Exceptions and static phonological patterns: cophonologies vs. prespecification

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1. Introduction

The topic of this paper[*] is the treatment of static regularities (i.e. lexical exceptions and static distributional patterns), the subject of long-standing controversy in generative linguistic theory. On the one hand, it is possible to handle all static patterns by lexical listing and not hold the grammar accountable for them. On the other hand, it is possible, through the use of cophonologies, i.e. subgrammars (including minor rules or constraint reranking), to capture even the smallest static regularity in grammar. Which of these techniques to apply to which static regularities is typically decided by the individual linguist, leading to overall methodological inconsistency in the literature.

The topic of static regularities is important for several reasons, the first being simply that it would be desirable to have more consensus about the nature of the phonological enterprise, especially in light of the increasing number of articles in the phonological literature drawing theoretical conclusions on the basis of static effects (e.g. McCarthy 1986, 1988; Itô and Mester 1986, 1993, 1995; Lombardi 1990; Yip 1991; McCarthy and Taub 1992; Itô, Mester and Padgett 1993, 1996). A second, more concrete reason is that there may be phonological phenomena that occur *only* in static, nonproductive form—that is, as morpheme structure constraints (of the "non-duplicating" kind (Kenstowicz and Kisseberth 1977:136)). If so, then the form of phonological theory will vary according to whether or not these regularities are to be accounted for. Third, the recent introduction of Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1993a,b) provides a fresh perspective on the old question of "rules vs. representations"; the explicitness of the theory on certain issues, such as the fixed number of constraints in universal grammar, makes it possible to evaluate certain consequences of the various approaches to static effects in a way that wasn't possible in past, derivational theories.

The claim to be defended in this paper is that empirical, theoretical and methodological reasons make it ill-advised to capture partial static distributional patterns directly in the grammar. Partial regularities should be accorded status in the linguist's grammar of a language only if there is evidence from observable alternations to support the generalization. Furthermore, subdivision of the lexicon into cophonologies (subgrammars) must be supported independently of the phonological alternation in question, e.g. by some morphological, syntactic, or perhaps even semantic or pragmatic criterion.

Although in one sense the overall methodological conclusions are essentially theory-neutral in character, our investigations have revealed several previously unheralded advantages that Optimality Theory has over derivational, rule-based theories. First, only Optimality Theory is sufficiently explicit on the issue of grammatical complexity to make it possible to discuss the ramifications of cophonology proliferation in a clear way; second, only Optimality Theory offers a principled means of determining the desired, possibly underspecified, underlying representations on which the approach we advocate relies. Past

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theories of underspecification developed within derivational frameworks run into empirical and conceptual problems in this regard.

2. Cophonologies: three examples from Turkish

A cophonology (sometimes termed "subgrammar" or "disjoint phonology" in the literature) is a phonological grammar, i.e. an input-output mapping, which coexists with other phonological grammars in a single language. In rule-based theories, a phonological grammar consists of a set of (potentially ordered) rules. In Optimality theory (Prince and Smolensky 1993), where constraints are claimed to be universal, a phonological grammar is a ranked set of constraints:[1]

(1) Cophonology: an ordered set of rules, (ranked) set of constraints, etc.

We begin our discussion of the proper—and improper—use of cophonologies by setting out three useful examples for study: a productive regularity, a static regularity, and a case of lexical exceptionality. For purposes of comparison, we will assume that each pattern is enforced by the grammar, i.e. that each justifies a cophonology.

The examples are all from Turkish; this is a deliberate decision, since any intelligent discussion of subpatterns in a given language presupposes analysis of some reasonably sized grammar fragment (as Itô and Mester (1993, 1995) and McCarthy and Prince (1993b), for example, have recently provided for Japanese and Axininca Campa, respectively).[2]

2.1 A productive regularity: Sezer stress

The first example is a productive pattern of stress assignment applying to place names and foreign proper names in Turkish (Sezer 1981b; Kaisse 1985, 1993; Hayes 1995; Inkelas 1994b). In this pattern, which we name after its discoverer, Engin Sezer, antepenultimate syllables are stressed if they are heavy and the penultimate syllable is light; otherwise, penultimate syllables are stressed. The weight of the final syllable is completely irrelevant:

(2)	a.	H́ L σ	[án.ka.ra]	(the place name 'Ankara')
	b.	L Ĺ σ	[a.dá.na]	(the place name 'Adana')
	c.	H H́ σ	[is.tán.bul]	(the place name 'Istanbul')
	d.	L H́ σ	[e.dír.ne]	(the place name 'Edirne')

The Sezer pattern differs markedly from the "regular" stress pattern in Turkish, which is final:[3]

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[1]In the Theory of Constraints and Repair Strategies (TCRS) (Paradis 1988) or Declarative Phonology (Bird 1990, Scobbie 1991), cophonologies would be sets of constraints; in Harmonic Phonology (Goldsmith 1993), they would consist of different sets of intralevel and interlevel rules or ways of evaluating harmony; in Two-level Phonology (Karttunen 1993 or Lakoff 1993), cophonologies would correspond to different finite-state transducers. Multiple cophonologies have, to our knowledge, thus far been utilized only in rule-based theories, Optimality Theory, and TCRS (e.g. Paradis, LaCharité and Lebel 1994).

[2]Turkish data are presented in IPA. Stress (marked with an acute accent) and syllable boundaries (marked with a dot) are indicated only when directly relevant to the discussion. Uppercase letters in underlying representations stand for archiphonemes, unspecified for predictable features (in the case of low vowels ("E"), [back]; in the case of high vowels ("I"), [back] and [round]; in the case of plosives (e.g. "B"), [voice].) Data represent the speech of the alphabetically second author, a native speaker of (Standard) Istanbul Turkish.

[3]Words containing inherently stressed suffixes present still a different non-final stress pattern; see Lewis 1967, Underhill 1976, Poser 1984, Barker 1989, Hayes 1995 and Inkelas 1994b for full details.

(3)

a.	/elma/	[el.má]	‘apple’
b.	/elma-lEr/	[el.ma.lár]	‘apple-plural
c.	/elma-lEr-DEn/	[el.ma.lar.dán]	‘apple-plural-ablative’

The Sezer pattern, though it characterizes a marked subset of roots, is productive. A suffixed word which otherwise exhibits final stress will shift to the Sezer pattern when used as a place name (Sezer 1981b:67):

(4)

		Suffixed word: final stress	Zero-derived place name: Sezer stress
/sirke-JI/	‘vinegar-agentive’	sir.ke.dʒ́i	sí r.ke.dʒi
/torba-lI/	‘bag-with’	tor.ba.lɯ	tór.ba.lɯ

All existing analyses of Turkish stress posit different rules (or constraint rankings) for the final stress and the Sezer patterns. Both constitute productive “cophonologies” in Turkish:

(5)

	Membership	Content of grammar
Cophonology A:	place names and foreign proper names	enforces Sezer stress
Cophonology B:	all other words	enforces Final stress

Cophonology A requires the presence of Sezer stress; Cophonology B requires the presence of Final stress. It is predictable on morphological grounds into which cophonology a stem will fall.[4]

2.2 A static subregularity: Labial Attraction

The second example from Turkish is Labial Attraction, first described by Lees (1966). According to Lees, Labial Attraction is a root-structure constraint to the effect that if the vowel /a/ is followed by a labial consonant and then a high back vowel, that high vowel should be round, i.e. /u/. (In fact, a consonant may occur immediately adjacent to the labial, on either side, but we omit this detail from the formal statement of Labial Attraction purely for notational ease. It does not affect the discussion in any way.) We will refer to strings containing /aBu/ sequences as manifesting the property of Labial Attraction and those containing /aBI/ sequences as lacking that property:

(6) A root has the Labial Attraction property iff the following statement is true:

$$\text{“}\forall\, /\text{aB}\begin{bmatrix}+\text{bk}\\+\text{hi}\end{bmatrix}/, /\text{aB}\begin{bmatrix}+\text{bk}\\+\text{hi}\end{bmatrix}/ = /\text{aBu}/\text{”}$$

(where “B” represents any labial consonant)

A root lacks the Labial Attraction property iff the same statement is false.

[4]There are in fact two types of apparent counterexamples to this claim. First, some (e.g. *másа* ‘table’) but by no means all (e.g. *televizjón* ‘television’) borrowed words show the Sezer stress pattern. Since no other factor distinguishes Sezer-stressed loans from regularly stressed ones, and since the stress of the apparently Sezer-stressed loans never alternates, we follow Inkelas (1994b) in assuming that their stress pattern is simply prespecified, like that of other, irregularly stressed morphemes in Turkish. Another class of words, e.g. *anadolú*, qualify morphologically as Sezer stems (in this case, as a place name) but exhibit the final stress pattern (e.g. *anadolú, anadolu-dán* ‘Anadolu(-Ablative)’. These forms appear to require diacritic prespecification for cophonology; for discussion and a possible solution, see Inkelas and Orgun (1994, 1995, to appear).

Some roots manifesting the Labial Attraction property are listed in (7):

(7) *karpuz* 'watermelon'
sabun 'soap'
habur (the place name 'Habur')
javru 'cub'

Lees's Labial Attraction constraint admits numerous exceptions, which is to say that there are many roots which lack the Labial Attraction property. Based on a dictionary search, Orgun (1994) estimates that for every three roots manifesting Labial Attraction there is one that lacks the property. Some examples are listed below[5]:

(8) *kapɯ* 'door'
kalamɯʃ (the place name 'Kalamış ')
tavɯr 'attitude'

Labial Attraction is not productively enforced. It is never manifested across morpheme boundaries, as shown by the suffixed form in (9), and there are no synchronic alternations involving /aBu/ and /aBI/ sequences.

(9) *kitap* 'book'
kitab-ɯ 'book-accusative' **kitab-u*

Nor is Labial Attraction active even in the sense of acting as a magnet for analogy (lexical diffusion (Kiparsky 1993b)). In fact, forms historically showing Labial Attraction appear to be regularizing *away* from it, in the direction of conformity with Vowel Harmony, which is in direct competition with Labial Attraction. (10) compares conservative and innovative forms within Istanbul Turkish:[6]

(10) **kapu > kapɯ* 'door'
**dʒamus > dʒamɯz* 'water buffalo'
namlu ~ namlɯ 'gun barrel'

Despite the defective, even decaying distribution of Labial Attraction, the fact that Labial Attraction is involved in no alternations of any kind, and the fact that the roots obeying Labial Attraction lack any independent morphological, syntactic, semantic or even etymological[7] characterization that would define them as a class, it is still technically possible to maintain that the existence of Labial Attraction is actively enforced as a regularity by the grammar of Turkish (see e.g. Itô, Mester and Padgett 1993, 1996 and Itô and Mester 1995). Itô, Mester and Padgett explicitly propose that there is a subset of the vocabulary of Turkish for which Labial Attraction is a required property (1993:22, fn. 10, 1995:818).[8]

This view requires cophonologies. To implement it, we must assume that one sector of the vocabulary subscribes to a cophonology (C) enforcing the presence of Labial Attraction, while its complement sector of the vocabulary subscribes to a cophonology (D) prohibiting the presence of Labial

[5]In light of such data, Clements and Sezer (1982) in fact conclude that Labial Attraction is not a rule or constraint of Turkish at all.

