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Lexical Irregularity and the Typology of Contrast

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1 Introduction

This paper[1] addresses the proper balance between the lexicon and grammar. Particularly, it takes a fresh look into lexical phonological irregularity and its implications for the lexicon-grammar interface, integrating insights from three domains: the use of prespecification in blocking alternations (Kiparsky 1993, Inkelas 1995, Inkelas, Orgun & Zoll 1997), phonologically driven allomorphy (Mester 1994, Burzio 1996, Kager 1996, Steriade 1997), and Richness of the Base (Prince & Smolensky 1993, Smolensky 1996, Prince 1998). I propose that irregular alternations involve listed allomorphs, whose surface distribution is conditioned by markedness constraints. My allomorphic model strongly reduces the use of morpheme-specific features for lexical irregularity, thus constraining the factorial typology of contrast.

Classical rule-based theory (Chomsky & Halle 1968, Zonneveld 1978) used two exception devices. *Negative* rule features exempt a lexical item marked [-R] from undergoing a phonological rule R. *Positive* rule features license a lexical item marked [+D] to undergo a 'minor rule' D. In neither case has the diacritic feature any local articulatory or perceptual definition; it is introduced exclusively to restrict the application of certain phonological rules to designated arbitrary classes of lexical items.

Lexical Phonology (Kiparsky 1982, 1985) offers a restrictive view of exceptions in phonology. The major observation was made (and accounted for) that exceptions to rules always involve *contrastive* features, never non-contrastive (*allophonic*) ones. This observation was explained by the organization of the grammar in LP, distinguishing a lexical and a postlexical

[1] Some ideas presented in this paper emerged from discussions with Marc Verhijde and Wim Zonneveld at the UiL-OTS in 1996. For various kinds of input to earlier presentations of this paper, I wish to thank John Alderete, Laura Benua, Geert Booij, Luigi Burzio, Paula Fikkert, Janet Grijzenhout, Harry van der Hulst, John Kingston, John McCarthy, Marc van Oostendorp, Alan Prince, Iggy Roca, Markus Walther, Dieter Wunderlich, Draga Zec, as well as audiences at Heinrich Heine University Düsseldorf (linguistics colloquium, December 1998), NELS 30 (Rutgers University, October 1999), University of Essex (linguistics colloquium, December 1999), and University of Potsdam (workshop on 'Conflicting Rules', December 1999). Finally, my special thanks go to Sharon Inkelas and Joe Pater for their thorough comments. Needless to say, I am fully responsible for any errors.

component. Contrastive features, by their very nature, are encoded in lexical representations, and hence they can be manipulated or contextually referred to by lexical phonological rules. Since all of a morpheme's distinctive features (including its exceptional properties with respect to rules) are located in lexical representation, lexical rules are predicted to have (positive or negative) exceptions. In the postlexical component, feeding on the output of the lexicon, direct access to underlying representation is lost, precluding any reference to exception features by postlexical rules.

For reasons unrelated to irregularity, the burden of explanation in phonology has shifted from rules and derivations to constraints and output representations, culminating in Optimality Theory (Prince & Smolensky 1993), a theory of ranked and violable constraints on output forms. The issue naturally arises of how OT deals with lexical irregularity, and moreover, whether OT captures the major generalization that lexical irregularity involves contrastive features. Upon first inspection, three assumptions of standard OT seem to preclude a treatment of lexical irregularity.

Firstly, according to *Richness of the Base* (Prince & Smolensky 1993, Smolensky 1996), no constraints hold on lexical representations. Anything can be an input—it is only the grammar to determine which input forms surface, and which are suppressed. Noncontrastive features, for example, can be specified in underlying forms, since the grammar fully neutralizes any such specifications at the surface. Contrast and neutralization are conceived of as interactions of two constraint types. Markedness constraints ban specific feature values from the surface (generally or contextually). These are counterbalanced by faithfulness constraints, enforcing the realization of lexical input feature values. *Neutralization* results if a markedness constraint with respect to a feature [F] dominates the faithfulness constraint with respect to this feature; *contrast* whenever the ranking is reverse:

(1) Neutralization and contrast as interactions of constraints
- **Neutralization** Markedness constraint » Faithfulness constraint
- **Contrast** Faithfulness constraint » Markedness constraint

On this view, it is not immediately clear how a contrastive specification of a feature differs from an exceptional specification of that feature. Should there be any difference?

Secondly, the prevailing position among OT theorists, to which I subscribe, is that constraints in Con are universal, hence cannot refer to individual morphemes. Although it has been argued that certain constraint types are to some extent morpheme-specific (for example, alignment constraints that position an affix as prefix or suffix; McCarthy & Prince 1993), I assume that markedness and faithfulness constraints are blind to individual morphemes. (Pace Hammond 1995, Russell 1995.) Conversely, I assume that individual morphemes cannot be lexically specified, positively or negatively, for being in the scope of some constraint. This type of diacritic has, as far as I know, never been proposed in OT, but it is worth stating the restriction.

Thirdly, I take the strong position that no morpheme-specific constraint rankings are allowed to encode a morpheme's phonological exceptionality. Cophonologies (Inkelas & Orgun 1995, Itô & Mester 1997) are motivated only on the basis of compelling morphological evidence for the organization of the lexicon into strata, on the basis of both the distribution and the shared phonological behavior of classes of morphemes. I refer to Inkelas, Orgun & Zoll (1997) for strong arguments against morpheme-specific cophonologies (Kirchner 1993, Cohn & McCarthy 1994, Pater 1995, Fukazawa, Kitahara & Ota 1998, and others).

In combination, these assumptions blocks the OT analogue of (positive and negative) rule features, disallowing diacritic reference by the grammar to individual morphemes. Given such a set of strong restrictions on the lexicon-phonology interaction, what theory of exceptions has OT to offer? I will argue for a maximal separation between lexicon and grammar. The grammar is exclusively responsible for determining the 'contrast space' within which alternations in a given language must occur. Any irregularity of morphemes is exclusively captured in the lexicon, by lexical specification of the relevant property rather than by diacritics.

2 The factorial typology of contrast

To assess the effects of lexical exceptionality on *contrast space*, we need an optimality-based theory of contrast (Prince & Smolensky 1993, McCarthy & Prince 1995, Smolensky 1996, Kirchner 1997, Prince 1998). This rests upon two assumptions. First, the afore-mentioned *Richness of the Base*, according to which no constraints on contrastiveness hold at the input level. Second, a division in *Con* between markedness and faithfulness constraints, of which only the latter have access to the lexical input, while the former are strictly surface-based.

Markedness constraints are blind to the lexical input, evaluating surface well-formedness only. They can be 'general' or 'contextual'. For example, nasality in vowels is evaluated by a pair of markedness constraints in (2), one banning nasal vowels regardless of context (2a), and another requiring nasality of vowels in a specific context, before a nasal consonant (2b):

(2) Examples of general and contextual markedness constraints

a. $\mathbf{*V_{NASAL}}$ Vowels must not be nasal. (general)

b. $\mathbf{*V_{ORAL}N}$ Vowels are nasal before nasal consonants. (contextual)

Contextual markedness constraints account for positional neutralization, the phenomenon that contrasts are neutralized in specific positions (while being preserved elsewhere).[2]

Faithfulness constraints militate against any divergence between input (lexical) and output (surface) specifications of a segment for some feature F or structural property P. In contrast to markedness constraints, faithfulness constraints have access to lexical representations. An example is (3):

(3) **IDENT-IO**[nasal]
Correspondents in input and output have identical values for [nasal].

For the sake of simplicity, I make the assumption that faithfulness constraints are always 'context-free' in the sense that their violation never depends on the (prosodic) position of a segment in surface form. This assumption may prove to be too strong, given arguments by Beckman (1997) and others, that faithfulness of segments occupying 'strong' positions (stressed syllables, onsets) is evaluated by positionally specific constraints, outranking general faithfulness constraints.[3] Positional faithfulness, and its consequences for the factorial typology, will be briefly considered in Section 7.

2.1 The factorial typology of contrast: nonalternating cases

Full permutation of rankings of universal constraints should not produce any (types of) grammars that are cross-linguistically unattested. For example, no language is known to contrast oral and nasal vowels *only* before nasal consonants, while neutralizing nasality in vowels elsewhere. Such a situation should be ruled out by the factorial typology—which is to say that no logically possible reranking should produce it. A factorial typology should predict the clusterings of linguistic properties on a cross-linguistic basis.

Reranking the three constraint types (general and contextual markedness, and faithfulness) results in a four-way typology (McCarthy & Prince 1995, Prince 1998, Kager 1999). In (4), three constraints pertaining to nasality in vowels are reranked, and predictions are shown for two contexts: a prenasal context (pan ~ pãn) for which general markedness ($*V_{NASAL}$) and contextual markedness ($*V_{ORAL}N$) are active, and an elsewhere context (pa ~ pã), where general markedness is active.[4]

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[2] A theory of positional neutralization should account for cross-linguistically recurrent patterns of neutralization, relating these to universal properties of articulation and perception (Steriade 1995a, Flemming 1995).

[3] See Zoll (1996) for an alternative view, couched in licensing by positional markedness.

[4] A full factorial typology of three constraints contains six logical possibilities, but only four rankings emerge as distinct. This is because both faithfulness and general markedness impose a total ranking on all candidates. Accordingly, these constraints, when undominated, obscure the relative ranking of any constraint they dominate.

(4) Factorial typology of markedness and faithfulness for [nasal] in vowels

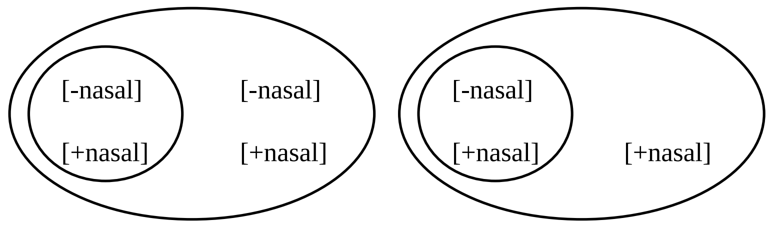
• Full contrast			Faith » M-Specific, M-General
	pan ~ pãn	pa ~ pã	
• Contextual neutralization			M-Specific » Faith » M-General
	pãn	pa ~ pã	
• Total neutralization			M-General » M-Specific, Faith
	pan	pa	
• Complementary distribition			M-Specific » M-General » Faith
	pãn	pa	

A *full contrast*, in which oral and nasal vowels freely contrast in both contexts, occurs when faithfulness (IDENT-IO[nasal]) is undominated, obscuring any effects of markedness constraints. Secondly, *contextual neutralization* (nasalizing all prenasal vowels) occurs if contextual markedness (*$V_{ORAL}N$) is undominated, while contrast is maintained elsewhere (Faith » M-General). Thirdly, *total neutralization* (with all vowels oral) stems from undominated general markedness, leaving no room for any role of the lexical input, nor for contextual markedness. Finally, *complementary distribution* (such that a vowel is nasal *iff* it is in prenasal position, producing allophonic variation) results when both markedness constraints rank above faithfulness, with the contextual constraint taking precedence over the general contraint.

