addition of a suffix should affect its ability to reduce.

A similar phenomenon occurs in Turkish with respect to the bimoraic minimal size condition (originally detected by Itô & Hankamer 1989). As observed by Inkelas & Orgun (1995), for some speakers who ordinarily impose this condition on the root cycle, there are some lexical items which nonetheless can surface, unaffixed, as CV:

(56) Bimoraic Minimality in Turkish:
- a. Underlying representation: /a/ 'letter *a*', /be/ 'letter *b*', /ce/ 'letter *c*', /ye/ 'eat'
- b. Surface representations: /a:/, /be:/, /ce:/, but /ye/

A more systematic version of this phenomenon occurs in Turkish with respect to the *disyllabic* minimality condition. Inkelas & Orgun (1995) observe that Disyllabic Minimality holds only on morphologically derived lexical items. As shown in (57), monosyllables that contain a suffix are judged ungrammatical by the speakers who observe the disyllabic size condition (not all do), while nonderived monosyllabic forms are accepted by all speakers:

(57) a. *fa-m 'note *fa*-1sg.poss'

*ye-n 'eat-passive (imperative)'
b. fa 'note *fa*'
ye 'eat (imperative)'
son 'end'

There is no sense, as in Catalan Vowel Reduction or Turkish Bimoraic Minimality, that the resistant forms are *lexically* exceptional; Turkish has a great number of native monosyllabic roots which can be used in their bare forms as words (TELL lists over 600). There are no roots which require phonological augmentation when used without suffixes, and there are no roots which can occur with a variety of suffixes but not on their own, as one would expect if the grammar were really banning monosyllabic words in general.[10]

We have now seen three cases, two involving lexical exceptionality and one involving systematic exceptionality, in which exceptionality disappears under affixation. Why should this regularization occur? Phonological prespecification cannot account for the resistance of the (b) forms in (54)-(56) to vowel reduction or minimality. As observed (for Catalan) by Kiparsky 1993 (p. 294), this kind of immunity is different in character from the kinds discussed earlier in the paper. The addition of a suffix does not change the phonological environment in any way that could be relevant to the application of the alternation or constraint in question.

What distinguishes the exceptionality that disappears under affixation is that it is *morphological* in character. The three examples just discussed can all be handled morphologically using mechanisms developed by Inkelas & Orgun (1995) under the term Level Economy.[11]

Inkelas & Orgun propose a variant of Lexical Phonology (Kiparsky 1982), subsequently worked out in much greater detail as the theory of Sign-Based Morphology and Phonology by Orgun 1996 (see also Inkelas 1998). According to this theory, each morphological construction (each compounding rule, each affix) is associated with its own "cophonology", or set of rules/constraints. A phonological alternation or phonotactic constraint is thus a property of the cophonology of a given morphological construction. If a particular phonological effect is associated only with affixes, it therefore follows that bare roots — which do not enter into any affixation construction — will be immune, by virtue of their morphological structure. The ensuing analysis for Turkish Disyllabic Minimality (from Inkelas & Orgun (1995) is sketched below:

(58) Level Economy, for Turkish:
Root cophonology: no disyllabic minimal size condition
Suffix cophonologies: disyllabic size condition imposed

According to this theory, the reason bare roots can be exceptional while their suffixed versions are not is that the former are never subject to Disyllabic Minimality at all.

The account in (58) predicts that no unaffixed form will be subjected to Disyllabic Minimality. This corresponds nicely to the Turkish data. However, imposing the same account on Turkish Bimoraic Minimality and Catalan Vowel Reduction would seem to overpredict that no unaffixed form in Catalan should be subject to either effect. This is wrong. In Catalan, unstressed vowels in unaffixed stems *do* reduce; for the Turkish speakers for whom the data in (57) are representative, underlyingly short vowels in unaffixed CV roots *do* lengthen, in general.

For Catalan Vowel Reduction and Turkish Bimoraic Minimality, then, we need to characterize the lexical exceptionality in underlying representation. Here again we can draw upon Inkelas & Orgun's (1995)

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[10] A very small handful of roots have been lexicalized together with derivational suffixes and do not occur by themselves, but this is presumably a case of morphological, rather than phonological, defectiveness.

[11] See also Buckley (1994) for early related proposal of level "skipping" in Manam. Itô & Mester (1996, 1998) make a very similar proposal to Level Economy under the name "Structural Economy"; Burzio (1997) also develops a similar idea. Yu (to appear) applies Level Economy to NDEB effects in Tohono O'Odham.

account of Turkish. To handle the data in (57), Inkelas & Orgun propose propose that exceptional lexical items can be prespecified *morphologically*, listed lexically as outputs of the morphological construction whose cophonology imposes the relevant alternation/constraint. Thus Inkelas & Orgun list exceptionally monomoraic *ye* 'eat' as a 'level 1' constituent, meaning that it has the same morphological representation as a root which has been subjected to the 'level 1', or root cycle, construction and cophonology.