[6]*kapu* is still used by some older generation speakers of Istanbul speakers and, more generally, in certain conservative non-Istanbul dialects.

[7] Of course, we do not consider etymology a sufficient criterion for establishing a subregularity in any case.

[8]Itô, Mester and Padgett (1993) cite psycholinguistic support for Labial Attraction; we discuss the relevant data in section 10.

Attraction (and instead requiring vowel harmony). A root is assigned to cophonology D if it possesses an /aBɨ/ sequence and to Cophonology C if it does not, as stated below:

(11)

	Membership	Content of grammar
Cophonology C	a subset of roots	If there is an /aB[+bk +hi]/ sequence, then that sequence is /aBu/
Cophonology D	a subset of roots, plus all derived forms	There is at least one sequence /aBɨ/

In sum, we have shown how it is possible to give exactly the same type of cophonology account to a static pattern (the existence of Labial Attraction) as is given to productive patterns (the existence of Sezer and Final stress). The difference is that in the case of the stress patterns, there are morphological correlates of the cophonology distinctions, while in the case of Labial Attraction, the cophonologies are based solely on one phonological property.

2.3 Lexical exceptionality: Coda Devoicing

Our final introductory example illustrates the possible use of cophonologies to handle what is widely regarded as a case of lexical exceptionality. The phenomenon in question is a well-known alternation in Turkish whereby certain plosives surface as voiced in onset position but as voiceless in coda position (Lees 1961; Lewis 1967; Underhill 1976; Kaisse 1986; Rice 1990; Inkelas and Orgun 1994, 1995)[9].

(12)	/kitab/	a.	/kitaB/	[ki.tap]	‘book’
		b.	/kitaB-lEr/	[ki.tap.lar]	‘book-plural’
			/kitaB-DEn/	[ki.tap.tan]	‘book-ablative’
		c.	/kitaB-I/	[ki.ta.bɯ]	‘book-accusative’
			/kitaB-E/	[ki.ta.ba]	‘book-dative’

Not all plosives alternate. For example, the root in (13) ends in nonalternating (/t/):

(13)	/devlet/	a.	/devlet/	[dev.let]	‘state’
		b.	/devlet-lEr/	[dev.let.ler]	‘state-plural’
		c.	/devlet-I/	[dev.le.ti]	‘state-accusative’

On the basis of the evidence in (12) and (13), voicing alternations have commonly been understood as coda devoicing (Kaisse 1986, Rice 1990, though see section 8). The alternating plosive in (12) is underlyingly voiced; the nonalternating plosive in (13) is underlyingly voiceless.

A more neutral statement of the facts would define a property of coda voicelessness:

(14) A string manifests the Coda Devoicing property if, for any and all coda plosives it possesses, all those coda plosives are voiceless
A string lacks the Coda Devoicing property if it possesses a voiced coda plosive

[9]The reader will notice that only root-final consonants exhibit voicing alternations; because Turkish is exclusively suffixing, nonfinal consonants generally occupy a constant syllable position (except in case of root-internal epenthesis, e.g. *kutup~kutb-u* ‘pole(-acc)’ (Clements and Sezer 1982, Inkelas and Orgun 1994, 1995)), and never alternate in voicing. The alternation is nonetheless sensitive to syllable position, and for the sake of maximum generality we opt to treat it solely in terms of syllable structure. Doing so captures the generalization that most root-internal plosive codas are voiceless; those which are not could be subject to the same treatment as root-final voiced plosive codas. See section 8.2.

Of special interest are the handful of forms that do *not* manifest Coda Devoicing; these forms, several of which are listed in (15), contain a voiced coda plosive, and can thus be said to lack the Coda Devoicing property:

(15)			
	/etyd/	[e.tyd]	'etude'
	/etyd-lEr/	[e.tyd.ler]	'etude-plural'
	/katalog/	[ka.ta.log]	'catalog'
	/katalog-DEn/	[ka.ta.log.dan]	'catalog-ablative'

Because the items lacking Coda Devoicing are relatively few in number, they are generally characterized as lexical exceptions. One standard approach to lexical exceptionality has been to mark recalcitrant forms with rule exception features (Chomsky and Halle 1968), indicating those rules that a form exceptionally resists (or triggers).[10] Rule exception features characterize whole morphemes. In the case of Turkish devoicing failure, the relevant roots would be marked as exceptions to a rule enforcing coda plosive devoicing.

Of course, marking a root as an exception to a rule is equivalent to saying that a given rule is not in the grammar that applies to that root—or, in more theory-neutral terms, to saying that the root belongs to a different grammar than the other, nonexceptional roots belong to.[11] When viewed this way, it becomes clear that lexical exceptionality is just a special case of a static pattern. The choice between the terms "pattern" or "exceptionality" in any given case is presumably affected by the relative size of the morpheme classes bearing (or lacking) the relevant properties; but to our knowledge, the cutoff point has never been discussed, and it is hard to imagine making the kind of exact numerical hypothesis that would be required. From our point of view, the two phenomena are formally identical,[12] and we will treat them uniformly.

Analyzing exceptions to coda devoicing (15) in terms of cophonologies involves postulating a further cophonology split. Cophonology (E) requires coda plosives to be voiceless; Cophonology (F) does not. In order to be able to assign a form without voiced coda plosives (e.g. the root in (13)) unambiguously to one or the other cophonology, we define Cophonology F so that it actually requires the presence of at least one voiced coda plosive.

(16)

	Membership	Content of grammar
Cophonology E	a subset of roots, and derived forms containing those roots	If any coda plosives exist, they must be voiceless
Cophonology F	a subset of roots, and derived forms containing those roots	At least one coda plosive must be voiced

[10]For other examples in rule-based phonology see e.g. Lees 1961; Schane 1963a,b; McCawley 1968; Lightner 1965; Postal 1968; Chomsky and Halle 1968; Harris 1969; Saciuk 1969; Kisseberth 1970; Lakoff 1970; Kiparsky 1973; Zonneveld 1978; Ringen 1978; Kiparsky 1982; Mohanan 1982; and Halle and Vergnaud 1987. The point that this approach treats exceptionality as formally identical to subregularity is quite apparent from the discussion in Saciuk (1969). Cophonology treatments of exceptionality in Optimality Theory can be found in e.g. Kisseberth 1993, Kirchner 1993, Pater 1994, and Cohn and McCarthy 1994.

[11]Note that there may be psycholinguistic or possibly even computational differences between assigning two roots to two different grammars vs. marking one of the roots as an exception to one rule in the other root's grammar. However, for our purposes (generating surface forms) the two approaches are identical: each root is associated with an ordered set of rules/ranked set of constraints—i.e. with a distinct grammar.

[12]The size of a pattern may have an effect on its diachronic "strength"; see e.g. Holden 1976. This is, however, presumably not a fact about the grammar (see section 10).

As was the case with the cophonologies based on the Labial Attraction property, the cophonologies in (16) are defined on the basis of a single phonological property (presence of voiced coda plosives).

3. Consequences of capturing static distributional patterns with cophonologies

In the previous section we have seen that it is possible to use cophonologies to capture productive as well as static patterns. In this section, however, we present five strong reasons for not doing so. While cophonologies are necessary to account for such productive, mutually exclusive, and morphologically well-defined patterns as Sezer and Final stress in Turkish, we argue that cophonologies lead to undesirable consequences when used to account for static phonological patterns. The questions we address are as follows:

(17) a. Even if we as linguists think we clearly recognize an inert pattern, do we want to claim that this pattern must be encoded in the idealized grammar that we assume all speakers of the language must have learned?
b. How does one justify the claim that there is a special subgrammar for a closed class of morphemes?

Specifically, we examine the consequences of defining cophonologies in the manner in (18). This is the standard methodology used by linguists who capture inert subregularities, i.e. static patterns that not all morphemes exhibit, in languages. It is the method that was used to establish cophonologies on the basis of Labial Attraction and exceptions to Coda Devoicing in the previous section.

(18) DISTRIBUTIONAL METHOD FOR ESTABLISHING COPHONOLOGIES: Given a phonological property P, assume that its presence is enforced by grammar. If not all morphemes in the language possess property P, then establish two cophonologies: one which requires the presence of P and another which requires its absence. Assign each morpheme to one of these two cophonologies.

If one is to capture static regularities grammatically, this is the way it has to be done. But this methodology is deeply problematic in at least five ways, detailed in turn in the following subsections.

3.1 Uninteresting cophonologies

The first objection to the Distributional Method is that many, if not most, of the cophonologies it causes to be defined hold absolutely no interest at all to the linguist. Consider, for example, the property of lacking a syllable coda. All languages have morphemes without codas, and most languages have morphemes with codas. Thus in most languages we could segregate morphemes into two classes: one in which codas are absent and one in which codas are present. Then we would define two cophonologies for each morpheme class, one which prohibits codas and one which requires them:[13]

(19) Cophonology G: No syllable may have a coda
Cophonology H: At least one syllable must have a coda

Turkish roots belonging to G: *su* ‘water’, *iki* ‘two’, *adana* (the place name ‘Adana’)
Turkish roots belonging to H: *ham* ‘unripe’, *karpuz* ‘watermelon’, *istanbul* (the place name ‘Istanbul’)

[13]It is crucial that Cophonology H require a coda. If Cophonology H simply tolerated the presence of codas, then a word without codas could belong to either cophonology, and the system would be indeterminate. Nothing would be gained by defining the two cophonologies.