The typology correctly excludes languages in which a nasal-oral contrast in vowels occurs prenasally (pan ~ pãn), but is neutralized elsewhere (pa, not *pã). This result rests on the assumption that contextual constraints are *negative* (neutralizing contrasts in specific contexts), not *positive* (licensing contrasts in specific contexts). Accordingly, positional faithfulness/licensing (Steriade 1995b, Zoll 1996, Beckman 1997) affects the factorial typology in some respects, to be briefly discussed in Section 7.

Degrees of contrastiveness predicted by a factorial typology of contrast can be represented in another way, using *Venn*-diagrams. The area enclosed by the outer oval represents the general context ('contrast space'), properly including a specific context, represented by the inner oval. Under *full contrast* (diagram 5a), both values of a feature occur in both the specific and general context. Under *contextual neutralization* (diagram 5b), however, only a single value may occur in the specific context, as indicated in the diagram by the lacking specification [-nasal] in the inner oval, representing the prenasal context referred to by the constraint *$V_{ORAL}N$.

(5) a. FULL CONTRAST b. CONTEXTUAL NEUTRALIZATION



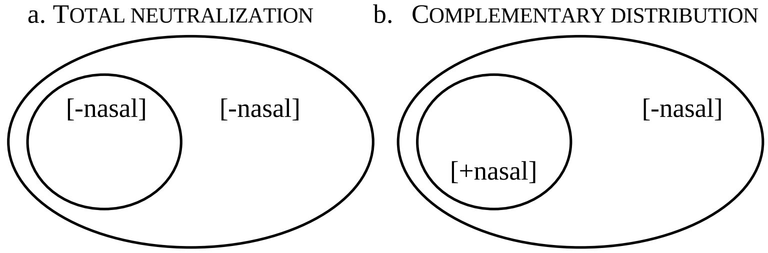
Faith » M-Specific, M-General M-Specific » Faith » M-General

Both diagrams show situations of(partial contrast, with both values licensed in the general context, due to faithfulness dominating general markedness:

(6) (Partial) contrast: Faithfulness » M-General

Two diagrams represent the reverse ranking, a complete loss of contrast, in different ways. First, under *total neutralization* (7a) toward orality, [-nasal] surfaces in both contexts. Second, *complementary distribution* (7b), with values [-nasal] or [+nasal occurring in complementary contexts:

(7) a. TOTAL NEUTRALIZATION b. COMPLEMENTARY DISTRIBUTION



M-General » M-Specific, Faith M-Specific » M-General » Faith

2.2 The factorial typology of contrast for alternations

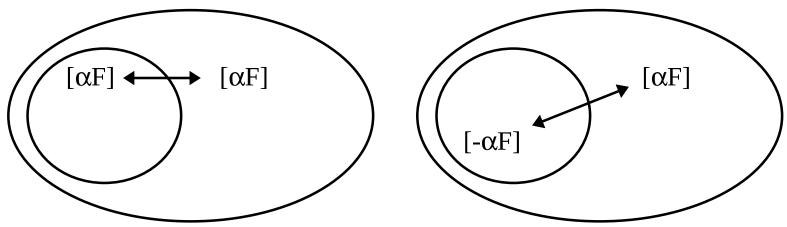
All of a morpheme's contextual realizations are licenced by the grammar, which is to say that each alternant constitutes a phonotactically licit output form, assuming a language's phonotactics (defined by the grammar by interactions of markedness and faithfulness constraints). Since alternations are, in this sense, *structure-preserving* (respecting the system of contrasts in the phonology of nonalternating morphemes), we can represent alternations in contrast space by connecting a morpheme's specification for a feature [F] in the specific context to its specification for [F] in the general context.

Abstracting away from nasality in vowels, let us assume a binary feature [F] with values [αF], [-αF] and a pair of markedness constraints M_G and M_S:

(8) M_G: *[-αF] (General M-constraint)
M_S: *[αF] in some environment *E*. (Contextual M-constraint)

First we consider the simplest situation, a complete loss of contrast, manifested either as total neutralization (9a) or complementary distribution (9b).

(9) a. TOTAL NEUTRALIZATION b. COMPLEMENTARY DISTRIBUTION

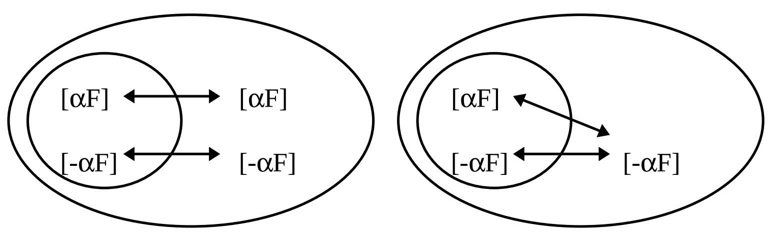


M-General » M-Specific, Faith M-Specific » M-General » Faith

Under *total neutralization* no alternations occur, and all morphemes are fixed [αF], the context-free unmarked value. In *complementary distribution*, contextual markedness takes priority over general markedness, making all morphemes alternate between $[\text{-}\alpha F]_S \sim [\alpha F]_G$.

Next we look into *full contrast* and *contextual neutralization*, connecting contextual values of [F] in the following ways:

(10) a. FULL CONTRAST b. CONTEXTUAL NEUTRALIZATION



Faith » M-Specific, M-General M-Specific » Faith » M-General

Under full contrast (10a), both values freely occur in both contexts, allowing two types of nonalternating morphemes ([αF] and [-αF]). Alternations are blocked by undominated faithfulness, obscuring any effects of markedness. In tableau (11), candidates are listed as mini-paradigms, pairs of values of [F], one for each context (general and specific). In cells below constraints, violations for individual contexts have been added up.

(11) Full contrast: IO-Faith » M_G, M_S

Input: /αF/	IO-Faith	$*[-\alpha F]_G$	$*[\alpha F]_S$
☞ $[\alpha F]_G \sim [\alpha F]_S$			*
$[\alpha F]_G \sim [-\alpha F]_S$	*!	*	
$[-\alpha F]_G \sim [\alpha F]_S$	*!	*	*
$[-\alpha F]_G \sim [-\alpha F]_S$	*!*	**	
Input: /-αF/	IO-Faith	$*[-\alpha F]_G$	$*[\alpha F]_S$
$[\alpha F]_G \sim [\alpha F]_S$	*!*		*
$[\alpha F]_G \sim [-\alpha F]_S$	*!	*	
$[-\alpha F]_G \sim [\alpha F]_S$	*!	*	*
☞ $[-\alpha F]_G \sim [-\alpha F]_S$		**	

Lexical inputs to this tableau reflect the assumption that lexical specification is *strictly binary*, /[αF]/ or /[-αF]/. *Richness of the Base* forces us, however, to consider two more possibilities: underspecification ([∅F]), discussed in Section 4, and and listed allomorphy ([αF] ~ [-αF]), the topic of Section 6.

In *contextual neutralization* (10b) a subset of morphemes are fixed [-αF] in all contexts, while others alternate $[-\alpha F]_S \sim [\alpha F]_G$. Top-ranked contextual markedness excludes nonalternating [αF]; elsewhere, faithfulness prevails over general markedness, producing a contrast.

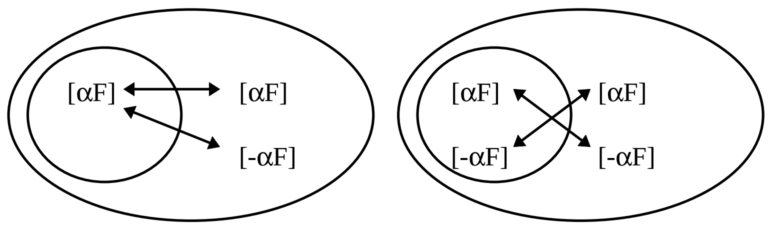
(12) Contextual neutralization: M_S » IO-Faith » M_G

Input: /αF/	$*[\alpha F]_S$	IO-Faith	$*[-\alpha F]_G$
$[\alpha F]_G \sim [\alpha F]_S$	*!		
☞ $[\alpha F]_G \sim [-\alpha F]_S$		*	*
$[-\alpha F]_G \sim [\alpha F]_S$	*!	*	*
$[-\alpha F]_G \sim [-\alpha F]_S$		**!	**
Input: /-αF/	$*[\alpha F]_S$	IO-Faith	$*[-\alpha F]_G$
$[\alpha F]_G \sim [\alpha F]_S$	*!	**	
$[\alpha F]_G \sim [-\alpha F]_S$		*!	*
$[-\alpha F]_G \sim [\alpha F]_S$	*!	*	*
☞ $[-\alpha F]_G \sim [-\alpha F]_S$			**

Summarizing, we find that under the assumption of strictly binary input specification, only two patterns of alternations are predicted by the factorial typology: *full contrast* (with nonalternating morphemes of both values while lacking alternating morphemes) and *contextual neutralization* (alternating morphemes and fixed morphemes of only one value). As we will see shortly, the typology seriously undergenerates, being unable to express a *three*-way division of morphemes (*two* fixed-value morphemes *plus* alternating ones, Inkelas 1995).