(59) Regular underlyingly CV root: $[fa]_0$
Subjected to 'level 1' construction: $[[fa]_0]_1 \rightarrow [fa:]_1$
Exceptional underlyingly CV root: $[ye]_1$
Not subject to 'level 1' construction, which takes 'level 0' as input

Note that the labels "0" and "1" for the morphological constructions are holdovers from Lexical Phonology; in fact, Inkelas & Orgun (1995, 1998) argue *against* level ordering, and thus these labels should be seen as quite arbitrary type labels (see Orgun 1996 for discussion of lexical types).

A similar approach would work for Catalan. Let us assume a morphological construction *W* which takes bare roots as input and produces constituents of type *W*. The cophonology of *W* reduces unstressed vowels. Let us also assume that each suffix cophonology — abbreviated here as *S* — imposes vowel reduction as well. As a result of these assumptions, *every* stem which is subject to *S* or *W* will undergo vowel reduction. Which will not? Those roots which are listed lexically as being *W* constructions and do not undergo affixation. Only these will not be redundantly subjected to *W*; as they are not affixed, they will not be subjected to *S* either. Of coruse, a root which is listed lexically as *W* but is combined with an affix *will* be subjected to *S*, and its unstressed vowels will reduce.

(60) Regular underlying root: /pesko/
Unaffixed, thus subjected to *W* cophonology: $[pesko]_W \rightarrow$ [pEsku]
Affixed, thus subjected to *S* cophonology: $[pesquem]_S \rightarrow$ [p´skEm]
Exceptional underlying root: /bóston/$_W$
Unaffixed, never subjected to *W* cophonology: surfaces unchanged
Affixed, thus subjected to *S* cophonology: [[bóston]$_W$ ya]$_S$ $\rightarrow$ [bustunyá]

(Note that one need not commit to the stress of *Boston* being underlying; it could be assigned by some construction other than *W*. It may also be that types *W* and *S* are really the same; extensive discussion of the Catalan lexicon would be needed to address these questions, and I therefore leave them open here.)

In summary, we have seen that Structural Immunity is not limited to phonological structure, but extends to *morphological* structure as well. Morphological Structural Immunity accounts for those cases which Kiparsky (1993) characterizes as "the elimination of exception features in derivatives (Kiparsky, 1973)". (Kiparsky mentions French *h*-aspiré as another phenomenon of this kind (p. 294).) These effects support, rather than detract from, the Structural Immunity account of nonderived environment blocking.

5.2 Lexicon Optimization and Richness of the Base?

A second apparent problem for the Structural Immunity approach is its interaction with the principle of Lexicon Optimization (Prince and Smolensky 1993).

Prince and Smolensky's original (1993) version of Lexicon Optimization pertained to nonalternating forms:

(61) LEXICON OPTIMIZATION (Prince and Smolensky 1993:192):

Suppose that several different inputs I_1, I_2, ..., I_n when parsed by a grammar G lead to corresponding outputs O_1, O_2, ..., O_n, all of which are realized as the same phonetic form Φ — these inputs are all *phonetically equivalent* with respect to G. Now one of these outputs must be the most harmonic, by virtue of incurring the least significant violation marks: suppose this optimal one is labelled O_k. Then the learner should choose, as the underlying form for Φ, the input I_k.

The version given by Inkelas (1994) has scope over morphemes with different surface allomorphs as well:

(62) Alternation-sensitive restatement of Lexicon Optimization:

Given a set S = $\{S_1, S_2, ... S_i\}$ of surface phonetic forms for a morpheme M, suppose that there is a set of inputs I = $\{I_1, I_2, ... I_j\}$, each of whose members has a set of surface realizations equivalent to S. There is some $I_i \in I$ such that the mapping between I_i and the members of S is the most harmonic, i.e. incurring the fewest marks in grammar for the highest ranked constraints. The learner should choose that I_i as the underlying representation for M.

As demonstrated by Inkelas (1994), (Alternation-sensitive) Lexicon Optimization predicts that segments will be underspecified — and thus be predicted to undergo structure-filling alternations — only when directly observed to do so. In the absence of such counter-evidence, Lexicon Optimization causes underlying forms to be identical to their fully specified surface forms.