Proceeding in a similar fashion, we could also employ the Distributional Method to define two cophonologies I and J, one (I) which requires all syllables to begin with /b/ and its converse (J) which requires at least one syllable *not* to begin with /b/:

(20) Cophonology I: All syllables begin with /b/
Cophonology J: At least one syllable does not begin with /b/

Turkish roots belonging to I: *bebek* 'baby', *baba* 'father', *biber* 'pepper'
Turkish roots belonging to J: *fɯndɯk* 'hazelnut', *bardak* 'glass', *kabak* 'pumpkin'

But cophonologies G, H, I and J are of no particular interest. No insight is gained by establishing separate grammars for *su* and *ham*, respectively, or for *bebek* and *bardak*, respectively, in Turkish. Unfortunately, however, the Distributional Method of assigning cophonologies to observed regularities makes it impossible to distinguish the interesting cophonologies (such as Cophonology A, which enforces Sezer stress) from the uninteresting ones (such as G-J). If we define cophonologies based on the presence or absence of given phonological properties in the member words, then the "coda presence" cophonology (H) and the "/b/ onset" cophonology (I) have exactly as much justification as the "Labial Attraction" cophonologies—and, for that matter, as the productive "Sezer" and "Final" stress cophonologies. But while we do want to base cophonologies on the stress properties, we almost certainly do not need or want cophonologies based on coda presence or /b/ onsets. Unfortunately, we have, so far, no formal principle to rule them out.

3.2 Defeats purpose of Optimality Theory

A second objection one can make to the Distributional Method in (18), which has been employed by some researchers (e.g., Itô, Mester and Padgett 1994, 1996, Cohn and McCarthy 1995) using Optimality Theory (Prince and Smolensky 1993) is that it is counter to the spirit of Optimality Theory, a phonological theory in which grammar consists of ranked and violable constraints. The value of using this type of system lies in seeing generalizations that emerge through constraint violation. But the Distributional Method sets up phonological grammars precisely such that the defining constraints will not interact. In the Labial Attraction cophonology (C), the constraint enforcing Labial Attraction would never be violated. In the non-Labial Attraction cophonology (D), the constraint enforcing Labial Attraction would *always* be violated. The Distributional Method defines away the possibility that the constraint enforcing Labial Attraction will be violated just when a higher ranked constraint (e.g. that enforcing vowel harmony) would thereby be satisfied. It deprives the linguist using Optimality Theory of the opportunity to learn something about the internal structure of a given phonological grammar from observing an instance of constraint violation. There can be no role for constraint ranking and interaction in such a system.

3.3 Complex words

Heterogeneous complex words pose descriptive problems for approaches which use the Distributional Method to capture static regularities with cophonologies. To see this, we turn to Labial Attraction in morphologically complex words. Consider the morphemes in (21):

(21)

a.			b.		
yamurʧa	'fallow deer'		/-m/	'1sg.possessive'
tambura	'stringed instrument'		/-I/	'accusative'
abluka	'blockade'		/-DI/	'past'
			/-lE/	'verbalizer'
			/-mIʃ/	'evidential'
			/-mIz/	'1pl.possessive'

According to the definition of the Labial Attraction cophonologies, repeated below, each of these morphemes belongs to Cophonology C. None possesses an /aB¹/ sequence; in fact, the roots in (21a) even possess outright /aBu/ sequences.

(22)

	Content of grammar
Cophonology C	If there is an /aB$\begin{bmatrix}+\text{bk}\\+\text{hi}\end{bmatrix}$ / sequence, then that sequence is /aBu/
Cophonology D	There is at least one sequence /aBɯ/

Now consider the words in (23), composed of the morphemes in (21). Even though all of the individual morphemes possess the Labial Attraction property (overtly demonstrated by the underlined sequences), the words they form *lack* that property. Each suffixed word contains an /aB¹/ sequence (double underlined), such that the word as a whole belongs to Cophonology D:

(23)	*jamurtʃa-m-ɯ*	'fallow deer-1sg.poss-accusative'	**jamurtʃamu*
	tamburа-m-dɯ	'stringed instrument-1sg.possessive-past'	**tamburamdu*
	abluka-mɨz	'blockade-1pl.possessive'	**ablukamuz*
	abluka-la-mɨʃ	'blockade-verbalizer-evidential'	**ablukalamuʃ*

This is a paradox. It results from our classification of morphemes into cophonologies based on the presence or absence of a phonological property in their phonological representation. It has no resolution (unless we abandon the Distributional Method for defining cophonologies—see section 7).[14]

A similar unresolvable paradox arises with the productive deletion of intervocalic velars in Turkish (see e.g. Lees 1961, Lewis 1967, Underhill 1976, Zimmer and Abbott 1978, Sezer 1981a). Examples illustrating velar deletion are shown below:

(24)	*bebek*	'baby'	*bebe-i*	'baby-accusative'
	tʃiɨtʃek	'flower'	*tʃiɨtʃe-e*	'flower-dative'
	gel-eɖʒek	'come-future'	*gel-eɖʒe-im*	'come-future-1sg'
	ol-aɖʒak	'happen-future'	*ol-aɖʒa-a*	'happen-future-dative'

We define the property of velar deletion as follows:

(25) A string exhibits Velar Deletion if it lacks intervocalic velars.
A string lacks Velar Deletion if it possesses intervocalic velars.

All morphemes in (24), as well as the complex words they form, display Velar Deletion. However, there are morphemes which lack it (as indicated by the double-underlined strings):

(26)	*gaga*	'beak'
	sokak	'street'
	abluka	'blockade'

These facts motivate yet another division into cophonologies:

[14]The only possible escape, given the Distributional Method, is a risky one, namely to claim that words like *yamurtʃa-m-ɨ* are divided into multiple domains (perhaps one domain per morpheme) and that the cophonologies of Turkish evaluate each domain separately from the others (see Dobrovolsky 1986 for a similar claim involving the domains of vowel harmony and stress assignment). However, the fact that vowel harmony and syllabification apply across the morpheme boundaries in the very examples in (23) belies this claim.

(27) Cophonology K: Intervocalic velars are prohibited
Cophonology L: At least one intervocalic velar is required

The morphemes in (24) belong to Cophonology K, while those in (26) belong to Cophonology L.

The problem we are interested in arises in the data in (28). Here, the first two roots in (26), both of which belong to Cophonology L, are suffixed with the vocalic third person possessive suffix /-I/, which, by virtue of containing no intervocalic velars, belongs to Cophonology K. Both complex words contain intervocalic velars, evidence that both belong to Cophonology L:

(28)	a.	/gaga-I/	[gagajɯ]	Lacks Velar Deletion	*[gaajɯ]
	b.	/sokak-I/	[sokaɯ]	Lacks *and* possesses Velar Deletion	*[soaɯ] , *[sokakɯ]

There are two problems here. The first is the same problem encountered in the previous example: how, given knowledge of the cophonologies to which its morphemes belong, do we predict which cophonology a complex word will belong to? The second problem is that we are forced, by virtue of its surface intervocalic velar, to assign the form in (28b) to Cophonology L—yet it shows evidence of the active imposition of Velar Deletion, which can only be forced in Cophonology K. What can possibly be motivating deletion in this case? These paradoxes certainly cannot be solved by stipulating that deletion applies only within morphemes, since it clearly applies across morpheme boundaries.[15]

In summary, capturing the distribution of Labial Attraction and Velar Deletion using cophonologies makes it very difficult, if not impossible, to handle suffixed words. This is unfortunate, since in both cases the generalization is clear enough. Labial Attraction is enforced (if at all) only in roots; Velar Deletion is enforced only across root-suffix boundaries. Employing the Distributional Method and defining cophonologies on the basis of the distribution of phonological structure in morphemes leaves no room for handling alternations in complex words. (Capturing Velar Deletion in terms of *morphologically* defined cophonologies is, however, discussed in detail in Inkelas and Orgun (1994, 1995) and summarized in section 7 of this paper).

3.4 Upper bound on cophonologies: one per morpheme

A fourth serious problem for the Distributional Method is that the potential for cophonology proliferation is astronomical. We have seen that the distribution of a single property spawns two cophonologies. In combination, of course, two properties spawn even more cophonologies. Consider the interaction of the cophonologies responsible for the distribution of Sezer stress (Cophonologies A and B) and those responsible for the distribution of Labial Attraction (Cophonologies C and D). Because Labial Attraction and Sezer stress are logically independent, their respective memberships intersect, as shown in (29), yielding four distinct cophonologies. (In the chart, 'yes' means that the form displays the relevant property; 'no' means that it does not.)

(29)

	LA	Sezer	Member words	
Cophonology A.C	yes	no	*karpúz*	'watermelon'
Cophonology A.D	no	no	*tavɯr*	'attitude'
Cophonology B.C	yes	yes	*hábur*	(the place name 'Habur')
Cophonology B.D	no	yes	*kalámɯf*	(the place name 'Kalamış ')

Thus two regularities, each based on a single property, define four cophonologies. If we add another independent property to the picture—say, coda presence (regulated by Cophonologies E and F)—then eight cophonologies will be required:

[15]Harris (1977, fn. 15) makes the same point for a similar Spanish example.

(30)

	LA	Sezer	Coda	Member words	
Cophonology A.C.E	yes	no	yes	*armút*	'pear'
Cophonology A.C.F	yes	no	no	*tapú*	'title'
Cophonology A.D.E	no	no	yes	*tavɯr*	'attitude'
Cophonology A.D.F	no	no	no	*kapɯ*	'door'
Cophonology B.C.E	yes	yes	yes	*hábur*	(the place name 'Habur')
Cophonology B.C.F	yes	yes	no	*osámu*[16]	(the foreign name 'Osamu')
Cophonology B.D.E	no	yes	yes	*kalámɯʃ*	(the place name 'Kalamış ')
Cophonology B.D.F	no	yes	no	*(Ø?)*	

The mathematical formula predicting the number of cophonologies it is possible to define in this manner is simple:

(31) Given n independent properties, the Distributional Method will define a total of 2^n cophonologies

This is a fairly alarming figure. 3 independent properties yield 8 cophonologies; 5 properties yield 32; 10 properties yield 1,024; 24 properties (still a small number) yield over 16 million. This is too many cophonologies for the learner of a single language to have to contend with. Something must limit the number of cophonologies a learner is required to consider positing.

Some practical help will surely come, to an unknown extent, from the nonzero probability that certain cophonologies will have no lexical membership. For example, there may be mutually exclusive properties, such that the morpheme class defined by their intersection will be empty, and thus no corresponding cophonology will exist. And even in the case of a set of properties that are logically compatible, a language may happen to have no morpheme displaying the whole set, obviating the need for a cophonology enforcing that particular combination of properties. (For example, we have so far found no word in Turkish which lacks a coda, lacks Labial Attraction, *and* displays Sezer stress (last row in (30).) This makes sense, since we are probably talking about over 16 million cophonologies, and no language has close to 16 million morphemes.