Before turning to this issue, I show that the factorial typology correctly excludes two logically possible types of alternation, in which feature points are connected in the following ways:

(13) a. 'REVERSE NEUTRALIZATION' b. 'CROSSED ALTERNATION'



(13a) shows 'reverse neutralization' to a marked value $[\alpha F]_S$, the situation in which morphemes alternate between $[-\alpha F]_G$ ~ $[\alpha F]_S$, their values crossed as compared to the 'natural' alternation $[\alpha F]_G$ ~ $[-\alpha F]_S$. Crossed neutralizations are intrinsically suboptimal as no ranking of our current constraints derives them (Prince 1998). Tableau (14) shows how the violation marks of a pair of 'natural' alternants are properly included in those of 'reverse' alternants.

(14) Intrinsic suboptimality of 'reversed' alternation

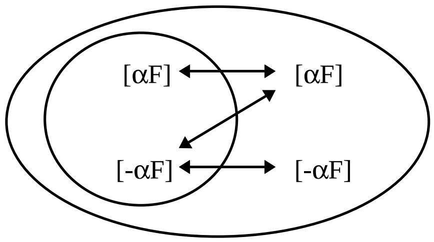
	$*[\alpha F]_S$	IO-Faith	$*[-\alpha F]_G$
☞ $[\alpha F]_G$ ~ $[-\alpha F]_S$		*	*
$[-\alpha F]_G$ ~ $[\alpha F]_S$	*!	*	*

Regardless of lexical value (/[αF]/ or /[-αF]/), alternation implies a violation of faithfulness by one of the alternants, cancelling out violations in the candidates. One alternant also violates general markedness, again cancelling out violations. Any differences between candidates only reside in their violation of specific markedness, a circumstance which favors a 'natural' alternation. Basically the same explanation holds for 'crossed alternation' (13b), a combination of a regular and a reverse alternation.

3 Neutrast

A third logically possible type of alternation is incorrectly excluded by the typology. This is what I will call a 'neutrast':

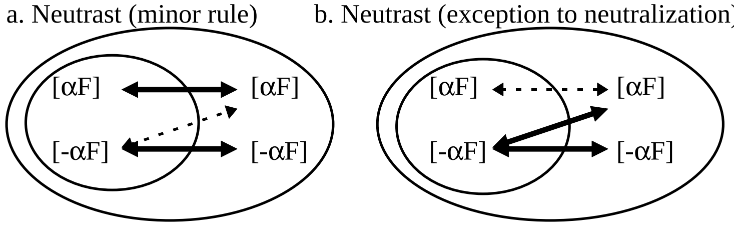
(15) NEUTRAST



The *neutrast* combines ingredients of full contrast and contextual neutralization. As in full contrast, both values occur freely in both contexts, but at the same time alternating morphemes occur, as in contextual neutralization. Assuming strictly binary input specification, the neutrast cannot be derived under any ranking. This is because (as we have seen above) free occurrence of both values in all contexts implies that the relevant faithfulness constraint (IDENT-IO[F]) is undominated, blocking any alternations. For alternation to arise, a contextual markedness constraint must dominate faithfulness.

Neutrast is incorrectly excluded by the factorial typology, since at least two types are cross-linguistically attested. First, full contrast combines with a designated set of alternating morphemes, a situation handled in rule theory by minor rules. Second, contextual neutralization may be subject to lexical exceptions, which is handled by negative exception features in rule theory. Both types of neutrast are represented below. Solid lines indicate 'regular' morphemes, while dotted lines indicate (positive or negative) 'exceptions':

(16) a. Neutrast (minor rule) b. Neutrast (exception to neutralization)



I hypothesize that any grammar in which neutrast with respect to [F] occurs, necessarily licenses a full contrast of [F], implying a ranking IO-Faith » M_G. The following generalization thus seems to hold:

(17) **Generalization**
Lexical irregularity with respect to [F] may only occur in grammars which maintain a contrast of [αF] ~ [-αF]. (Implying IO-Faith » M_G)

This generalization echoes a theorem of Lexical Phonology (Kiparsky 1982) that lexical rules may have exceptions, while postlexical rules are exception-free. For exceptionality with respect to a feature [F] to occur, [F] must occur in lexical representations, which implies that [F] is contrastive. In OT, due to Richness of the Base, contrast is not captured at the level of lexical representation, but at surface level by interactions of constraints. The question then is: can OT capture generalization (17)?

Earlier I noted that the factorial typology fails to predict neutrast. One way of capturing neutrasts in OT is by diacritic means: morpheme-specific faithfulness constraints or morpheme-specific cophonologies. In the context of this paper, the drawback of diacritic approaches is that these essentially abandon 'contrast' as a grammar-wide notion, leaving (17) unexplained. If individual morphemes can enforce their lexical specifications by their own faithfulness constraints ranked in specific positions in the hierarchy, the entire notion of 'contrast' becomes meaningless. All phonological features would become contrastive, as no exceptionless neutralization of any feature could be enforced by the grammar. That is, it would become an accident that for a *noncontrastive* feature [F], every morpheme-specific faithfulness constraint enforcing [F] is dominated by some markedness constraint neutralizing [F]. To enforce grammar-wide noncontrastivess of a feature, language-specific metarankings fixing the rankings of morpheme-specific faithfulness constraints would be needed. Morpheme-specific cophonologies are more restrictive than morpheme-specific constraints, but as Inkelas, Orgun, & Zoll (1997) demonstrate, serious problems still remain.

To account for neutrast (that is, *three*-way lexical contrasts among morphemes), while explaining generalization (17), we must give up the assumption of strict binarity in lexical specification, and allow for input ternarity, as Inkelas (1995) and Inkelas, Orgun & Zoll (1997) convincingly argue on the basis of negative exceptions.[5] My theory of neutrast builds on insights from Inkelas' prespecification theory, to be discussed in Section 4. Section 5 will argue, however, that prespecification accounts for a subset of neutrasts only, that is, those involving segmental features, but not those involving prosodic properties. To achieve full coverage, I will propose a theory of *lexical allomorphy* in Section 6, allowing a set of alternants in a morpheme's lexical representation, and deriving phonology-governed distributions by markedness constraints. Finally, Section 7 will address the consequences of lexical allomorphy for the factorial typology.

[5] Kiparsky (1993) allows some degree of ternarity, in the sense that the lexicon is free to contain segments specified for all three values (plus, minus, or zero) of a feature [F]. However, in any given context, he still adheres to binarity by limiting underlying contrasts to two (for example, plus and zero, or minus and zero).

4 Archiphonemic underspecification and the factorial typology of contrast

As implied by Inkelas (1995), the assumption of strictly binary lexical specification is incompatible with Richness of the Base. Both a stronger and a weaker version of lexical binarity are ruled out. Under a strong version, the lexicon contains only two values for any feature [F], whether [+/-], [+/0], or [-/0]). The weaker version allows all three values in the lexicon, while limiting prespecification to two values in any given context (contextual prespecification, Kiparsky 1993). Under Richness of the Base, the grammar has to produce a mapping for all three logically possible input values of [F] in any context. We now turn to a prespecification account of ternary contrasts, in the context of the factorial typology of contrast.

4.1 Negative exceptions to neutralization

When considering contextual neutralization in the context of a discussion of contrast, we must distinguish degrees of lexical completeness: exceptionless neutralization and exception-sensitive neutralization. That is, given a feature [F], whose values [αF] and [-αF] freely occur in a set of environments E_G, there exists a specific environment E_S in which either:

- only the value [αF] occurs (exceptionless neutralization), or
- the value [-αF] occurs residually (exception-sensitive neutralization)

An example of exceptionless contextual neutralization is Dutch coda devoicing (Kager 1999, Booij this volume). Stems ending in obstruents which, by affixation, occur in two phonological contexts (onset and coda), fall into two lexical sets: nonalternating stems have voiceless obstruents everywhere (e.g. [pɛt] ~ [pɛ.tən] ‘cap(s)’), while alternating stems have two alternants: voiceless coda and voiced onset (e.g. [bɛt] ~ [bɛ.dən] ‘bed(s)’):

(18) Dutch devoicing

a. Alternating stems [-voice]~[+voice]

bed	[bɛt]	‘bed’	bedden	[bɛ.dən]	‘beds’

b. Nonalternating stems [-voice]

pet	[pɛt]	‘cap’	petten	[pɛ.tən]	‘caps’

c. *No* nonalternating stems [+voice]

No stems occur whose final consonant surfaces as voiced in both contexts. Of course, this gap is not due to a lexical property of stems; it falls out of a general phonotactic pattern of Dutch: coda obstruents are always voiceless. The grammar of Dutch expresses this generalization.

Under exceptionless neutralization, a contextual markedness constraint outranks a faithfulness constraint. I assume three markedness constraints to be potentially relevant to obstruent voicing. Two are contextual markedness constraints; the third bans voiced obstruents across the board.

(19) Markedness constraints potentially relevant to obstruent voicing:

- NO-VOICED-CODA ‘Obstruents are voiceless in coda position.’
- INTER-V-VOICE ‘Obstruents are voiced intervocalically.’[6]
- *[-son, +voice] ‘Obstruents are voiceless.’

The ranking (20) captures complete neutralization of voice in Dutch codas:

(20) Exceptionless neutralization of voice in codas: M-Specific » Faith
NO-VOICED-CODA » IDENT-IO[voice] » INTER-V-VOICE, *[-son, +voice]

This is simply a case of the ranking scheme (10b), with an extra contextual markedness constraint. Note that the relative ranking of *[-son, +voice] and INTER-V-VOICE cannot be established. First, for any stem whose lexical input is either [-voice] or [+voice], IDENT-IO [voice] obscures any effects of the lower-ranked markedness constraints. Hence, /pɛt/ surfaces faithfully as [pɛt ~ pɛt-ən], while /bɛd/ surfaces as [bɛt ~ bɛd-ən], maximally faithful to its input specification to the extent that NO-VOICED-CODA allows it. Second, a hypothetical stem unspecified for [voice] runs into a competition between INTER-V-VOICE and *[-son, +voice], since any output candidate will violate IDENT-IO[voice] to the same extent, twice in this case.[7] Assuming a hypothetical stem /mɛD/, either of two output pairs is optimal:

(21) Unestablished constraint ranking for hypothetical unspecified input:

Input /mɛD/	NO-VOICED-CODA	IDENT-IO [voice]	INTER-V-VOICE	*[-son, +voice]
☞ mɛt ~ mɛt-ən		**	*	
☞ mɛt ~ mɛd-ən		**		*
mɛd ~ mɛt-ən	*!	**	*	*
mɛd ~ mɛd-ən	*!	**		

[6] This might be stated more generally as intersonorant voicing, *[-voice] / [+son] __ [+son].
[7] Alternatively, we may assume that feature-filling mappings go unpenalized by featural faithfulness. That is, IDENT-IO[F] is violated only if the output changes a specified lexical value of [F], while no violation mark is assigned if the lexical input lacks specification for [F].

