Chapter 2

Deriving Nonconcatenative Morphology

2.1 Introduction

The main goal of this chapter is to examine various formal properties of nonconcatenative morphology and to build up a theoretical system dubbed here "Realizational Morphology Theory (RMT)". RMT offers a comprehensive and explanatory account for the range of morphological phenomena of relevance. The type of root-and-pattern morphology attested in Semitic languages is a famous example of nonconcatenative morphology, where phonological segments of more than one morpheme are dispersed and intermingled such that a unique demarcation of the morphemes cannot be drawn. The focus of the nonconcatenative morphological processes here is not on root-and-pattern or templatic morphology, however. Rather, nonconcatenative morphology is roughly defined here as morphologically conditioned phonological changes without fixed segmentism. Thus, additive or concatenative morphology like the plural formation in English (e.g., $[\text{kæt-s}]_{\text{Plural}}$) is outside the scope of principal interest. The phenomena considered instead include subtractive morphology, morphologically governed metathesis, various segmental changes known as umlaut, suppletion, and mutation, morphological haplology or fusion, among others. They are clearly nonconcatenative since a stem undergoes some phonological modification to express the existence of a morpheme (e.g., part of a stem is elided in subtractive morphology). Another important phenomenon to be considered below is reduplication. Reduplication falls into the category of phenomena investigated here since the reduplicant does not have fixed segmental

content, although reduplication is standardly regarded as a kind of concatenative morphology like regular affixation (Marantz 1982).

It is nonetheless quite important to pay close attention to concatenative morphology as well because concatenative and nonconcatenative morphology should both be understood as phonological manifestations to achieve the same goal, namely to obtain some overt phonological expression to illuminate the presence of a morpheme. Thus, uncovering underlying formal similarities and differences between concatenative and nonconcatenative morphology is of critical importance in a unified and principled understanding of the two types of morphology. In the subsequent sections of this chapter, therefore, the two types of morphology will be compared when necessary.

The rest of this chapter is devoted to a careful examination of fundamental descriptive aspects of nonconcatenative morphology, followed by a proposal of a general theory which provides a satisfactory account in a unified manner. In section 2.2, I investigate the nature of nonconcatenative morphology and claim that it exhibits anti-faithfulness effects which should be crucially distinguished from non-faithfulness effects observed in regular phonology. As will be argued in detail, this is the most outstanding property of nonconcatenative morphology distinguishing it from concatenative morphology. In section 2.3, I examine the role played by a Realize Morpheme constraint (RM) proposed and employed in various contexts in the earlier literature such as Samek-Lodovici (1993), Akinlabi (1996), Gnanadesikan (1997), Rose (1997), Walker (1998, 2000), Piggott (2000), and Kurisu (1999, 2000ab, 2001, to appear) among others. Paying close attention to similarities and differences between concatenative and nonconcatenative morphology, the notion of RM is

conceptualized and formalized toward an integrated understanding of realizational morphology. This is a key constraint throughout this dissertation and plays a central role in the analysis of various nonconcatenative morphological phenomena. After establishing RM, I propose a general schema to account for nonconcatenative morphology in section 2.4. The essential notion is relativized faithfulness, the relativization referring to morphosyntactic categories. I also discuss some important theoretical consequences arising from the general theory in this section. Given anti-faithfulness effects, an obvious analytical possibility is anti-faithfulness theory, as advocated by Alderete (1999). In section 2.5, I critically review anti-faithfulness theory and maintain that it is not an appropriate theoretical device to analyze the range of phenomena considered here. I also discuss that the theory itself is not desirable for various conceptual reasons. Arguments developed in this section are based on both empirical and conceptual grounds. Finally, section 2.6 summarizes the main results of this chapter.

2.2 Anti-Faithfulness Effects

This section is aimed at investigating the formal characteristics of nonconcatenative morphology under consideration. The most prominent common property shared by nonconcatenative morphological processes is that a base form is subject to a phonological change in some manner. In subtractive morphology, for instance, part of the base is subject to elision so that the form of the derived grammatical category is phonologically smaller than the base form. From the perspective of correspondence theory (McCarthy and Prince 1995), this incurs one or more violations of Max which requires each input segment to have a correspondent in the output representation. In

the same fashion, various kinds of faithfulness constraints are violated in the whole range of nonconcatenative morphology, as summarized in (1).

(1)

Morphological Process	Violated Constraint
Subtractive morphology	Max
Umlaut, Suppletion, Mutation	Ident
Morphological epenthesis	Dep
Metathesis	Linearity
Infixation	Contiguity
Reduplication	Integrity
Haplology (Fusion)	Uniformity

Faithfulness violations are frequently observed in regular phonology, but the nature of faithfulness violations involved in nonconcatenative morphology is special. As a simple example of phonological phenomena where a faithfulness violation occurs, consider word-final devoicing in German. As exemplified in (2), German exhibits a voicing alternation in the word-final position. The descriptive generalization is that word-final obstruents are devoiced word-finally (Rubach 1990; Wiese 1996b). The fact is more complicated than this oversimplified generalization, but the precise formulation does not concern us here. Assuming WFD as a descriptive constraint motivating word-final devoicing in the relevant environment, the alternating pattern can be easily captured by WFD » Ident-IO-[voi]. The crucial point is that the devoicing process is phonologically governed in the sense that all that matters is the phonologically defined position occupied by the relevant obstruent. Thus, phonologically motivated changes are explained by Markedness » Faithfulness.