Realistically, of course, this system of cophonologies cannot generate more cophonologies than there are (phonologically distinct) morphemes in a language. But this upper bound is still far too high: we still have too many cophonologies.

3.5 Lower bound on cophonologies: one per morpheme

Even worse than the discovery that the upper bound on the number of cophonologies definable for a given language is equal to the number of (phonologically distinct) morphemes in that language is the discovery that the *upper* bound is also the *lower* bound: if cophonologies are defined on the basis of the presence or absence of phonological properties in morphemes, then there will always be exactly as many cophonologies as there are (phonologically distinct) morphemes. Each morpheme will belong to its own unique cophonology.

To see this, consider the following Turkish roots, classified into the coda presence Cophonologies G *(No syllable may have a coda)* and H *(At least one syllable must have a coda)*:

[16]The native-speaker author imported this proper name into Turkish (which is easy to do) for purposes of filling out this table.

(32)	a.	[ba.ba]	'father'	Cophonology G
		[i.ki]	'two'	
		[a.ra.ba]	'car'	
		[a.na.do.lu]	(the place name 'Anadolu')	
	b.	[el.ma]	'apple'	Cophonology H
		[tek.me]	'kick'	
		[ki.tap]	'book'	
		[ka.bak]	'pumpkin'	
		[bar.bun.ya]	'bean'	
	c.	[fɯn.dɯk]	'hazelnut'	Cophonology H
		[bar.dak]	'cup'	
		[is.tan.bul]	(the place name 'Istanbul')	

The (a) forms possess no codas, and unambiguously belong to Cophonology G. The (b) and (c) forms each possess at least one coda each, and therefore belong to Cophonology H. But notice a difference between the (b) and (c) forms: the (c) forms have codas in every syllable, while the (b) forms lack codas in at least one syllable. This system classifies words with open syllables in the same cophonology in which it classes words with closed syllables.

But the whole purposes of defining Cophonology G, and thereby capturing the "no-coda" regularity, was so that we wouldn't have to stipulate in underlying representation that each syllable has a coda. If we now admit that the information that a syllable has a coda does have to be prespecified in the language, then we have no justification for Cophonology G at all. If we are to maintain the cophonology system, it must therefore be the case that the existence of codas in the (c) words is predictable. Let us therefore define another property, and base another cophonology split on that property:

(33) A string has the NoCoda property if at least one of its syllables is open
A string lacks the NoCoda property if all of its syllables are closed

(34) Cophonology M: requires at least one syllable to be open
Cophonology N: requires all syllables to be closed

Intersecting cophonologies M and N with cophonologies G and H yields three non-null cophonologies, enabling us to characterize the difference between the roots in (32b) and those in (c) in terms of cophonologies:

(35)

Cophonology	Definition	Members
G.M:	All syllables are open ∩ At least one syllable is open	e.g. *baba* (32a)
G.N:	All syllables are open ∩ All syllables are closed (= Ø)	Ø
H.M:	At least one syllable is closed ∩ At least one syllable is open	e.g. *kabak* (32b)
H.N:	At least one syllable is closed ∩ All syllables are closed	e.g. *barbunja* (32c)

But there are still further distributional regularities to be captured. Consider the roots in (32b), which belong to Cophonology H.M. In the case of *elma* and *tekme*, the closed syllable is initial and the second syllable is final; in the case of *kitap* and *sanat*, however, the closed syllable is final and the second syllable is initial. These subregularities can be captured in terms of cophonologies.

(36) Cophonology O: requires the initial syllable to be heavy
Cophonology P: requires the initial syllable to be light

Intersecting these cophonologies with Cophonology H.M, we obtain two new cophonologies which capture all the regularities we have observed so far:

(37)

Cophonology	Definition	Members
H.M.O:	At least one syllable is closed ∩ At least one syllable is open ∩ The first syllable is heavy	e.g. *elma*
H.M.P:	At least one syllable is closed ∩ At least one syllable is open ∩ The first syllable is light	e.g. *kitap*

It is obvious that this kind of breakdown can continue indefinitely. As long as there are any differences at all between two morphemes in the same cophonology—for example, the segmental differences distinguishing *elma* and *kitap*—it is possible to capture the distinct pattern of each morpheme with a distinct cophonology. Since there is nothing in the Distributional Method that tells us when to stop, defining cophonologies in a consistent fashion entails establishing a distinct cophonology for each (phonologically distinct) morpheme.

4. Possible remedies for cophonology proliferation

It ought by now to be clear that no linguist should want to propose a system with the problems that the Distributional Method, with its proliferating cophonologies, exhibits. *If* we are to use cophonologies to capture static regularities in a language, some systematic means of constraining their number and variety must be developed. In the next section, we consider several such proposals.

4.1 Limiting set of universal grammars

One approach already in practice is to limit the number of possible grammars the theory can describe and thereby reduce the number of cophonologies available within any given language. In rule-based theories, such approaches take the form of conditions on possible rules and on rule ordering; in Optimality Theory, they take the form of universally fixed ranking among constraints. Examples of the latter include the sonority hierarchy of Prince and Smolensky (1993), the markedness hierarchy of Smolensky (1993), and the ranking of LEX≈PR above *STRUC (Prince and Smolensky 1993).

While it does reduce the problem to some degree, fixing constraint rankings is still vastly insufficient as a solution to our problem. The number of constraints whose rerankability has been shown to correlate with observed differences across languages is still large enough to make the cophonology proliferation problem intractable.[17]

4.2 Limiting set of grammars available within a given language

The next logical option would be to focus on a given language and limit the number (or range) of cophonologies possible there, regardless of the number of grammars available universally. One interesting

[17]The extent to which this type of solution can reduce the number of grammars is actually limited by the very problem we are seeking to solve. If the "database" from which we compute universal grammar includes constraint rankings based on static subregularities, then it will be impossible to use universal grammar to exclude unwanted cophonologies. Every logically possible (albeit unneeded) cophonology—except those which are a priori banned, such as ones altering the sonority hierarchy ranking—will be definable, therefore a part of universal grammar. By contrast, if the database from which we compute universal grammar were composed solely of grammars motivated by regularities supported by alternations in language, as we later suggest, then it *would* be logically possible for certain grammars to be unattested, and therefore for universal grammar to exclude certain possibilities.

approach along these lines has been suggested by Itô and Mester (1993, 1995) in a dicussion of the phonotactics of native and loan words in the vocabulary of Japanese (see also Paradis, LaCharité and Lebel 1994 for a related proposal within the Theory of Constraints and Repair Strategies).

Itô and Mester observe that the Yamato (etymologically native) vocabulary items in Japanese all obey the following three constraints:

(38) *P: Single [p] is prohibited
*NT: Post-nasal obstruents must be voiced
*DD: Voiced geminate obstruents are prohibited

Some loanwords also obey these constraints and can for all purposes be classified as Yamato. Others, however, violate one or more of the constraints in (38). Based on the observed patterns of constraint violation, Itô and Mester define two additional strata—cophonologies, in our terms—for these loans. A loan is classified as "Foreign" if and only if it violates the *DD constraint; a form violating only *NT or *P (or both), but not *DD, is classified as "Assimilated Foreign":

(39)

Stratum	Definition	Examples
"Foreign"	*DD necessarily violated	*beddo* 'bed'
"Assimilated Foreign"	*DD necessarily obeyed; at least one of *NT, *P necessarily violated	*peepaa* 'paper', *hantai* 'opposite'

Itô and Mester observe that the differences between Yamato, Foreign and Assimilated Foreign are not random but rather show a range of degrees of assimilation to the constraints characterizing the etymologically native words. On the basis of this observation, they propose a general organizational system of the lexicon:

(40) "The less nativized an item, the more it is exempt from lexical constraints, e.g. the more it is located toward the periphery, falling outside of various constraint domains. These constraint domains are centered around an abstract core, governed by the maximum set of lexical constraints." [Itô and Mester 1995:824]

An implementation of this idea in Optimality Theory initially appears to offer an exciting potential for constraining cophonology proliferation generally. Mester and Itô (1993) suggest, purely as an implementation of the idea in (40), that each language has a "core" cophonology from which other cophonologies in the language may differ only in the relative ranking of FAITH constraints (PARSE and FILL) (lecture notes, 11/3/93)[18]. The more peripheral a cophonology is, the higher FAITH is ranked, such that more of the core constraints are violable.[19] (41) shows the characterization of Japanese Yamato, Foreign and Assimilated Foreign cophonologies in these terms:

(41)

Yamato	*COMPLEX	»	*DD	»	*NT	»	*P	»	FAITH
Assimilated Foreign	*COMPLEX	»	*DD	»	FAITH	»	*NT	»	*P
Foreign	*COMPLEX	»	FAITH	»	*DD	»	*NT	»	*P

Mester and Itô formulate the hypothesis underlying this system as follows:

[18]We are grateful to Junko Itô and Armin Mester for making available to us their work in progress.

[19]This system predicts that if a word in the Foreign stratum violates, say, both *DD and *P, it should conform to *DD before conforming to *P in its diachronic course towards nativization.

(42) Core-Periphery hypothesis: (In the unmarked case,) noncore cophonologies in a language differ from the core cophonology only in the relative ranking of FAITH conditions with respect to the other constraints [Mester and Itô 1993]

An advantage of this organizational system, Mester and Itô show, is that it extends to another cophonology of Japanese, namely the mimetic vocabulary (for discussion see Mester and Itô 1989 and Itô and Mester 1993, 1995). Of the three constraints in (38), only *P is violable in mimetic forms, such that the Mimetic cophonology can be neatly captured by positioning FAITH between *NT and *P in the fixed constraint hierarchy:

(43) Mimetic *COMPLEX » *DD » *NT » FAITH » *P

A disadvantage of the account, however, is that other cophonologies of Japanese does not conform to the system. In Sino-Japanese, for example, *NT—but not *P or *DD—can be violated. Thus the cophonology of Sino-Japanese requires a reranking not only of FAITH, but also of *NT with respect to *P.

(44) Sino-Japanese *COMPLEX » *DD » *P » FAITH » *NT

In light of this fact, Mester and Itô (1993) suggest that (39) is a statement about unmarked cophonology relationships, rather than an absolute requirement.

4.2.1 The case of Turkish Stress: Reranking of Alignment constraints

A look at another example, this time from Turkish, confirms the violability of the Core-Periphery hypothesis. In this section we compare two productive stress patterns of Turkish and show that they differ only in the relative ranking of non-FAITHFULNESS constraints.