Note that these are precisely the two output patterns for lexically specified stems. Since underspecification fails to add a third surface pattern, there is no reason for the learner to posit a three-way lexical contrast. In sum, we have not seen any crucial evidence for underspecification so far. This will be presented shortly.[8]

We now turn to Turkish coda devoicing, which is discussed by Inkelas (Inkelas 1995), Inkelas & Orgun (1995) and Inkelas, Orgun & Zoll (1997). As compared to Dutch, Turkish has an additional type of stem (22c):

(22) Turkish devoicing

a. Alternating stems [-voice]~[+voice]

kanat	'wing'	kanad-ɨ	'wing-ACC'
kanat-lar	'wing-PL'	kanad-ɨm	'wing-1SG.POSS'

b. Nonalternating stems [-voice]

sanat	'art'	sanat-ɨ	'art-ACC'
sanat-lar	'art-PL'	sanat-ɨm	'art-1SG.POSS'

c. Nonalternating stems [+voice]

etüd	'etude'	etüd-ü	'etude-ACC'
etüd-ler	'etude-PL'	etüd-üm	'etude-1SG.POSS'

Inkelas (1995), following an earlier proposal by Hayes (1990), argues that this three-way contrast is due to a three-way lexical specification, [+voice], [-voice], [0voice]. In the Turkish grammar, faithfulness to [voice] is high-ranking, such that any prespecified value of voice surfaces in all contexts; alternating stems are lexically underspecified, their surface values filled in by markedness constraints. The markedness constraints pertaining to [voice] 'apply' in a fashion similar to feature-filling rules in Lexical Phonology. All three logically possible lexical values coincide with an attested stem pattern:

(23) Three-way contrast in URs

stem type	*lexical*	*output*	*example*
• unspecified	/D/	[t ~ d]	/kanaD/
• specified [-voice]	/t/	[t]	/sanat/
• specified [+voice]	/d/	[d]	/etüd/

[8] Lexicon Optimization leads the learner to posit input [-voice] in nonalternating voiceless stems, while for alternating stems, either [+voice] or [0voice] suffices. Inkelas argues that alternating morphemes are lexically underspecified, assuming feature-changing mappings to be more costly in terms of faithfulness constarints than feature-filling ones. See previous footnote.

This three-way division among stems constitutes the empirical argument for underspecification (which could not be construed for Dutch, where only two patterns surface due to exceptionless contextual neutralization).

Inkelas (1995) and Inkelas, Orgun & Zoll (1997) argue that the three-way contrast implies undominated faithfulness to the lexical specification of [voice]. Dominated markedness constraints only take effect in the case of an unspecified lexical input, in a 'feature-filling' fashion. Intervocalic voicing and coda devoicing arise from the ranking below:

(24) Exception-sensitive neutralization of voice: Faith » M-Specific
IDENT-IO[voice] » NO-VOICED-CODA, INTER-V-VOICE » *[-son, +voice]

The minimal difference with the Dutch ranking (20) is that IDENT-IO[voice] dominates all markedness constraints, and crucially, NO-VOICED-CODA. The tableaux in (25) show the selection of the most faithful candidate paradigms for inputs specified as [-voice] and [+voice], respectively.

(25) Fully specified inputs: nonalternation enforced by Faith » M-Specific

Input /sanat/	IDENT-IO [voice]	NO-VOICED-CODA	INTER-V-VOICE	*[-son, +voice]
☞ sanat ~ sanat-ɨ			*	
sanat ~ sanad-ɨ	*!			*
sanad ~ sanat-ɨ	*!	*	*	*
sanad ~ sanad-ɨ	*!*	*		**
Input /etüd/	**IDENT-IO [voice]**	**NO-VOICED-CODA**	**INTER-V-VOICE**	***[-son, +voice]**
etüt ~ etüt-ü	*!*		*	
etüt ~ etüd-ü	*!			*
etüd ~ etüt-ü	*!	*	*	*
☞ etüd ~ etüd-ü		*		**

Alternating forms derive from an underspecified input, e.g. /kanaD/. Inkelas, Orgun & Zoll (1997) assume that insertion of a value of [voice] in lexically underspecified forms amounts to violation of a faithfulness constraint FAITH, which I will equate with the correspondence constraint IDENT-IO[voice]. If we assume surface specifications to be fully specified ([+voice] or [-voice]), all candidates incur the same amount of violation of this constraint:[9]

---

[9] Implicitly, I assume Inkelas' suggestion (p.c.) of ranking SURFACE-SPEC (the requirement that output forms be fully specified) above IDENT-IO[voice].

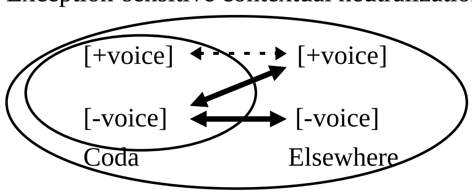
(26) Underspecified inputs: alternation enforced by a pair of markedness constraints

/kanaD/	IDENT-IO [voice]	NO-VOICED-CODA	INTER-V-VOICE	*[-son, +voice]
kanat ~ kanat-ɨ	**		*!	
☞ kanat ~ kanad-ɨ	**			*
kanad ~ kanat-ɨ	**	*!	*	*
kanad ~ kanad-ɨ	**	*!		

With violations of IDENT-IO[voice] cancelled between candidate paradigms, previously dormant contextual markedness constraints are activated, favoring devoiced codas and voiced intervocalic obstruents, and giving a surface alternation [kanat ~ kanad-ɨ]. We witness an *emergence of the unmarked*, a phenomenon well-attested in reduplication and other phenomena (McCarthy & Prince 1994, 1995).

Judged by the numerical distribution in the Turkish lexicon, stems specified as [-voice] or [0voice] are regular, while stems specified as [+voice] are exceptional. From the prespecification perspective of Inkelas, Orgun & Zoll (1997), however, voicing in Turkish is simply a *full contrast*, enforced in all contexts by a high-ranking faithfulness constraint. The implicit claim is that the skewed distribution of stems in three classes has no grammatical status. (The grammar does not refer to individual stems, nor to any lexical diacritic on specific stems.) In diagram (27), an instantiation of the neutrast (16b), the rareness of stems with prespecified [+voice] is indicated by dotted lines:

(27) Exception-sensitive contextual neutralization



In sum, the grammar (not the lexicon) determines the degree of lexical completeness of neutralization. The constraint ranking of exception-sensitive neutralization is identical to that of full contrast: F » M. While the grammar determines the contrast-space within which all alternations must occur, the lexicon supplies morphemes ([+F], [-F], [0F]), in various frequencies.

5 Problems with underspecification

Archiphonemic underspecification, although it provides an adequate account of ternary alternations that involve a binary segmental feature, is difficult to extend to prosodic alternations. Segment insertion, deletion, and alternations of length do not involve a binary feature, but rather some prosodic element (mora, root node, etc.). While the lexical presence and absence of a prosodic element can be viewed as the counterparts of a prespecified feature [+F] and [-F], respectively, it is not clear what the counterpart of the underspecified value [0F] might be. I will argue below that what seems the most reasonable choice, lexical specification of autosegmental association lines, is essentially a nonalternation diacritic in disguise.

Let us focus on a length alternation. An example is trisyllabic shortening (Kiparsky 1982), a contextual neutralization that has lexical exceptions:[10]

(28) Ternary alternation in trisyllabic shortening (TSS)

a. Alternating vowel ('regular undergoer'):
   ser[iː]ne ~ ser[e]nity

b. Nonalternating short vowel ('vacuous nonundergoer'):
   tranqu[ɪ]l ~ tranqu[ɪ]lity

c. Nonalternating long vowel ('exceptional nonundergoer'):
   ob[iː]se ~ ob[iː]sity

I make the standard assumption that TSS is an alternation of length, involving monomoraic and bimoraic vowels.[11] If we conceive of length as a property whose surface specifications are monomoraic or bimoraic, while lexical specifications add a third (underspecified) value, the question arises what is the counterpart of /0F/. First, if we assume the alternating vowel of *serene* to be lexically long, then prespecified length is no longer available to encode the exceptional nonshortening of *obesity*. Second, if we prespecify nonalternating *obesity* as long, it becomes unclear what to underspecify in *serene* ~ *serenity*. For example, if *serenity* is short, with structure-filling lengthening in *serene*, the contrast with *tranquil* is lost. Simple moraic preservation does

[10] Other exceptionally long vowels before 'shortening' suffixes (from Fudge 1984:222) occur in *apical, vibrative, migratory, vibratory, cyclical, psychical, amenity, denotative, restorative, codify, glorify, nodical, probity.*

[11] Lahiri & Fikkert (1999) show that, diachronically, length alternations in trisyllabic shortening were due to wholesale borrowing of Romance loans, both suffixed and unsuffixed. Lahiri & Fikkert (1999:229) argue that '[o]nly later, when these words came to be derivationally related, were quantity alternations observable with TSS operating as a constraint dictated by the prosodic structure of the modern language.' This result is fully compatible with my proposal.

not suffice to capture the ternarity. We need extra machinery: a lexical contrast between prelinked and floating moras.[12]

That is, we might distinguish *serene* from *obese* in the following fashion. The second vowel of *obese* would have two prelinked moras, while that of *serene* would have one linked mora plus a floating one. Consider the lexical representation of a vowel alternating in length (with a floating mora, 29a), and its surface alternants (29b, c):[13]

```
(29)   a.  μ μ        b.  μ μ        c.  μ
           |              | /            |
           V              V              V
```

I assume concreteness of representation: surface alternants of underspecified vowels are represented identically to nonalternating long and short vowels.