Lexicon Optimization poses a problem for some of the Structural Immunity accounts of nonderived environment blocking that have been developed thus far. Consider, for example, the case of Turkish assibilation, which is responsible for the [t~s] alternation in *tilat-a, tilas-i*. If a new, uninflected verb [bilat] enters the language, Lexicon Optimization predicts that speakers will predict [bilat-i], even though the actual behavior would presumably be [bilasi] (a problem pointed out by Burzio (1997)). The reason is that until the [bilas-] allomorph has actually been heard, Lexicon Optimization forces the hearer of [bilat], [bilat-a], etc. to posit an underlyingly fully specified /t/:

(63) Lexicon Optimization tableau, given surface input [bilat] (or bilat-a, etc.)

	[bilat-]		MAX[cont]	ASSIBILATION	DEP[cont]
💣 a.	/bilat/	bilat			
(☞) b.	/bilaT/	bilat			*!

Positing /bilat/ as the underlying representation of [bilat-] predicts that speakers will produce [bilat-i] under inflection, presumably the wrong result. Finnish borrowings uniformly *conform* to the assibilation rule (in derived environments), rather than flouting it in the manner predicted here:

(64)

	/bilat/	MAX[cont]	ASSIBILATION	DEP[cont]
💣 a.	bilat-i		*	
(☞) b.	bilas-i	*!		*

Only if a speaker has heard both [bilat-] *and* [bilas-] will Lexicon Optimization result in an underlying representation with underspecified /T/:

(65) Lexicon Optimization tableau, given surface inputs [tilat-a] *and* [tilas-i]

	[tilat-a], [tilas-i]		MAX[cont]	ASSIBILATION	DEP[cont]
a.	/bilat/	bilat-a			
		bilas-i	*!		*
☞ b.	/bilaT/	bilat-a			*
		bilas-i			*

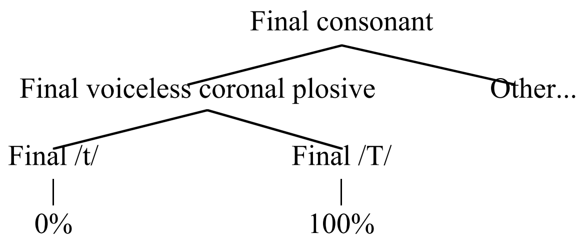
How can a prespecification approach be made to predict that speakers will assume that a final [t] is the alternating, underspecified sort, without positive evidence?

There are two possible solutions to this problem:

(66) Solution #1: make grammar force underspecification in just those environments where alternations happen to occur. Redundant.
Solution #2: sort underlying representations of lexemes by phonological specification and use analogy to come up with lexical representations for new lexemes for which the observed data doesn't yet force a particular underlying representation

One, proposed by Kiparsky (1993), is to make the grammar force underspecification in just those environments where alternations happen to occur. But this approach is redundant, essentially stipulating that stem-final /t/'s alternate in Finnish. The other approach, using lexical typing and analogy, is the one I will advocate here. On this approach, lexical items are sorted by phonological specification into phonological types, as shown below (on types, see e.g. Koenig & Jurafsky 1994, Orgun 1996 and references therein):

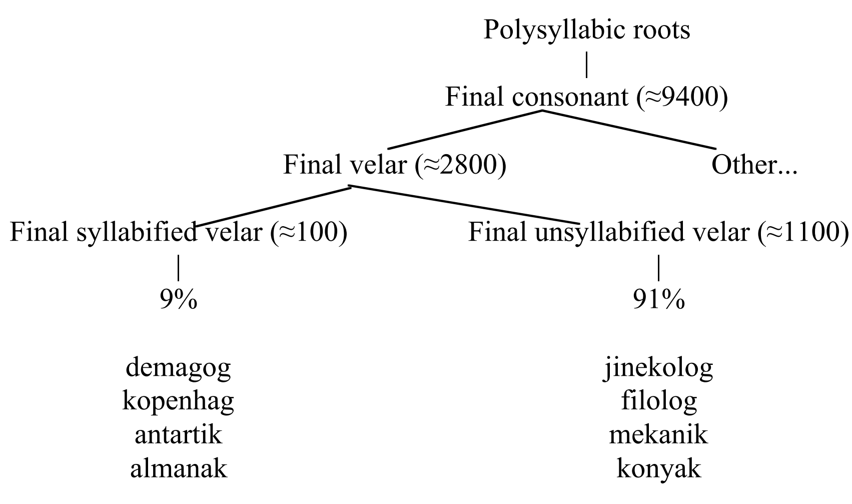
(67)



This sorting over known underlying forms serves as the basis for analogy, the method used to come up with underlying representations for new surface forms that are observed. In the case of Finnish, stems ending in /T/ greatly outnumber those ending in /t/, to the point where there are literally none of the latter. When a new form like /bilat-/ is heard, analogy to similar existing lexical items is going to produce an underlying representation with /T/. (On analogy, see e.g. Skousen 1989, Bybee 1988, Steriade 1997, among many others.)