The Sezer pattern, described earlier in section 2.1, assigns stress to the penultimate syllable unless the antepenultimate syllable is heavy *and* the penultimate syllable is light (Sezer 1981b, Kaisse 1986, Hayes 1995). The distinctive quantity-sensitivity of the Sezer pattern may be captured using the following constraint (from Prince and Smolensky 1993):[20]

(45) **WSP** Weight-to-stress, i.e. if heavy then stressed

The fact that stress is usually penultimate follows from the following constraints (also from Prince and Smolensky 1993).

(46) a.	**FOOTFORM = IAMB**		Feet are iambic
b.	**ALIGN-WORD**	Align (Word, R, Foot, R)	Each word ends in a foot
c.	**NONFINALITY**	Align (Foot, R, Syl, L)	Each foot is followed by a syllable

For the Sezer pattern, WSP must outrank ALIGN-WORD, which must in turn be outranked by NONFINALITY.

[20]In the more complete Optimality account of these facts offered by Inkelas (1994b), it is shown that WSP is actually inadequate to capture the limited quantity-sensitivity of the Sezer pattern in longer words; another, more context-sensitive constraint is offered in its place. The details need not concern us here, as the point still holds that the Sezer and Final patterns differ in ways other than the ranking of FAITH.

(47) Sezer cophonology: WSP, NONFINALITY >> ALIGN-WORD

input	an.ka.ra	WSP	NONFINALITY	ALIGN-WORD
a.☞	(x) an kara			**
b.	(. x) anka ra	*!		*
c.	(. x) an kara	*!	*	

The final stress pattern, by contrast, is quantity insensitive. In the final-stress cophonology, ALIGN-WORD outranks both WSP and NONFINALITY.

(48) Final stress cophonology: ALIGN-WORD >> WSP, NONFINALITY

input	tek.me.le	ALIGN-WORD	WSP	NONFINALITY
a.	(x) tekmele	*!*		
b.	(. x) tekmel e	*!	*	
c.☞	(. x) tek mele		*	*

Thus, the difference in relative ranking between the ALIGN-WORD constraint with respect to the WSP and NONFINALITY constraints is sufficient to distinguish the two cophonologies. In the examples we have seen, the two cophonologies take as input words without any underlying stress feet; thus, PARSE (like other FAITH conditions) is irrelevant to the outcome.[21]

The fact that two productive patterns in Turkish differ from one another, and that Sino-Japanese differs from the core Yamato phonology, in the relative ranking of constraints other than FAITH casts doubt on anything as strong as the Core-Periphery hypothesis as a general theory of language-internal cophonology relationships. But if the Core-Periphery hypothesis is not universal, then why does it work so nicely for most of the Japanese data?

A noticable pattern in the (admittedly small) corpus of data examined so far suggests a possible explanation. Consider the following difference between the cophonologies of Japanese which obey the Core-Periphery hypothesis and those (of Japanese and Turkish) which do not: the former are defined on purely phonological grounds and are distributional patterns holding among roots,[22] while the latter are definable on morphological grounds and are productive patterns holding over complex forms. For example, a root may be identified (on the basis of its morphological behavior) as a member of the productive Sino-Japanese stratum even if it violates *none* of the "core" phonological constraints of the language; by contrast, the only criterion for membership in the Foreign stratum is violation of *DD. What seems to be the case is that the Core-Periphery hypothesis works well as a characterization of the degrees of nativization (or, more concretely, adherence to "core" constraints) in the vocabulary of a language, which is, of course, the function for which it was introduced. The apparent exceptions to the Core-Periphery hypothesis are all

[21]In fact, both Sezer and final stress patterns are both overridden by inherent stress on a root or affix morpheme (see e.g. Sezer 1981b, Poser 1984, Barker 1989); however, since again both patterns behave alike in this regard, the relative ranking of PARSE does not distinguish the two patterns (Inkelas 1994b).

[22]There is some controversy over the morphological status and productivity of mimetic palatalization in Japanese; see Mester and Itô (1989) and Schourup and Tamori (1992) for discussion. We do not have a position on this issue.

cophonologies to which it really does not apply, namely productive cophonologies having nothing to do with characterizing degree of conformity to what is considered to be the "native" constraint ranking.

4.3 Summary

In conclusion, the Distributional Method is still devoid of any workable means of checking cophonology proliferation. There is no formal, principled method for distinguishing intuitively justified cophonologies from obviously pointless ones. Worse, there are good reasons for thinking that no principled method *can* exist for deciding which static patterns in grammar to encode. As we have seen, regardless of what phonological property is taken to define a cophonology, the task of determining where in a string that property appears still resides with underlying representation. And if underlying representation must record the property, then there is no gain in defining the cophonology in the first place.

The lack of a principled method for defining cophonologies leads to a serious methodological consequence: grammars should not be allowed to capture even one static pattern with a cophonology, since doing so leads, out of logical consistency, to the unfortunate situation of allowing the grammar to encode *all* definable patterns with cophonologies.[23] As the consequences of allowing all possible cophonologies are unacceptable, we must therefore refrain from capturing any static patterns—at least until a workable, repeatable method for discriminating among them is established.

5. Methodology for positing cophonologies

In this section we make two proposals for a methodology for choosing which patterns should be encoded using cophonologies.

5.1 Relying on statistical significance

One possible method for choosing which distributional regularities to capture would be to establish cophonologies for only those patterns which are statistically significant. The underlying assumption would be that only these patterns come to the attention of the language learner and are encoded in grammar.

For example, given some property P exhibited by a certain proportion of the vocabulary, one could apply standard statistical tests to determine whether its distribution correlates to a significant extent with that of another independent property (or set of properties), or whether the distribution of P is essentially random (thus not worth encoding as a grammatical pattern). A standard figure used in such tests is 5%: if there is a probability of less than 5% that the distribution of P is due to chance, then its pattern of occurrence is judged to be statistically significant.

While this approach is reasonable, it does have an important consequence. The linguist employing this approach must be willing to commit to the validity of any pattern proving to be significant, even if linguistically uninteresting. To illustrate this point, we turn to an example of a statistically significant but linguistically irrelevant static pattern that occurs in Slave.

As Rice 1988 has shown, continuants in Slave are subject to voicing alternations: they are voiceless when initial, and voiced when medial, subject to certain morphological conditions. There are a number of exceptions to these alternations. The class of exceptions we are concerned with have voiced initial continuants (Rice 1988:64, 202). Examples, taken from various dialects of Slave (transcribed in IPA), are shown in (49):

[23]At the TREND II workshop, it was suggested that we could avoid this problem by simply resisting the temptation to define every possible cophonology in a language; however, this is not the point. We are concerned with finding a principled method for defining just the right cophonologies. Relying on intuition or common sense is a notoriously unreliable method; as we have learned while writing this paper, intuitions vary widely on this issue.

(49)

zo	‘marten’
ja	‘sky’
jah	‘snow’
jeé	‘over there’
zǫ	‘only’
já	‘louse’
jú	‘clothes’
widá	Victor
lai	lights, lamp
jíski	yeast cake

Loanwords from French constitute a large subset of this class of exceptions. French nouns have been borrowed in their definite form, and thus have an initial [l] corresponding to the definite article *le* of French. A few of the very large number of nouns of this type are illustrated in (50):

(50)

Slave	English	French
líʃabú	hat	le chapeau
lífuʃé	fork	le fourchette
líbahdú	barge	le bateau
lígarí, lígar	cards	les cartes
lamé	mass	la messe
líselí, lísel	salt	le sel
líbarí	barrel	le baril
lífilí	thread	le fil

French loanwords are by far the dominant source of initial [l] in Slave. Rice cites very few other [l]-initial forms in her comprehensive (1988) grammar of Slave; an exhaustive list of these is given in (51).

(51)

lamǫ́	‘ring’
ladʒu, ladʒi	‘gloves’
ledʒai	‘window’
la	‘work’
ladíʔǫ	‘thimble’
láidi	‘where is it?’
láni, láondi	‘like’

The crucial point is that if a noun is [l]-initial, the probability is very high that the nucleus of the first syllable will be [i]. This pattern is, of course, due entirely to historical factors: [i] is the reflex in Slave of the vowel of the definite article in French, found in most [l]-initial nouns (50). If, however, it proves statistically significant, as it presumably will, the linguist committed to encoding all statistically significant patterns in grammar will have to encode this one as well. We regard this as a highly unfortunate consequence of the methodology based on significance.

5.2 The alternation criterion

The second approach, and the one we endorse, is the following: static regularities are not encoded in grammar at all. Regularities are encoded as cophonologies only if the regularity is supported by evidence

from alternations (i.e. phonological alternations arising through morpheme combination, through phrasal concatenation, or through optional rule application).[24] With deference to past debate over the grammatical treatment of static patterns (e.g. Kiparsky 1973a,b), we term this the ALTERNATION CRITERION:

(52) ALTERNATION CRITERION: Cophonologies may be established only if they induce alternations

The Alternation Criterion requires a cophonology to interact with the rest of the grammar (e.g. morphology) in order to be justified.[25]

According to (52), the Sezer pattern justifies a distinct co-phonology, while Labial Attraction does not. The Sezer class is an open, productive one; as seen earlier in (3) (and illustrated again below), a suffixed word which otherwise exhibits the normal final-stress pattern will shift to the Sezer pattern when used as a place name (Sezer 1981b:67):

(53)	*sirke-dʒí*	'vinegar seller'	*sírkedʒi*	(place name)
	torba-lɯ	'with a bag'	*tórbalɯ*	(place name)
	ʃíʃ-lí	'with a skewer'	*tʃíʃli*	(place name)
	kandil-lí	'with a candle (= lamp)'	*kandílli*	(place name)

The Yamato and Sino-Japanese cophonologies posited by Itô and Mester for Japanese also satisfy the criterion; each is correlated with productive morphology and thus induces alternations.

Labial Attraction, by contrast, does *not* satisfy the Alternation Criterion. It does not describe an open class of items; recall from section 2 that suffixed forms are not subject to the condition. Moreover, the class of items which obey Labial Attraction cannot be defined independently. As shown by Orgun (1994), the native/nonnative distinction is orthogonal to the Labial Attraction/non-Labial Attraction split; no phonological or morphological differences have been shown to correlate with obedience to Labial Attraction.