To enforce nonshortening and nonlengthening by mora prespecification, we need a faithfulness constraint militating against changes in input length, WT-IDENT-IO (McCarthy 1995, Borowsky & Harvey 1997, Broselow, Chen & Huffman 1997, Gussenhoven this volume):

(30) WT-IDENT-IO
If $\alpha \in$ Domain(f),
if α is monomoraic, then $f(\alpha)$ is monomoraic. (‘no lengthening’)
if α is bimoraic, then $f(\alpha)$ is bimoraic. (‘no shortening’)

WT-IDENT-IO requires identical quantity of output segments and their input correspondents. This requirement is made in both directions, excluding both the addition of quantity (‘lengthening’) and its loss (‘shortening’). Note that the constraint does not refer to association lines, on the tacit assumption that lexical moras are preassociated. With underspecification of length, however, this assumption cannot hold.

If the alternating stems are lexically represented by a floating mora, then nonalternating stems are not faithful to moras, but to root-to-mora *association lines*. Let us examine the four logically possible changes. Two occur in alternations (31a-b), and the other two are excluded nonalternations (31c-d):

---

[12] A contrast between prelinked versus floating segments has been proposed in the literature on ghost segments (Zoll 1996). The alternative is to prespecify higher-level prosodic structure on top of nonalternating segments. For example, Inkelas & Orgun (1995), to account for lexical exceptions to Turkish intervocalic velar deletion, assume prespecification of syllable structure (under extrasyllabicity of stem-final consonants and cyclicity). Inkelas, Orgun & Zoll (1997) acknowledge, however, that this analysis cannot be generalized to alternations involving nonperipheral elements.

[13] Contrasts between prelinked versus floating segments have been proposed in the literature on ghost segments (Zoll 1998).

(31) a. ser[iː]ne

$$\begin{array}{ccc} \mu\,\mu & & \mu\,\mu \\ | & \rightarrow & |\,/ \\ \mathrm{V} & & \mathrm{V} \end{array} \quad \text{add line}$$

b. ser[e]nity

$$\begin{array}{ccc} \mu\,\mu & & \mu \\ | & \rightarrow & | \\ \mathrm{V} & & \mathrm{V} \end{array} \quad \text{delete } \mu$$

c. *ob[e]sity

$$\begin{array}{ccc} \mu\,\mu & & \mu \\ |\,/ & \rightarrow & | \\ \mathrm{V} & & \mathrm{V} \end{array} \quad \textbf{delete line}\text{, delete } \mu$$

d. *tranq[aɪ]l

$$\begin{array}{ccc} \mu & & \mu\,\mu \\ | & \rightarrow & |\,/ \\ \mathrm{V} & & \mathrm{V} \end{array} \quad \text{add line, } \boldsymbol{\text{add } \mu}$$

The only way to distinguish (31a-b) from (31c-d) is to render WT-IDENT-IO sensitive to different violations, of moras and association lines separately. A constraint NO-DELINK, enforcing the autosegmental association of segments to moras, was proposed in McCarthy (1997). Informally, this constraint says that if a segment S_1 is linked to a mora μ_1 in the input, then its correspondent segment S_2 must be linked to the corresponding mora μ_2 in the output. Note that for a violation of NO-DELINK to occur, the segment and the mora must be present in both input and output. For *obesity*, however, we crucially need violation of NO-DELINK for a prelinked mora that is no longer present in the output. A stipulation must then be made that a deletion of a prelinked mora violates NO-DELINK.

A prespecification analysis of TSS based on this assumption is given in tableau (32). Undominated NO-DELINK blocks shortening in *obesity*. Shortening of *serenity* (that is, deletion of its floating mora), satisfies NO-DELINK, even though it violates WT-IDENT-IO. Shortening itself is conditioned by a metrical constraint EVEN-TROCHEE (Prince 1990, Hayes 1995) requiring the trochaic foot to be quantitatively balanced (i.e. short-short).

(32) A prespecification analysis of trisyllabic shortening

prelinked length	NO-DELINK	EVEN-TROCHEE	WT-IDENT-IO	NO-LONG-V
☞ ob[iː]sity		*		*
ob[e]sity	*!		*	
floating length	**NO-DELINK**	**EVEN-TROCHEE**	**WT-IDENT-IO**	**NO-LONG-V**
ser[iː]nity		*!		*
☞ ser[e]nity			*	

The dual use of faithfulness (to segment-to-mora association lines and moras separately) amounts to diacritic use of association lines. Both constraints, NO-DELINK and WT-IDENT-IO, have identical patterns of violation except that the former enforces length in nonalternating stems only, while the latter is relevant to all types of stem. NO-DELINK, under its revised interpretation, is essentially a parochial version of length faithfulness (WT-IDENT-IO) with local relevance for a designated class of stems. It is difficult to distinguish this analysis from one involving morpheme-specific (diacritic) ranking of a pair of faithfulness constraints, with nonalternating stems selecting a non-deletion ranking (FAITH$_1$ » EVEN-TROCHEE), and alternating ones selecting a deletion ranking (EVEN-TROCHEE » FAITH$_2$).

In sum, a prespecification theory of ternary alternation successfully deals with structure-filling featural alternations, but runs into problems in dealing with ternary prosodic alternations. Since alternating prosodic elements such as moras cannot be underspecified themselves, indirect underspecification is required, implying faithfulness to lexical moraic association lines, which is arguably diacritic. Ternary alternations involving entire segments (deletions or insertions) involve similar (or more serious) complications.[14]

Nevertheless, I believe that the prespecification theory of neutrasts offers two ideas of genuine importance. First, the idea that neutrast is essentially a *full contrast*, in which IO-Faithfulness to a lexical property *P* dominates all markedness constraints with respect to *P*. This captures the generalization that neutrast only occurs in grammars which license a contrast with respect to *P*. Hence, neutrast is *not* a 'leaking' contextual neutralization, with lexical exceptions to a neutralization ranking M-Specific » Faith. The second valuable idea is *cancellation of faithfulness* violations in alternating morphemes in neutrast, allowing markedness constraints to jump into activity (producing an Emergence of the Unmarked). Cancellation is straightforward in the case of featural alternations, but comes at a higher cost in dealing with prosodic alternations, involving length, and presence or absence of entire segments.

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[14] For example, to account for lexical exceptions to Turkish intervocalic velar deletion, Inkelas & Orgun (1995) assume syllable structure to be prespecified in the input (under extrasyllabicity of stem final consonants and cyclic syllabification). However, Inkelas, Orgun & Zoll (1997) acknowledge that this analysis is difficult to generalize to alternations involving nonperipheral elements. Another problem for prespecification is posed by exceptions to minimality conditions, e.g. exceptional monomoraic words in Turkish (Inkelas & Orgun 1995) and Japanese (Itô 1990). Kiparsky (1993:304) assumes prespecification of a monomoraic foot, while canonical bimoraic stems are unspecificied for foot structure. It is unclear, however, why prespecified monomoraic feet would block canonical lengthening while monomoraic vowels unspecified for foot structure freely undergo it. Thanks to Sharon Inkelas for pointing this out.

6 Lexical allomorphy

We can maintain both central insights into ternary alternation (full contrast ranking and the cancellation of faithfulness in alternants), while avoiding the problems of prespecification of prosodic properties. This implies, however, that we allow multiple alternants in a morpheme's lexical representation and develop a theory of phonology-driven *allomorphy*.

6.1 Allomorphy in Dutch length alternations

We begin by introducing the 'minor rule' that is the focus of this section. Dutch has an alternation of vowel length known as 'open syllable lengthening', which occurs in a number of (mostly nominal) stems (Zonneveld 1978, Booij 1995, this volume), as exemplified in (33c). Nouns in (33a) and (33b) represent the far larger classes of nonalternating stems.

(33) Ternary alternation in Dutch open syllable lengthening

a. Nonalternating short vowel (many stems):

kl[ɑ]s	~	kl[ɑ]sen	'class(es)'
p[ɔ]t	~	p[ɔ]ten	'pot(s)'
h[ɛ]g	~	h[ɛ]gen	'hedge(s)'
k[ɪ]p	~	k[ɪ]pen	'chicken(s)'

b. Nonalternating long vowel (many stems):

b[aː]s	~	b[aː]zen	'boss(es)'
p[oː]t	~	p[oː]ten	'paw(es)'
r[eː]p	~	r[eː]pen	'bar(s)'

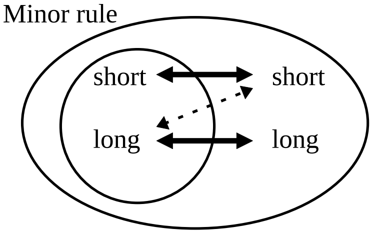
c. Alternating short ~ long vowel (few stems):

gl[ɑ]s	~	gl[aː]zen	'glass(es)'
sl[ɔ]t	~	sl[oː]ten	'lock(s)'
w[ɛ]g	~	w[eː]gen	road(s)'
sch[ɪ]p	~	sch[eː]pen	'ship(s)'

In alternating stems (33c), short vowels occur in closed syllables (singulars), and long vowels in open syllables (plurals). In nonalternating stems (33b), long vowels occur in both closed and open syllables. In nonalternating stems (33a), short vowels occur in closed syllables (singulars), or before a single intervocalic consonant (plural). Intervocalic consonants after (stressed) short vowels are usually considered ambisyllabic, an aspect to which I will return.

As shown in diagram (34), this is a neutrast. Three types of stem occur: those with nonalternating length are represented with solid lines in the diagram, while 'exceptional' alternating stems are represented by a dotted line.

(34) Minor rule



Basically this is a full contrast (with short and long vowels occurring freely in both contexts), with a 'leakage' of alternating stems. Note that contrast diagrams of exception-to-neutralization and minor-rule are identical, except for the relative frequency of alternating morphemes. In exception-sensitive neutralization, the nonalternating morphemes are rare, while in minor rules, alternating morphemes are. Since the numerical distribution of morphemes of various alternation types is due to the lexicon, the grammars underlying both types of neutrast will be assumed to be identical.