In Finnish, there are apparently no exceptions to assibilation in derived environments. But in Turkish, there are plenty of exceptions to Velar Deletion in derived environments. Analogy on the fly is particularly clearly at work in the latter case, where some new borrowings conform to Velar Deletion and others do not. Based on a search of the TELL database, the following structure emerges for the Turkish lexicon:

(68)



Analogy to this structure (abstracting away from such effects as word frequency, etc. which might affect which category a form is analogized to) predicts that 91% of newly borrowed velar-final roots should alternate. Without doing a psycholinguistic experiment with the speaker who was the source for the numbers in (68), this is impossible to confirm. However, suggestive supporting evidence is that when only velar-final polysyllables tagged in the TELL database as French loans are considered, 2 (or 4%) are nonalternators and 46 (96%) have an alternating velar.[12]

Structural Immunity thus does not predict that nonassibilating final /t/'s in Finnish are ungrammatical; it predicts only that they are rare, even more rare than nonalternating velars in Turkish. This lack of categorial predictive power might be objected to by those (e.g. Burzio 1997) sympathetic with Smolensky's (1996) Richness of the Base hypothesis. Richness of the Base is the hypothesis that *the set of all inputs* is available to every grammar, and thus each grammar is responsible for ensuring that *every possible input* map to a possible form in the language.

Thus for adherents of Richness of the Base it is not enough to propose a mechanism whereby /tilaT/ will be inferred from attested [tilat-a], etc. Richness of the Base advocates assume that the underlying form /tilat/ is nevertheless available, and demand that the grammar ensure that a speaker who perversely selected such a form would still assibilate in the environment of an /i/-initial suffix.

One response to this charge, specific to the Finnish case, comes from Dolbey (1998)[13], who observes that

> "the borrowing process [in Finnish] is in fact more complex than it appears on first sight. Namely, Finnish makes use of a construction, [[NewRoot]-*T*-], when bringing new verbal roots into the lexicon. The affix /-T-/ is in fact the realization of a tremendously productive morphological construction with a number of uses in Finnish, including (native) denominal verbs, onomatopoetic verbs, as well as new loan words... The following data show examples which display assibilation (3sg preterite):

[[tila-T]-i]	[[töppä-T]-i]	[[digga-T]-i]
tilasi	*töppäsi*	*diggasi*
'ordered'	'behaved stupidly'	'thought was really cool'

> The construction essentially takes root 'chunks', and forces them into a nominal slot for purposes of conversion into a verb. The fact that new verbs undergo assibilation is thus the byproduct of the segmental structure of the affix used to bring new verbs into the lexicon. Evidence for the underspecified structure of the affix is therefore abundantly available; indeed, Karlsson (1983) notes that this construction is the most productive and frequent verbal construction found in Finnish today."

But reducing the scope of the Finnish borrowing "problem" still leaves the more general issue of why exceptions which should in principle be possible in a language happen not to exist. Here, Richness of the Base and Structural Immunity should converge, rather than opposing each other. Structural Immunity accounts predict that any lexical representation *which there is reason to posit*, based on ambient data, is possible. In this sense it accords with Richness of the Base, but it does *not* assume that every lexical representation exists for every language, any more than it assumes that every speaker of the same language has the same mental lexicon. Finnish morphology conspires to prevent exceptions to assibilation from entering the language, but this will not be the case for every alternation in every language. Richness of the Base is a hypothesis which is empirically testable: do languages fill gaps through contact and change, or do they not? Structural Immunity predicts that they can.

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[12] About 11,000 of the approximately 17,500 items in TELL are etymologically tagged.
[13] Paul Kiparsky (pc) made a similar point at the Lexicon in Focus workshop.

6. Conclusion

A Structural Immunity account of nonderived environment blocking effects not only does a better job than various Optimality Theory proposals in accounting for (a representative sample of) the observed range of alternations but also extends naturally to systematic and lexical exceptions to those same alternations. Using structure to account for such data is consistent with the Richness of the Base hypothesis in that the grammar is allowed to posit lexical representations freely *as needed to account for observed alternations*. However, following common sense, lexical representations that do not accord with any observed data are not posited, and need not be contended with. The mechanism of analogy is proposed for assigning lexical representations to lexemes for which the observed data underdetermines a lexical representation.

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