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[24]We deliberately leave loanword adaptation out of this list in deference to the considerable controversy over how exactly it bears on synchronic grammar (see e.g. Hyman 1970, Silverman 1992, and Paradis, LaCharité and Lebel 1994 for a sampling of the range of views). While it is tempting to assume that the phonemic representation of a word in the source language serves as the input to the borrowing language, such that any adaptations would directly reflect the grammar of the latter, there are enough areas of interference—e.g. perception, history, inter-speaker variability, code-switching—for us to be conservative and take no position here.

We also distance ourselves from the issue of degree of productivity of an alternation. This is a very thorny methodological issue in its own right, and one that we choose not to contribute to here. The Alternation Condition simply says that alternation (of any sort) is necessary; it does not say that it is sufficient. We leave it up to others to determine whether "semi-productive" alternations (e.g. velar softening or trisyllabic laxing in English) deserve to be encoded in the grammar.

[25]The ALTERNATION CONDITION is a sufficient condition for justifying a cophonology. As stated in (49), it is also a necessary condition. However, this is in all likelihood too strong. While we firmly reject partial static patterns such as Labial Attraction as justification for a cophonology, we suspect that other types of nonalternation-inducing patterns may well justify encoding in grammar. Likely candidates include the systematic cooccurrence of two truly independent properties in a closed class (an exceptionless implicational generalization, e.g. if continuant then voiced), or the exceptionless occurrence of a phonological property in each member of the class (e.g. "all roots end in a consonant"). Thus the ALTERNATION CRITERION may turn out to be one of a disjunctive set of necessary conditions motivating cophonologies. Establishing this set is the topic of sorely needed future research. The point of the present paper is that it is methodologically unsound to base a cophonology on the defective distribution of a single phonological property, and that it is methodologically sound to base a cophonology on an alternation.
the partial distribution of a single phonological property is not sufficient to motivate a cophonology split, while an alternation is sufficient.

The Alternation Criterion thus constitutes a principled, systematic method of discriminating among cophonologies—and, as seems appropriate, rejects the exception-plagued and static Labial Attraction regularity as a sufficient basis for a cophonology of Turkish. By preventing static subregularities like Labial Attraction from achieving formal status in the grammar, we avoid problems of co-phonology proliferation.

But if static regularities are not handled by grammar, then how are they handled? The alternative method we propose is prespecification, namely lexical storage of the relevant phonological structure.

(54) PRESPECIFICATION METHOD: Handle exceptions and static subregularities by prespecifying (in underlying representation) the relevant phonological structure.

Like rule exception features and cophonologies, prespecification is also a time-honored method in generative phonology. It has coexisted with rule exception features since the beginning as a method for handling exceptionality (e.g. Chomsky and Halle 1968), and figured prominently in the debates over abstractness in the 1970's (e.g. Kiparsky 1973a,b; Hyman 1970; Kisseberth 1969) and more generally in the "rules vs. representations" controversy that has raged throughout the history of generative phonology. Although Kiparsky (1973b) made the case for using rule features rather than prespecification for exceptionality (in those cases where prespecification would require abstract underlying segments), the introduction of autosegmental phonology, metrical theory and underspecification theory revived prespecification (Clements 1976b, 1977; Vago 1976; Kiparsky 1982; Levergood 1984; McCarthy 1984; Poser 1982, 1984; Goldsmith 1985). Prominent uses of prespecification to account for typologies of exceptionality include Hayes 1981 (for exceptions to English stress), Clements and Sezer 1982 and Ringen 1988 (for exceptions to vowel harmony), Inkelas and Cho 1993 (for geminate inalterability), Hyman 1985, Szpyra 1992 and Zoll 1993 (for "ghost" segments) and Kiparsky (1993a,b) for patterns of sound change and nonderived environment blocking.[26]

But prespecification has not been recognized as the only treatment of exceptions; in the autosegmental literature, prespecification and rule features still coexist. We are unaware of previous attempts to formalize the criteria for using one method over another; generalizing, it appears to us that rule features tend to be used in practice as a last resort. In this paper, we advocate the use of prespecification for all instances of exceptionality (and static patterns), and reject the use of rule features (cophonologies) for static patterns completely.[27,28]

For Labial Attraction, the prespecification method amounts to positing the underlying representations in (55). The root which "conforms" to Labial Attraction has an underlying /aBu/ sequence; the other root does not.

(55) "LA" root: /sabun/ 'soap'
"No-LA" root: /kapɯ/ 'door'

We couch our use of prespecification within a version of underspecification theory in which only predictable, alternating structure is underspecified (Inkelas 1994a).[29] Both values of a (bivalent) feature

[26]The fuller list of works making crucial use of featural or structural prespecification to handle exceptionality is too vast to cite, but let us at least mention the following additional works: Mester 1986, Myers 1987; Vago 1988; van der Hulst 1985, 1988; Archangeli and Pulleyblank 1989; Pulleyblank 1988; Buckley 1992, 1993; Ringen and Vago 1994; Paradis and Prunet 1993, Roca 1995.

[27]This claim is obviously a strong one, and we welcome suggestions of apparent counterexamples.

[28] We do, of course, endorse the use of cophonologies to account for alternations induced by specific morphemes of morphological constructions.

[29]If alternation (as opposed to, for example, unmarkedness) is the key cause of underspecification, then underspecification theory avoids many of the problems pointed out by Steriade (1995) and McCarthy and Taub

may be present underlyingly, and redundant features may be filled in at any level. Crucially, the alternations admitting exceptions must be of a structure-filling nature (Kiparsky 1993a) in order for the prespecified structure to have any effect. According to Kiparsky (1993a) (see also Inkelas 1994a), the optimal grammar is one in which structure-filling processes are maximized and structure-changing ones, minimized.

On this theory, exceptions differ from "non-exceptions"—and those morphemes conforming to a static distributional subregularity differ from other morphemes—by possessing some underlying phonological structure causing them to resist or trigger a different class of phonological alternations than morphemes not similarly specified undergo. Crucially, alternations are governed by phonological structure, not by rule or grammar features. The contrast between a "regular" and "exceptional" morpheme is formally indistinguishable from that between any two phonologically distinct morphemes. Membership in a static subregularity and lexical exceptionality are formally identical, a species of simple lexical variety.

In the next three sections, we explore descriptive and theoretical advantages that prespecification has over the cophonology approach to exceptionality and static regularities.

6. Prespecification approach to static patterns is in spirit of Optimality Theory

A significant result of Optimality Theory is the discovery by McCarthy and Prince of "Emergence of the Unmarked" effects. McCarthy and Prince (1994) observe that in Optimality Theory, the structure created by grammar can differ from underlying structure to a considerable degree. When this occurs, they show, it is always the case that the structure created by the grammar is "unmarked" in comparison to the lexical structure (where markedness is computed with respect to the grammar, possibly also universally). Prespecification is the only way to make sense of these results: the marked structure is listed, while the unmarked structure is derived by grammar. Using the Distributional Method of postulating cophonologies, by contrast, the grammar would be forced to derive all structure, marked as well as unmarked. All structure would be an emergent property of the grammar; "Emergence of the Unmarked" effects would no longer be illuminating. One would no longer have access to the information about what is idiosyncratic about the language and what is systematic.

7. Prespecification offers only workable approach to complex words

The second advantage of prespecification theory is that it offers the only workable approach to morphologically complex, phonologically heterogeneous words.

Recall the difficulties encountered in trying to assign the words in (56) to the Labial Attraction or the no-Labial Attraction cophonologies:

(56)	*jamurʧa-m-ɯ*	'fallow deer-1sg.possessive-accusative'
	tambura-m-dɯ	'stringed instrument-1sg.possessive-past'
	abluka-mɯz	'blockade-1pl.possessive'
	abluka-la-mɯʃ	'blockade-verbalizer-evidential'

If "Labial Attraction" consists simply of the prespecification of [labial] on certain high vowels following /aB/ sequences, then these forms pose no problems at all. Since Labial Attraction is not an active constraint in Turkish (meaning that, if Labial Attraction exists at all in universal grammar, in Turkish it is outranked by Vowel Harmony), it does not affect the underspecified suffix vowels, which instead harmonize normally to the last stem vowel.

(1992) (among others) to the effect that certain segment classes said on markedness grounds to be underspecified act, in particular languages at least, as though they are not. See Inkelas (1994a) for discussion.

Prespecification similarly makes easy work of velar deletion, which also caused serious problems for cophonology assignment. As noted earlier, velar deletion, though a clearly productive alternation, admits many root-internal exceptions, e.g.:

(57) *gaga* 'beak'
so̱kak 'street'

This fact pose no obstacle to a prespecification account, as Inkelas and Orgun (1994, 1995) have shown. Since there are no alternations involving root-internal velars, there is no reason to suppose that velar deletion is actively imposed on roots at all. Following Inkelas and Orgun, we assume that velar deletion is due to a constraint holding (i.e. sufficiently highly ranked) only at levels 3 and 4 in the morphology. Moreover, it affects only velars not syllabified in the input. Since velars in roots are syllabified early on the root level, they are immune to velar deletion at levels 3 and 4. Only root-final (and affix-final) consonants are subject to deletion. Final consonant extrametricality, motivated in great detail by Rice (1990) and Inkelas and Orgun (1994, 1995), protects them from root-level syllabification and makes them available to deletion at later levels.

The moral of the story is that by restricting cophonologies to (productive) morphological *levels*, we obtain a simple account of velar deletion in Turkish; when cophonologies correspond to *morphemes*, we run into serious trouble.

8. Prespecification offers superior account of exceptionality

A third significant advantage of prespecification is that it can locate and identify the exceptional area of the morpheme. Like exceptionality, prespecification is segment/syllable specific. By contrast, as we have seen, when cophonologies correspond to morphemes, the ensuing prediction is that exceptionality—or more generally membership in specific static regularities—is a property of morphemes as wholes (for extensive discussion of this point, see Chomsky and Halle 1968, Harris 1977, Vago 1978).

We discuss two examples from Spanish and Turkish to prove that, contra standard assumptions going back at least to SPE (though cf. especially Harris 1977a,b), exceptionality is *not* a feature of the morpheme as a whole.