As is typical of minor rules, the direction of the alternation is not directly clear. Alternating stems occur in two contexts, both of which are positively characterized, either as an open or a closed syllable. Upon first inspection, the process may be characterized either as open syllable lengthening (OSL) or closed syllable shortening (CSS), both natural processes, attested in many of the world's languages. Both OSL and CSS are interactions of antagonist effects: the maximization of weight in stressed syllables (due to the STRESS-TO-WEIGHT PRINCIPLE) and avoidance of overweight (due to *μμμ) which would arise by a long vowel in a closed syllable.[15]

(35) Constraints triggering length alternations

- STRESS-TO-WEIGHT PRINCIPLE (SWP) 'If stressed then heavy'
- NO-TRIMORAIC-SYLLABLES (*μμμ) 'No trimoraic syllables'

Nevertheless, the literature on Dutch phonology (Zonneveld 1978, Booij 1995) considers the alternation a lengthening rather than a shortening be-

[15] If intervocalic consonants after short lax vowels are ambisyllabic, a standard assumption for Dutch phonology (Van der Hulst 1984, Kager 1989, Booij 1995, Gussenhoven this volume), and if closed syllables are heavy (same references), then a third constraint is at play to select a tense long vowel in an open syllable, rejecting a short lax vowel plus ambisyllabic coda. This constraint is NO-CODA, militating against closed syllables. See Gussenhoven (this volume) for an analysis of Dutch vowel length and word stress on different assumptions.

cause of its partly neutralizing character. As indicated in (35c), there are two sources for long [eː] in stems participating in the alternation: either /ɛ/ (*weg*) or /ɪ/ (*schip*). Because of the neutralization in the direction of the long vowel alternants (/ɛ, ɪ/ → [eː]), most analysts assume a minor rule of OSL which has approximately the following format:

(36) Dutch OSL as a rewrite rule

$$\begin{array}{ccccc} \text{V} & \rightarrow & \text{V:} & / & \underline{\quad\quad} \,]_{\sigma} \\ \text{<[-back]>} & & \text{<[-high]>} & & \\ \text{[+D]} & & & & \end{array}$$

The features in angled brackets express the generalization that front vowels are simultaneously lowered, accounting for the neutralization referred to above. The positive exception feature [+D] spells out the 'handshake' between lexicon and grammar: only morphemes marked [+D] undergo the rule.

6.2 The counterpart of 'minor rule' in OT

At this point, having discussed a rule-based analysis of OSL, we should first ask what the counterpart of the notion of 'minor rule' in OT is. Two answers can be rejected off-hand, after discussions in earlier sections. First, *morpheme-specific rankings* (markedness and faithfulness are ranked in a morpheme-specific way) have been discussed, and rejected, above. Essentially, this solution merges the grammar with the lexicon, and loses any generalization about the grammar-wide, morpheme-independent roles of contrastive (or redundant) features. Second, the option of *morpheme-specific faithfulness constraints* is rejected for the same reason. Under this heading, I also rubricize attempts to use prelinked association lines to enforce a distinction between alternating and nonalternating morphemes, as discussed in the previous section. Third, there is a well-established option of *cophonologies*, understood as subdividing the grammar into rankings depending on principled lexical strata (Inkelas & Orgun 1995 on Turkish, Itô & Mester 1995 on Japanese). To avoid their diacritic use, however, cophonologies should be used for genuinely morphologically defined strata only. Clearly this is not the case here, since the set of stems participating in OSL does not form a stratum by any independent criteria.

Essentially, the rejection of these options entails that we have given up the diacritics approach to exceptions, involving features to establish contact between a set of ranked constraints and a set of designated morphemes. But if the grammar is 'blind' to specific morphemes, how to restrict alternations to specific morphemes? My view is that all unpredictable properties of morphemes should be expressed solely in the lexicon, including their alternating or nonalternating status. This brings us to allomorphy. Let us first establish that Dutch OSL has all properties of a lexically listed alternation (see Bybee 1988, 1995, Lieber 1982, and for Dutch, Booij, 1995, this volume).

First, the set of alternating stems is idiosyncratic. This is, of course, the essence of a minor rule, an alternation restricted to a designated set of morphemes. In this case, the set of alternating stems fails to reoccur in other alternations in Dutch, which means that the designated class of stems is unpredictable by any independent means, ruling out any stratal account.[16]

Second, the OSL alternation itself is idiosyncratic because no productive alternations of length in Dutch (see Gussenhoven, this volume) are accompanied by obligatory tense-lax alternations. Moreover, OSL is accompanied by alternations in height which are partly predictable (for example, high [ɪ] only alternates with mid [eː]), and partly unpredictable (for example, leveled height in [ɑ]~[aː], *glas~glazen,* next to alternation in [ɑ]~[eː], *stad~steden*). Tenseness and height alternations accompanying OSL in nominal plurals are shown below (partly from Zonneveld 1978:58, Booij 1995:87, this volume):

(37) Tenseness and height alternations accompanying OSL, and examples

[ɪ] ~ [eː]	*gelid* 'rank', *lid* 'member', *schip* 'ship', *smid* 'blacksmith'
[ɛ] ~ [eː]	*bevel* 'order', *gebed* 'prayer', *gebrek* 'shortcoming', *spel* 'game', *weg* 'road'
[ɑ] ~ [eː]	*stad* 'city'
[ɑ] ~ [aː]	*bad* 'bath', *bedrag* 'amount', *blad* 'leaf', *dag* 'day', *dak* 'roof', *dal* 'valley', *glas* 'glass', *graf* 'grave', *pad* 'path', *staf* 'staff', *vat* 'barrel', *verdrag* 'treaty'
[ɔ] ~ [oː]	*gebod* 'command', *god* 'god', *hertog* 'duke', *hof* 'court', *hol* 'hole', *lof* 'benediction', *lot* 'lot', *oorlog* 'war', *slot* 'lock'

The long vowel participating in OSL alternations is obligatorily nonhigh (a fact to which I will return shortly), causing a kind of minor 'neutralization' of height in the case of [ɪ, ɛ] ~ [eː]. (In Dutch, alternations of height only ever occur under OSL alternations.) Moreover, no alternations of rounding occur between short and long vowels under OSL.

Third, OSL lengthening 'overapplies' in certain morphological contexts (Zonneveld 1978) systematically in denominal verbs (*smeed* 'to forge', *baad* 'to bathe', *loot* 'to draw lots'), and idiosyncratically in diminutives (*glaasje,*

[16] Although most OSL stems are monosyllabic nouns, a few polysyllabic nouns occur (*oorlog ~ oorlogen* 'war(s)', *hertog ~ hertogen* 'duke(s)', both with a conditioning secondary stress on the long vowels), plus a handful of verbs (e.g. *gaf ~ gaven* 'gave-SG/PL', *kom ~ komen* 'come-SG/PL', *kwam ~ kwamen* 'came-SG/PL'), and even a single adjective (*grof ~ grove* 'crude').

scheepje). In these morphological contexts, the same stem allomorphs occur as in plurals, but without matching OSL's canonical open syllable context. Regardless of the issue of how to analyzse overapplication, the point is that only stems that have long vowel allomorphs in their plurals can have long allomorphs in diminutives and verbs.[17] This 'lexical conservatism' (Steriade 1997) is accidental under a derivational analysis of OSL, using minor rules for different morphological contexts, but not under an allomorphic account (Lieber 1982 offers similar arguments for other languages).[18]

6.3 Phonologically driven allomorphy

I now turn to an analysis of OSL alternations by allomorphs. I assume that lexically unpredictable alternations (such as minor rules) are encoded in the lexicon by *listed allomorphs*, which are selected by markedness constraints. My model of phonology-driven allomorphy builds on earlier work by Prince & Smolensky (1993), Mester (1994), Burzio (1996, to appear), Kager (1996, 1999), Drachman, Kager, & Malikouti-Drachman (1996), Perlmutter (1996), Steriade (1997), and Hayes (1999).[19] Assumptions are stated below.

First, a morpheme's lexical phonological representation may contain one or more allomorphs, each of which is independently available as an input to grammatical mapping. For example, the phonological representation of the stem 'ship' in the lexicon is a pair of allomorphs of distinct vowel lengths {/sxɪp/$_1$ ~ /sxeːp/$_2$}, each carrying a different index, for reasons appearing immediately below.[20]

Second, I assume 'split inputs'. *Gen* supplies a full set of candidate outputs for each individual lexical allomorph. Accordingly, an output candidate is a pair consisting of a candidate output analysis, plus the lexical allomorph which serves as its input. The relation between output analysis and its input allomorph is indicated by coindexation, allowing IO-faithfulness constraints to match each output analysis to its lexical allomorph. An output candidate C can thus be seen as a coindexed pair of an output analysis O and a lexical

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[17] See Benua (1997) on overapplication effects due to output-to-output faithfulness.

[18] Zonneveld (1978) places diminutives and denominal verbs in angled brackets in the OSL rule. However, this analysis fails to explain why long vowel allomorphs of OSL stems need not occur in diminutives, e.g. *slotje* 'lock-DIM.', *godje* 'god-DIM.'. I will not go into idiosyncratic length alternations in OSL stems before suffixes such as *-ig* (*glas ~ glazig*, but nonalternating *gebrek ~ gebrekkig*) and *-elijk* (*stad~stedelijk*, but *god ~ goddelijk*), see Booij (this volume).

[19] Some of these reseaerchers, more ambitiously, attempt to eliminate the notion of underlying representation from phonological theory (Burzio 1996, to appear, Steriade 1997, Hayes 1999). Perhaps the central issue is whether perfectly productive alternations should be dealt with in terms of listed allomorphs. I believe that the issue can be partly resolved, since the grammar constrains the notion of 'possible allomorph' in a language, as we will see later.

[20] Presumably, nonalternating aspects of allomorphs are collapsed in lexical representations, locating the alternation on the relevant segments, e.g. /sx{ɪ$_1$ ~ eː$_2$}p/. See Walther (1999).

allomorph I, together (I_i, O_i). In our particular case, the output candidates [sxeːp]$_1$ and [sxeːp]$_2$ are phonetically identical, but each is based on a different lexical allomorph.

Third, *Eval* considers all output candidates based on different lexical allomorphs in parallel. In the case of output candidates [sxeːp]$_1$ and [sxeːp]$_2$, only the former (coindexed with the lexical allomorph /sxɪp/$_1$) violates faithfulness to length, tenseness, and height; the latter (coindexed with /sxeːp/$_2$) is fully faithful. More generally, a faithfulness constraint evaluating identity for a feature [F] faces structurally identical output candidates, O_1 and O_2, each having a different allomorph I_1 and I_2 as its input. Since O_1 and O_2 are structurally identical, both specified as [+F], the candidate is selected whose input allomorph is specified as [+F]. The net result is a kind of cancellation of faithfulness: in the case of two allomorphs with opposite values of [F], at least one output candidate will satisfy the faithfulness constraint:

(38) Vacuous optimization of input allomorph

Input {[+F]$_1$, [-F]$_2$}	IDENT-IO[F]
☞ [+F]$_1$	
[+F]$_2$	*!

Now consider a case in which the candidate set, at the point of evaluation by IDENT-IO[F] still contains potentially winning candidates for both values of [F], as in the next tableau. Since for each value of [F] in output candidates, an input allomorph can be found that is faithful, candidates of both values (here, [+F]$_1$ and [-F]$_2$) are passed on for evaluation by markedness:

(39) Invisibility of allomorphy to faithfulness

Input {[+F]$_1$, [-F]$_2$}	IDENT-IO[F]	*[+F]
[+F]$_1$		*!
[+F]$_2$	*!	
[-F]$_1$	*!	
☞ [-F]$_2$		

This explains why allomorphy seems ‘invisible’ to faithfulness constraints, an explanation requiring nothing but standard assumptions about the lexical input (Richness of the Base), *Gen* (Freedom of Analysis), and *Eval* (minimal violation). Invisibility to faithfulness implies that phonological distributions of allomorphs (everything else being equal) uniquely depend on *markedness* constraints, precisely as we saw in the discussion of Turkish voice alternations (see tableau 26). Underspecification and lexical allomorphy share this phonology-driven property. The full virtues of the allomorphic model only become clear, however, when we turn to prosodic alternations such as Dutch OSL, which resist treatment in terms of prespecification.

6.4 Constraining allomorphy

The main faithfulness constraint relevant to OSL alternations is WT-IDENT-IO (30). Since OSL is an alternation that is part of a neutrast (see 34), this constraint is undominated. In nonalternating stems, which have only a single lexical phonological representation (with either a short or long vowel), WT-IDENT-IO outranks all (potentially relevant) markedness constraints:

(43) Faithfulness respected in single-input stems

Input {/pɔt/}	WT-IDENT-IO	SWP	*μμμ	NO-LONG-VOWEL
☞ pɔt ~ pɔ.tən		*		
pɔt ~ poː.tən	*!			*
poːt ~ pɔ.tən	*!	*	*	*
poːt ~ poː.tən	*!*		*	**
Input {/poːt/}	WT-IDENT-IO	SWP	*μμμ	NO-LONG-VOWEL
pɔt ~ pɔ.tən	*!*	*		
pɔt ~ poː.tən	*			*
poːt ~ pɔ.tən	*	*	*	*
☞ poːt ~ poː.tən			*	**

But for stems with length allomorphs, satisfaction of WT-IDENT-IO becomes vacuous—selection of allomorphs comes to depend on markedness constraints only:

(44) Alternating stems: emergence of the unmarked

Input {/slɔt/$_1$ ~ /sloːt/$_2$}	WT-IDENT-IO	SWP	*μμμ	NO-LONG-VOWEL
slɔt$_1$ ~ slɔ.tən$_1$		*!		
☞ slɔt$_1$ ~ sloː.tən$_2$				*
sloːt$_2$ ~ slɔ.tən$_1$		*!	*	*
sloːt$_2$ ~ sloː.tən$_2$			*!	**

The tableau only compares candidate pairs that satisfy WT-IDENT-IO, since, as I argued above, the availability of lexical length allomorphs allows every surface alternant to derive from a lexical counterpart of matching length. In effect, IO-faithfulness to length is by-passed by a judicious choice of lexical allomorphs. This analysis raises a number of important general questions.

First, how does allomorphy predict *phonologically driven* distribution of allomorphs? That is, why is the distribution not reverse, with the long allomorph in a closed syllable, and short allomorph in an open syllable (**sl*[oː]*t* ~ **sl*[ɔ]*ten*)? This follows from the natural assumption that *allomorphs are not subcategorized for phonological context*, so that any phonological context-sensitivity must be due to markedness constraints (Kager 1996, 1999). In the alternating candidate paradigms in (44), optimal [slɔt_1 ~ sloː.tən_2] and suboptimal [sloːt_2 ~ slɔ.tən_1] the violation marks incurred by the markedness constraints for the optimal paradigm form a proper subset of those of the suboptimal paradigm. The suboptimal paradigm is *intrinsically* ill-formed—it is never selected, regardless of ranking (Prince 1998).

Second, can this theory capture any (consistently) *nonalternating* aspects of allomorphs? For example, OSL is never accompanied by alternations of rounding, as in hypothetical *[nɔt_1 ~ naː.tən_2]. From a diachronic angle, the explanation is evident: all lexical alternations start out as transparently predictable by markedness constraints (Kiparsky 1982, Booij, this volume). In the absence of a transparent rounding process, why should lexical rounding alternations ever develop? A diachronic account, however, fails to explain the systematic lack of synchronic rounding alternations under OSL.

If allomorphy is driven by contextual markedness constraints, then the lack of allomorphy for a feature [F] may be simply interpreted to reflect the lack of the relevant contextual markedness constraint in UG. That is, lexical allomorphy would be leveled out by general markedness constraints: a kind of *Stampean occultation*. In this particular case, UG may happen to contain no markedness constraints linking roundness to OSL's canonical prosodic context (syllabification, stress). This account, however, does not generalize.

Alternatively, we may assume surface allomorphy to be checked by special constraints maximizing the phonological similarity between members of a paradigm—OO-Faithfulness constraints (Burzio 1996, Benua 1997). For example, the lack of rounding alternations accompanying OSL is captured by a sufficiently high-ranked identity constraint:

(45) IDENT-OO[round]
Corresponding segments in output forms agree in values of [round].

For the hypothetical set of lexical allomorphs {/nɔt/$_1$ ~ /naːt/$_2$} alternating in rounding, this alternation would not be able to surface, being blocked by the ranking IDENT-OO[round] » M-specific [round]:

(46) Enforcing paradigm uniformity in allomorphy

Input {/nɔt/$_1$ ~ /naːt/$_2$}	IDENT-OO [round]	M-specific [round]
☞ nɔt$_1$ ~ noː.tən$_2$		*
nɔt$_1$ ~ naː.tən$_2$	*!	

Presumably, this ranking comes at minimal cost to the learner, assuming all OO-Faithfulness constraints to be undominated in the initial state (Hayes 1999). Without rounding alternations at surface, the learner has no positive evidence to demote IDENT-OO[round], so that it will remain undominated.

Third, can we capture *obligatory alternating* aspects of allomorphs? We find, for example, that allomorphy is ‘structure-preserving’ in the sense that specifications for tense/lax automatically alternate along with length in OSL stems, matching the phonotactics of the Dutch vowel system. Consider, for example, the neutralization of height under OSL (briefly discussed above), which is explained by inviolate phonotactics of Dutch. Recall that short high [ɪ] alternates with long mid [eː] (e.g. *schip* ~ *schepen*), implying a neutralization of height under OSL, where short mid [ɛ] alternates with [eː] as well (e.g. *weg* ~ *wegen*). This neutralization is due to a high-ranked constraint HIGHV-μ: high vowels are short (Gussenhoven, this volume). Diagram (47) shows neutralization of height in relation to length and tenseness.

(47) Neutralization of vowel height under OSL

	lax	tense
high	ɪ	*iː
mid	ɛ	eː

Since allomorphy is driven by quantitative constraints, hypothetical height-preserving tenseness alternations such as **sch*[ɪ]*p* ~ *sch*[i]*pen* simply fall short of meeting the quantitative goal, while height-preserving length alternations such as **sch*[ɪ]*p* ~ *sch*[iː]*pen* would be phonotactically illegitimate. How to capture this idea by ranked constraints? What we must show is that hypothetical allomorph pairs such as those mentioned above would not be able to surface. To limit the set of ‘possible allomorphs’, the grammar must obscure the lexical input, as in any standard case of allophonic variation.

First, tableau (48) shows how a height alternation accompanying OSL {*schip* ~ *schepen*} is grammatically enforced, licensing the lexical paradigm {/sxɪp/$_1$ ~ /sxeːp/$_2$}. After eliminating the topmost paradigm for its long lax [iː], two paradigms are fed into IDENT-IO [high], which guarantees faithfulness to the input values of [high] in both surface allomorphs:

(48) Grammar licenses alternation of height in input paradigm

{/sxɪp/$_1$ ~ /sxeːp/$_2$}	WT-IDENT-IO	HIGH V-μ	SWP	*μμμ	IDENT-IO [high]	IDENT-OO [high]
sxɪp$_1$ ~ sxiːpən$_2$		*!			*	
☞ sxɪp$_1$ ~ sxeːpən$_2$						*
sxɛp$_1$ ~ sxeːpən$_2$					*!	

This offers an argument for the ranking IDENT-IO[high] » IDENT-OO[high]. Any leveling of height (*sxɛp$_1$ ~ sxeːpən$_2$) is rejected by IO-Faithfulness, at the expense of a violation of OO-Faithfulness. (Of course, leveled height in input paradigms will be respected, as *weg* ~ *wegen* shows.)

This ranking correctly predicts that height alternations are impossible for input paradigms that are stable in length. Assuming a hypothetical lexical paradigm {/sxɪp/$_1$ ~ /sxɛp/$_2$}, with leveled length but alternating height, the grammar rejects the height alternation since the distribution of alternants is undetermined by quantity-sensitive constraints. First, any attempt to introduce alternation of length fails on undominated WT-IDENT-IO. Next, the set of remaining candidate paradigms evaluated by IDENT-IO[high] is homogeneous in the sense that all have leveled length but alternating height. Each of these paradigms is rooted in a pair of height-matching lexical allomorphs, by-passing any effects of IDENT-IO[high]. The leveling of height in output paradigms is then due to IDENT-OO[high]:

(49) Grammar levels out alternating height in pair of short allomorphs

{/sxɪp/$_1$ ~ /sxɛp/$_2$}	WT-IDENT-IO	HIGH V-μ	SWP	*μμμ	IDENT-IO [high]	IDENT-OO [high]
sxɪp$_1$ ~ sxɪ.pən$_1$			*			*!
☞ sxɪp$_1$ ~ sxɛ.pən$_2$			*			
sxɛp$_2$ ~ sxɪ.pən$_1$			*			*!
☞ sxɛp$_2$ ~ sxɛ.pən$_2$			*			
sxɪp$_1$ ~ sxeː.pən$_2$	*!					*

In tableau (48) we saw that the lexical length allomorphy indirectly *licenses* a height alternation, which can be said to be 'parasitic' on the length alternation. We now see that if the lexical paradigm is leveled in length, pressure for alternation from quantity-sensitive constraints drops, leading to leveling of height by paradigmatic constraints.