8.1 Two cases of exceptionality by prespecification

8.1.1 Spanish diphthongization

In Spanish, as discussed in various works by Harris (Harris 1969, 1977a,b, 1985), some but not all mid vowels diphthongize under stress, as shown in (58). The property of diphthongization must be encoded underlyingly in morphemes of the (a) type:[30]

(58)	a.	Diphthongizing /e,o/:	*c[o]ntó*	'he told'	*n[e]gó*	'he denied'
			c[wé]nto	'I tell'	*n[jé]ga*	'he denies'
			[o]rfandád	'orphanhood'		
			[wé]rfano	'orphan'		
	b.	Non-diphthongizing /e,o/:	*m[o]ntó*	'he mounted'	*p[e]gó*	'he hit'
			m[ó]nto	'I mount'	*p[é]go*	'I hit'

It is crucial that the diphthongization property be marked on individual vowels, rather than on morphemes as wholes. The strongest evidence is words like those in (59) which have *two* mid vowels; one

[30]Data are taken from Harris 1985, except for *huerfano*, which comes from Saporta 1959:52.

diphthongizes under stress and the other does not (Harris 1985:42). It is impossible to characterize the morpheme atomically either as [+Diphthongization] or as [-Diphthongization].

(59) *r[é]pr[o]bo* (N.) /e/ does not diphthongize under stress
r[e]pr[wé]bo (V.) /o/ *does* diphthongize under stress

/reprobo/ 'reprobate': [+Diphthongization] *and* [–Diphthongization]

Harris (1985) proposes a simple prespecification treatment, assigning diphthongizing vowels an unlinked timing unit which gets filled only under stress:

(60)

short vowel	true diphthong	alternating vowel
X	XX	XX
|	| |	|
e	u e	e

The X slots of short vowels and true diphthongs are completely filled; fully prespecified, they exhibit no alternations. No rule features or distinct cophonologies are required.

8.1.2 Turkish coda devoicing

The second example is Turkish coda devoicing, our original example (in section 2.3) of a lexical exception, which posed such a problem for a cophonology treatment. Some exceptions to Coda Devoicing are repeated below:[31]

(61)

edʒ.dat	'ancestors'
is.tib.dat	'despotism'
pɯ.re.lyd	'prelude'
ad	'name'
e.tyd	'etude'
ka.ta.log	'catalog'

A simple means of representing these forms underlyingly, such that they can all be assigned the same grammar, is shown in (62). The feature [voice] is linked underlyingly to those plosives on which it always surfaces (Inkelas and Orgun 1994, 1995):

(62)

/edʒda:D/	/istibda:D/	/pɯrely d /
\/	\/	|
vd	vd	vd

Plosives which alternate in [voice] depending on surface position (indicated here in uppercase) are underlyingly unspecified for that feature. We further assume, following Inkelas and Orgun (1994, 1995), that voicing alternations are structure-filling. [–voice] is inserted on coda plosives *not already specified* for voicing; similarly, [+voice] is inserted on underspecified onsets. Crucially, underlying structure is not affected. A "mixed form" presents no problems under this account. There is no impediment to prelinking [voice] to one plosive and not to another.

8.2 Exceptionality *without* prespecification?

Now that we have suggested that prespecification is sufficient to handle lexical exceptionality, we must also show that it is necessary. To show this, we consider the same data just seen from the viewpoint of a

[31]Forms like *tak.dim* 'introduction', *kut.b-u* 'pole-Acc', and *mat.baa* 'press' show that coda voicing is no predictable from the voicing of the following onset.

theory that does not rely on prespecification at all and uses only cophonologies. We focus on the particular task of locating the area of exceptionality within the word. This is a formidable challenge; even those analyses in the literature which assign separate grammars to exceptions still make heavy use of prespecification as well to localize the exceptional area. Let us explore the consequences of not doing so. There are two logical options for a "pure" cophonology treatment.

8.2.1 Option #1: explode constraints

The first possibility is to explode constraints to be sensitive to position of the relevant constituent within the word. For example, in Turkish, assuming that all coda plosives have identical underlying [voice] specifications, we could distinguish *edʒdat*, *istibdat* and *pɯrelyd* from one another by creating three different cophonologies. The first (Cophonology X) would require a voiced coda in the initial syllable; the second (Cophonology Y) would require a voiced coda in the second syllable; and so on.

(63)

	edʒdat	*istibdat*	*pɯrelyd*
	ad	*etyd*	*katalog*
Cophonology X: initial syllable has voiced coda	√		
Cophonology Y: second syllable has voiced coda		√	
Cophonology Z: third syllable has voiced coda			√
etc...			

Under this approach, exceptionality is, technically, still a property of the morpheme as a whole. But the analysis is quite undesirable: not only does it greatly multiply the number of universal constraints (the explosion problem, again), but it also violates the universal prohibition against counting (i.e. against the mention of integers other than 0, 1 and perhaps 2 in rules or constraints) (McCarthy and Prince 1986).

8.2.2 Option #2: explode co-phonologies

The second option is to assign separate grammars to individual phonological constituents (features, segments, syllables, etc.) within the word (for such a move in a rule-based theory, see Phelps 1978 and Ringen 1982, though cf. Vago 1978). Thus, in Spanish we would (following Harris 1977a) mark diphthongizing vowels as [+D], and other vowels in the same morpheme as [–D]. Each segment in a morpheme could thus belong to a different grammar.

(64) reprobo [Harris 1977]

[–D]	[+D]				

This move is also undesirable. First, it is not clear what it means to say that the segments of a morpheme are distributed among different cophonologies—what grammar does such a morpheme belong to? Second, this move leads to cophonology explosion even beyond what we have already considered, and must be rejected for all the reasons already mentioned in section 3. Third, it doesn't make any sense for single segments to belong to distinct cophonologies, since the alternations in question in the Spanish example require reference to more than one segment. The only way to implement this type of approach would be to assign the equivalent of "alphabet" features (see e.g. Chomsky and Halle 1968, Zonneveld 1978) to individual segments and state phonological rules or constraints so that they hold only on segments marked (or unmarked) for those alphabet features. But if the behavior of the morpheme is going to be handled with underlying representation, it is surely more desirable to use real phonological features rather than alphabet features, for all the reasons discussed in Harris (1985) and Inkelas and Cho (1993).

Notice that on both options #1 and #2, the load carried by the phonological material in underlying representation is less than in the prespecification approaches. In fact, if one is willing to postulate a distinct cophonology for each morpheme (a scenario discussed earlier), then one logically arrives at the situation in

which underlying representation is unnecessary: morpheme-specific cophonologies carry the entire burden of assigning the morpheme a surface form. In this logical extreme, *all* morphemes could be underlyingly identical—e.g. /Ø/, or /tata/, or /qpbz/—and differ only in the grammars they (or their segments) belong to. Ironically, this extreme scenario is simulating prespecification in a very clumsy way, by generating in grammar what prespecification theory would place in the representation. Comparing the two, prespecification theory has the advantage of skipping this generation step.

The point of reducing this approach to the point of absurdity is to show that any sensible theory assumes *some* degree of prespecification in order to distinguish nonhomophonous morphemes from one another. Prespecification theory does not introduce prespecification as a new device; it simply relies on this concrete method as much as possible, maximizing its share of the burden of generating unpredictable surface structure.

9. How constrained is prespecification?

Part of our argument that prespecification is superior to cophonologies as an account of static patterning is the claim that the cophonology approach leads to extreme cophonology proliferation. The question then naturally arises as to how principled our use of underspecification and prespecification is: as John McCarthy and David Corina have separately pointed out to us (p.c. 1994), it would be unfortunate to close one door on cophonology explosion but open another door to an equally large explosion of possibilities in underlying representation.

We argue in this section that it is precisely the problem of unprincipled underlying representation which doomed approaches such as ours in derivational theories, but that OT has two properties crucial to a principled implementation of our account of exceptionality and static patterns.

9.1 Violable constraints: OT and prespecification

Exceptions (and static patterns) have always posed a real problem for derivational theories which seek to impose principles on underlying representation. Many such principles have been proposed in derivational approaches, the most well-known being Radical Underspecification (Kiparsky 1982, 1993; Archangeli 1994), in which universally unmarked feature values are prohibited in underlying representation, and Contrastive (or Restricted) Underspecification (Clements 1987, Steriade 1987, Mester and Itô 1989), in which all and only those features which crucially distinguish segments within a natural class are permitted underlyingly. Both of these principles assign a high priority to economy in underlying representation. Both are incompatible with the representational approach to exceptionality. For example, in order to encode the fact that the final /t/ of /sanat/ ‘art’ in Turkish does not alternate, it is necessary to prespecify [-voice], the universally unmarked feature value, contradicting the premise of Radical Underspecification; in order to encode the fact that the final plosive of /kitaB/ does alternate in voicing, it is necessary to underspecify the plosive for [voice], a contrastive feature, contrary to the requirements of Contrastive Underspecification. In derivational theory, the only way to regulate underlying form is to directly impose constraints on it. And by their very nature, exceptions violate these constraints.

The response to this difficult situation has been twofold. Some linguists remain devoted to principles of underlying form and dismiss the counterexamples, either by choosing not to discuss exceptions or by proliferating cophonologies (and encountering all the problems we have raised in this paper). Other linguists (such as Harris (1985) or Inkelas and Cho (1993)) opt to use underlying form to characterize exceptions, thus essentially rejecting all regulatory principles. Neither outcome is satisfactory.

Optimality Theory, however, provides a suitable framework in which to achieve both goals at once. Exceptionality can be captured by prespecification, as we have done in this paper, *and* underlying representations can be regulated in a principled manner. The reason that Optimality Theory is able to achieve both goals is that, in Optimality Theory, constraints can be violable. Thus, for example, Prince and Smolensky (1993) propose a constraint, termed *SPEC, which prohibits structure in underlying form.

When *SPEC is ranked below PARSE, the result is that underlying structure will be preserved, as desired. *SPEC corresponds directly to the economy principles of derivational approaches to underlying representation. However, because it can be violated, exceptions no longer cause a rift in the theory.

2. LEXICON OPTIMIZATION. A second crucial reason why the representational approach to exceptionality is principled when implemented in Optimality Theory is that Optimality Theory has a deterministic method, termed Lexicon Optimization (Prince and Smolensky 1993) for figuring out underlying representation (given knowledge of what cophonology the morpheme in question belongs to). According to Prince and Smolensky (1993) (see also Itô, Mester and Padgett (1993, 1996) and Inkelas (1994a)), that underlying representation is chosen which leads to the violation of the fewest highly ranked constraints in the generation of surface form. Each morpheme has exactly one best underlying representation. There is no analytical problem on the scale of deciding which constraints (subregularities) to base cophonologies on in a given language. The worst-case scenario—and for that matter the only scenario—is that in which each phonologically distinct morpheme has a unique underlying representation. This is not to be feared; it is the standard view.