More generally, this theory predicts that alternation of a property A may be confined to specific contexts, in which another property B alternates. In Dutch, for example, an alternation of length indirectly licenses an alternation of height. This parasitic licensing of one alternation by another alternation is an interesting result, since it suggests an account of *nonderived environment blocking* effects (Kiparsky 1993) in which 'derivedness' is due to 'prior application of a phonological rule'.[21] There is an empirical prediction here, that NDEB effects are found only in alternations that display the syndrome of properties of neutrasts: contrastiveness and lexical irregularity.

We are now in a position to explain the lack of hypothetical OSL alternations such as [ɪ] ~ [iː], with alternation of length and leveled height. Since any long vowel allomorph with [iː] runs into high-ranked HIGHV-μ, either its quantity or height will be obscured. The long allomorph's quantity is preserved since it satisfies SWP in an open syllable, hence its vowel is lowered to [eː]. Minimal violation of IDENT-IO[high] predicts that the optimal output paradigm is {sxɪp$_1$ ~ sxeːpən$_2$}.

(50) Grammar imposes alternation of height in pair of length allomophs

{/sxɪp/$_1$ ~ /sxiːp/$_2$}	WT-IDENT-IO	HIGH V-μ	SWP	*μμμ	IDENT-IO [high]	IDENT-OO [high]
sxɪp$_1$ ~ sxiːpən$_2$		*!				
sxɪp$_1$ ~ sxɪpən$_1$			*!			
☞ sxɪp$_1$ ~ sxeːpən$_2$					*	*
sxɛp$_1$ ~ sxeːpən$_2$					**!	

The grammar enforces an alternation in height that is not lexically specified. This explains the neutralization of vowel height accompanying OSL, where high and mid short vowels [ɪ, ɛ] both alternate with mid long [eː] (e.g. *schip* ~ *schepen* and *weg* ~ *wegen*).

Finally, let us consider the fate of a hypothetical lexical allomorph pair {/sxɪp/$_1$ ~ /sxip/$_2$} leveled in length and height, while alternating in [tense].

[21] Lubowicz (1998) offers an account of NDEB-effects based on constraint conjunction.

The explanation for its ill-formedness is analogous to the leveling of height in tableau (49). The grammar rejects any alternation of tenseness which is unaccompanied by a quantity alternation, and returns only tenseness-leveled output paradigms: either lax (a pattern attested in *kip~kippen* 'chicken(s)'), or tense (a pattern attested in *iep ~ iepen* 'elm(s)').[22]

(51) Grammar levels out alternating tenseness in input paradigm

{/sxɪp/$_1$ ~ /sxip/$_2$}	WT-IDENT-IO	HIGH V-μ	SWP	*μμμ	IDENT-IO [tense]	IDENT-OO [tense]
☞ sxɪp$_1$ ~ sxɪpən$_1$			*			
sxɪp$_1$ ~ sxipən$_2$			*			*!
sxip$_2$ ~ sxɪpən$_1$			*			*!
☞ sxip$_2$ ~ sxipən$_2$			*			

This finishes the discussion of phonotactic restrictions on allomorphic patterns. In sum, I have argued that a theory of lexical allomorphy is perfectly capable of capturing generalizations on obligatory alternations, leveling, and neutralization. Quite remarkably, this result was achieved without diacritic means, and fully in line with Richness of the Base.[23]

7 The factorial typology of allomorphy

We now have all ingredients that we need to compute the factorial typology of contrast in a theory of listed allomorphy. Four constraint types will be reranked in the factorial typology:

[22] Whenever the input is leveled for tenseness, the output paradigm reflects this specification, licensing the contrast between lax *kip ~ kippen* and tense *iep ~ iepen*. But whenever [tense] alternates in the input, a leveling takes place toward one of both values, depending on general markedness constraints governing [tense].

[23] A separate issue that I will not discuss here is how to capture any morphologically-governed types of allomorphy. Arguably allomorphs may be subcategorized by morphological contexts, with constraints enforcing morpho-subcategorization overriding markedness constraints.

(52) Markedness constraints

- $M_{General}$ *[-αF]
- $M_{Specific}$ *[αF]   / X __ Y

Faithfulness constraints

- IO-Faith   Input value of [F] equals output value of [F]
- OO-Faith   No alternations of [F], hence *{[αF] ~ [-αF]}

For reasons of perspicuity I have stated constraints in terms of values of [F]. Recall, however, that lexical allomorphy is crucially motivated by prosodic alternations that are problematic in a (segmental) underspecification model, as shown in Sections 5 and 6. The full factorial typology is below:

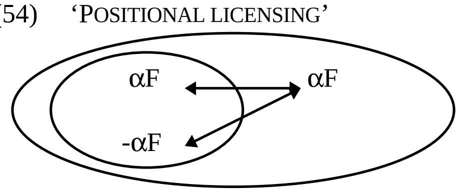
(53) Factorial typology of allomorphy (see appendix for full tableaux)

1. Neutrast: IO-Faith » M_S » M_G, OO-Faith
   $[\alpha F]_G \sim [\alpha F]_S$ $[\alpha F]_G \sim [-\alpha F]_S$ $[-\alpha F]_G \sim [-\alpha F]_S$
2. Full contrast: IO-Faith, OO-Faith » M_G, M_S
   $[\alpha F]_G \sim [\alpha F]_S$ $[-\alpha F]_G \sim [-\alpha F]_S$
3. Contextual neutralization: M_S » IO-Faith » M_G, OO-Faith
   $[\alpha F]_G \sim [-\alpha F]_S$ $[-\alpha F]_G \sim [-\alpha F]_S$
4. Total neutralization I: M_G, OO-Faith » IO-Faith, M_S
   $[\alpha F]_G \sim [\alpha F]_S$
5. Total neutralization II: M_S, OO-Faith » IO-Faith, M_G
   $[-\alpha F]_G \sim [-\alpha F]_S$
6. Complementary distribution: M_S » M_G » IO-Faith, OO-Faith
   $[\alpha F]_G \sim [-\alpha F]_S$

This is essentially the original four-way typology of Section 2, which is now supplemented by two novel patterns: *Neutrast* (as distinct from full contrast by relative ranking of OO-Faith), and *Total neutralization II*, which is a Morpheme Structure Constraint (McCarthy 1998): OO-identity fixes a single (marked) value [-αF] for all morphemes occurring in both contexts, due to domination of a specific markedness over the general constraint.

I briefly turn to a pattern incorrectly excluded by the typology:

(54) ‘POSITIONAL LICENSING’



In *positional licensing* a contrast occurs in the specific context that is neutralized in the general context. An example is the restriction of long vowels to occur in initial syllables (Steriade 1995b, Beckman 1997). Accordingly, Beckman (1997) proposes the faithfulness constraint format below:[24]

(55) IDENT-IO ([F], P)
An output segment *standing in position P* has the same value for [F] as its input correspondent.

Inclusion of positional faithfulness constraints in the typology adds no new patterns. Although the nonalternating pattern of positional licensing (54) is generated, it is predicted that there is no corresponding 'neutrast'. There are only two possible outcomes of for a ternary (allomorphic) input:

(56) Positional faithfulness: IDENT-IO ([F], P) » M_G » IDENT-IO([F])

Input: /αF/	IDENT-IO([F],P)	M_G	IDENT-IO([F])
☞ $[\alpha F]_G \sim [\alpha F]_S$			
$[\alpha F]_G \sim [-\alpha F]_S$	*!	*	*
$[-\alpha F]_G \sim [\alpha F]_S$		*!	*
$[-\alpha F]_G \sim [-\alpha F]_S$	*!	**	**
Input: /-αF/			
$[\alpha F]_G \sim [\alpha F]_S$	*!		**
☞ $[\alpha F]_G \sim [-\alpha F]_S$		*	*
$[-\alpha F]_G \sim [\alpha F]_S$	*!	*	*
$[-\alpha F]_G \sim [-\alpha F]_S$		**!	
Input: /αF ~ -αF/			
☞ $[\alpha F]_G \sim [\alpha F]_S$			
$[\alpha F]_G \sim [-\alpha F]_S$		*!	
$[-\alpha F]_G \sim [\alpha F]_S$		*!	
$[-\alpha F]_G \sim [-\alpha F]_S$		**!	

This means that neutrasts cannot be phonologically 'driven' by positional faithfulness, a prediction that should be tested against actual cases.

[24] See Zoll (1996) for an alternative theory of positional licensing in terms of positive markedness constraints (e.g. 'if a vowel is long, then it stands in σ_1').

8 Conclusions

This paper has explored lexical irregularity from the perspective of the typology of contrast. First, I have observed that phonological irregularity with respect to a feature [F] presumes the occurrence of a contrast [αF]~[-αF] in the general context. This echoes a theorem of Lexical Phonology, replicable under allomorphic OT (as neutrast involves IO-Faith » M-General.) Second, 'lexical irregularities' are situations of *neutrast*, a three-way division among morphemes with respect to an alternation. Richness of the Base predicts two kinds of input ternarity: archiphonemic underspecification (Inkelas 1995, Inkelas, Orgun & Zoll 1997) and lexical allomorphy (the input supplies alternating pairs). Lexical allomorphy may be seen to include underspecification as a special case, although Richness of the Base predicts that both are possible. Hence, allomorphy need not replace underspecification of featural alternations (such as Turkish devoicing), but it crucially does so in prosodic neutrasts (such as Dutch open syllable lengthening). Third, I have argued that phonologically conditioned allomorphy is driven by a pair of markedness constraints, with a contextual constraint dominating a general constraint (IO-Faith » M-Specific » M-General). Fourth, phonology-driven allomorphy has the property of invisibility to IO-faithfulness constraints, due to the split inputs assumption, the counterpart of cancellation in underspecified inputs. OO-faithfulness levels out lexical allomorphy, however, if OO-faithfulness » M-Specific. Fifth, and perhaps most importantly, the factorial typology of contrast is not weakened by adding lexical allomorphy, and presumably, not even by adding positional faithfulness.

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