Given a theory of Lexicon Optimization and a single grammar, underlying specification is constrained, even determined, by the surface forms of morphemes. If *SPEC (Prince and Smolensky 1993) is one of the constraints in the grammar, then the best underlying form is the one that adheres the most closely to *SPEC, all other things being equal (i.e. given that it can generate the correct surface forms). However, underlying form is still principled even if constraints such as *SPEC are not part of the grammar at all. Even if, as advocated in Inkelas (1994a), no constraints at all are dedicated to shaping underlying form, Lexicon Optimization still ensures that underlying representation is deterministic. It provides a principled way of deciding underlying form while allowing exceptionality to be handled using prespecification, precisely the combination of goals that derivational theories have been unable to achieve.

In a theory which permits the unbounded postulation of cophonologies for any or all observed patterns, surface form alone cannot constrain, much less determine, underlying form. The representational approach to exceptionality, crucially implemented within Optimality Theory, is the only principled theory that has the descriptive adequacy to address productive, static and exceptional patterns in phonology.

10. Psychological reality of static subregularities

In this final section, we take up the status of static subregularities. Although we have argued that, for empirical, theoretical and methodological reasons, these should not be codified in the grammar, this is not to say that static regularities play no role in language. It is clear that they play a role in language change, forming the basis for analogy and lexical diffusion (Kiparsky 1993b, Labov 1994). They may also emerge in psycholinguistic experiments; as Zimmer has shown, some speakers appear to be appealing to static generalizations when they judge the well-formedness of nonsense words (Zimmer 1969).

What we would like to suggest is that, although we cannot elevate static regularities to grammatical status in the grammar that we assume all speakers of a language to share, nothing prevents individual speakers from noticing these static patterns in one fashion or another. We would expect, on this scenario, that the static generalizations which get noticed in this manner would vary from speaker to speaker. The arbitrariness inherent in this scenario is consistent with several observations in the literature.

10.1 Lexical diffusion (analogy)

According to Kiparsky (1993b) (see also Labov 1994), lexical diffusion involves the analogical extension of structure-building lexical rules to new contexts, accompanied by the item-by-item simplification (i.e. underspecification) of lexical representations in the relevant phonological context. For this approach to work, Kiparsky observes, static distributional regularities *must* play a role in synchronic and diachronic phonology (p. 12).

(65) Kiparsky 1993b: lexical diffusion is
   a. the analogical extension of structure-building lexical rules to new contexts *and*
   b. the item-by-item simplification (i.e. underspecification) of lexical representations in the relevant phonological context.

Note, however, that if all static regularities were codified in the grammar, then we would expect all of them to be magnets for this sort of analogy. But of course, we find the opposite: statistically, some regularities are much stronger magnets than others. As Holden (1976) observes for Russian, the "nativization" of loanwords progresses at different rates depending on the constraint in question. Holden considers three morpheme structure constraints: e-reduction, o-reduction, and palatalization. In his sample, adaptation to O-REDUCTION and E-REDUCTION is almost complete in the data set[32] (with regularization to E-REDUCTION occurring at a faster rate). By contrast, regularization of dentals to PALATALIZATION does not seem to be occurring. (Some adaptation of labials to PALATALIZATION does occur, but very slowly.)

(66)

E-REDUCTION	e → i when unstressed	*adaptation widespread*
O-REDUCTION	o → a when unstressed	⇓
PALATALIZATION:	C (except ʒ, ʃ, c) → C^j / __ e	*adaptation uncommon*

Holden proposes to index each rule in (65) for its relative strength (i.e. productivity) with respect to the other rules of Russian, such that they exert different "magnetic forces" on analogical adaptation of loanwords.

An alternative we'd like to consider, retaining Holden's basic insight that adaptation is analogy, is simply that (perhaps for various considerations suggested by Holden) a statistically greater proportion of speakers notice the generalization about E-REDUCTION than notice the generalization about O-REDUCTION than notice the generalization about PALATALIZATION. However, one could notice none of those generalizations and still be considered to speak Standard Moscow Russian.[33]

Holden's approach essentially involves saying that loanwords fall into different cophonologies and that the cophonology in which E-REDUCTION is active is the most populous, i.e. has the most member morphemes. He still must list, in the lexical entries of each morpheme, which cophonology it belongs to. Our account also requires lexical listing, but does not require cophonologies.

Our account is also consistent with the findings of Pinker and Prince (1992) and Marcus et al. (1993) that static, nonproductive patterns are encoded differently than productive ones. The former are encoded in the form of a connectionist network, where notions of "strength" or "noticeability" translate into strength of network connections based on lexical item frequency.[34] Pinker and Prince and Marcus et al.

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[32]The data Holden discusses come from work by Glovinskaja, who had native speakers read aloud lists of obvious loan words (Holden 1976:135). Carole Paradis has pointed out to us (p.c.) that this method of elicitation is unreliable for purposes of studying loanward adaptation.

[33]Jaye Padgett and Draga Zec point out (p.c.) that if palatalization before /e/ is an automatic, low-level process, as is often assumed, our claim that speakers fail to notice the generalization is somewhat surprising. So is, for that matter, the fact that speakers fail to apply the rule to loanwords. However, Wayles Browne and Johanna Nichols observe (p.c.) that while speakers typically fail to palatalize loanword consonants before tautomorphemic /e/, they do systematically palatalize loanword consonants in derived environments (e.g., *f-temp-^{j}-e* 'a tempo' (**f-t-^{j}emp-^{j}-e*)). This suggests to us an analysis along the lines proposed for other languages by Kiparsky (1993a): palatalization is a structure-filling process affecting only those consonants underspecified for the palatal/nonpalatal distinction. Prevocalic consonants in loan (and native) morphemes are fully specified, whereas those at morpheme edges are, by default, underspecified, therefore available to be palatalized by suffixes. According to this account, morpheme-*internal* palatalization is not an active rule of Russian, a position consistent with the general stance of this paper that alternations are a crucial prerequisite to the encoding of grammatical patterns.

[34]Shen (1993) argues that in two lexical diffusion sound changes studied in Chinese, the order in which diffusion affected words varied from speaker to speaker, in a pattern Shen characterizes as random. Thus no single estimate

strongly make the point that frequency plays a role only in the behavior of static, nonproductive patterns; productive patterns are not influenced by the corpus frequency of the lexical items they apply to.

10.2 Psycholinguistic evidence: Zimmer 1969

The prediction that speakers may "notice" certain static, distributional regularities on an arbitrary, perhaps even random basis is supported by the experimental work of Zimmer (1969). Zimmer conducted two experiments on native speakers of Istanbul Turkish designed to test the psychological reality of Labial Attraction. In each experiment, Zimmer provided subjects with a pair of nonsense words and asked them to choose which sounded more like it could be a word of Turkish. One element of each pair had the vowel sequence /...aCu.../ and the other, the sequence /...aCɯ.../.

In the first experiment, subjects were provided with 5 pairs in which the medial consonant was labial (e.g. *tafuz/tafɯz*) and 2 in which the medial consonant was not labial (e.g. *tatuz/tafɯz*). For those pairs with a labial medial consonant, only 23.5% provided the expected /...aCu.../ response. For those pairs with a *nonlabial* medial consonant, about the same proportion of speakers still selected the /...aCu.../ pattern, which in this case was *not* the expected response.

(67) Experiment #1 (23 subjects)

	Labial Group (e.g. *tafuz/tafɯz*) (5 pairs)	Nonlabial Group (e.g. *tatuz/tatɯz*) (2 pairs)
a...u preferred:	23.5%	19.6%
a...ɯ preferred:	50.4%	58.7%
"No preference" response:	26.1%	21.7%

The second experiment was similar to the first in design and results, but was faster and forced choice:

(68) Experiment #2 (16 subjects)

	Labial Group (e.g. *tafuz/tafɯz*) (5 pairs)	Nonlabial Group (e.g. *tatuz/tatɯz*) (2 pairs)
a...u preferred:	48.1%	34.4%
a...ɯ preferred:	51.9%	65.6%

Zimmer found that there was no statistically significant difference in the rate of /...aCu.../ preference when the medial consonant was labial as opposed to nonlabial. In fact, the only statistically significant correlation in the data was a *negative* one between expected responses to word in the Labial Group and expected responses to word in the Nonlabial Group. That is, speakers who preferred /...aCu.../ in one case also tended to prefer it in the other (see Orgun (1994) for more extended discussion and analysis).

If interpretable at all (and for a negative view, see Orgun 1994), the consistent behavior of speakers does suggest that regularities (including Vowel Harmony) are being appealed to, but Labial Attraction is not among them. Moreover, the "Have /...aCu.../" regularity which some speakers are apparently relying on is, though available in the data, *not* a regularity which most linguists would choose to include in the grammar of Turkish.

In sum, we have concluded that some words in Turkish have /...aCu.../ sequences underlyingly and others do not. Significantly, this is, in fact, virtually the same conclusion arrived at by Itô, Mester and Padgett (1993, 1996) as well. In their discussion of an analogous phenomenon in Japanese (homorganic

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of text frequency of items for Chinese could correlate with the patterns of change. However, this may simply mean that average text frequency is not an adequate estimator of the frequency with which individuals are exposed to particular lexical items over a lifetime. It is hard to see how an estimate of the latter could ever be made.

nasal-obstruent clusters which share voicing), Itô, Mester and Padgett conclude that the best analysis in Optimality Theory is to specify the shared voice feature underlyingly. The same reasoning holds for their (1993) Labial Attraction analysis: the shared labial feature should be marked underlyingly in the words exhibiting it on the surface, and should not be marked in the words not exhibiting it. This is prespecification.

11. Conclusion

In this paper, we have argued that prespecification is the best available approach to static distributional subregularities, including lexical exceptions, in Optimality Theory in particular and also more generally. We have specifically argued against the use of cophonologies to handle these phenomena.

This conclusion has several important consequences. First, phonological arguments based primarily on evidence from static regularities will have to be reevaluated. Second, underspecification must be maintained as an option in phonological theory. To work, the prespecification approach crucially assumes some version of underspecification theory; thus, arguments in favor of prespecification are also arguments in favor of underspecification theory in general. (This conclusion bears on recent claims that at least certain types of underspecification may be unnecessary in Optimality Theory (McCarthy 1994) or in general (Steriade 1995).) Third, lexical exceptionality has been shown to be of crucial importance in evaluating phonological theories. In contrast to the common practice of disregarding exceptionality in phonological analyses, future debates over analyses and phonological theories must take exceptionality into account.

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