(2)

Voiced forms	*Gloss*	*Devoiced forms*	*Gloss*
Kin**d** [t]	child	Kin**d**-isch [d]	childish
Ta**g** [k]	day	Ta**g**-e [g]	days
Hau**s** [s]	house	Häu**s**-er [z]	houses

Next, consider the data given in (3).

(3)

Infinitive	*Gloss*	*Deverbal Noun*	*Gloss*
klifra	climb	klifr	climbing
kumra	bleat	kumr	bleating
grenja	cry	grenj	crying
söötra	sip	söötr	sipping
puukra	conceal	puukr	concealment
kjöökra	wail	kjöökr	wailing

As the examples show, deverbal nouns are derived from the corresponding infinitive forms in Icelandic. The generalization is that a word-final vowel is deleted in the deverbal noun formation (Orešnik 1972, 1978ab; Arnason 1980; Kiparsky 1984; Itô 1986; Benua 1995). Since vowel deletion takes place, one might postulate a markedness constraint such as Free-V that militates against the presence of a word-final vowel (Prince and Smolensky 1993) or Final-C which requires a word to be closed by a consonant (McCarthy 1993). However, if the constraint is active in Icelandic phonology in general, we do not expect the presence of a final vowel in infinitive forms either, whatever the markedness constraint is. This suggests that final vowel deletion observed in the deverbal noun formation is not phonologically conditioned. In other words, there exists no phonological markedness constraint that motivates vowel deletion in the deverbal noun formation. More interestingly, deverbal nouns are in a sense more marked than infinitive forms because *Complex(coda) is violated in the former while it is otherwise completely satisfied in Icelandic in general. Moreover, the distribution of long vowels is restricted to

stressed open syllables elsewhere in Icelandic. Thus, the general ranking schema holding of phonologically conditioned changes (i.e., Markedness » Faithfulness) cannot be extended to subtractive morphology. Rather, the reason why faithfulness violations are incurred is morphological. More specifically, they are required to express the presence of a morpheme overtly in the surface representation. Thus, the overt phonological contrast between infinitives and deverbal nouns is denoted by the presence/absence of a final vowel in Icelandic, for instance. The same is true of other nonconcatenative morphological operations such as morphological metathesis and umlaut and so on listed in (1). Given this argumentation, I call faithfulness violations involved in nonconcatenative morphology anti-faithfulness effects following Alderete (1999) in order to make a clear distinction between faithfulness violations in regular phonology and those in nonconcatenative morphology.

The reason why nonconcatenative morphology is an interesting area in the context of the OT program becomes even clearer if we also pay attention to the fact that derived forms have worse faithfulness values compared with a perfectly faithful candidate. This is obvious because deverbal nouns decrease their faithfulness by clipping a final vowel in Icelandic, for example. This indicates that neither the Markedness » Faithfulness nor the Faithfulness » Markedness schema is satisfactory for capturing various nonconcatenative morphology. The immediate question is then what serves as the driving force of stem modifications given the OT assumption that the set of universal constraints, *Con*, consists only of faithfulness and markedness constraints. The answer to this question is postponed until sections 2.3 and 2.4.

This problem does not arise in concatenative morphology employing normal affixation because the phonological shape of a base remains unaffected. Even if the

stem form undergoes some morphophonological change by fulfilling the environment in which some phonological change takes place on the stem (e.g., regressive place/voicing assimilation), it is a matter of phonology rather than morphology. Such cases are simply explained by ranking an appropriate markedness constraint over competing faithfulness constraints (see chapter 5 for cases where a stem change takes place in addition to affixation for purely morphological reasons). This difference between concatenative and nonconcatenative morphology resides in their more fundamental difference. While the morpheme attached to a stem has some phonological material in concatenative morphology, the morpheme yielding a derived category does not contain any such element in nonconcatenative morphology.

Before closing this section, some remarks are in order regarding Dep, Contiguity, and Integrity in (1). The first point concerns Dep. That Dep is violated represents the kind of morphology where some (maybe default) segment is epenthesized to denote a particular grammatical category. One might claim that such a case is actually not attested since the default segment would be reanalyzed as an authentic affix associated with the relevant morphosyntactic category. Presumably, the only one potential argument for this claim would come from the consideration of lexicon optimization (Prince and Smolensky 1993:192; see also Itô, Mester and Padgett 1995 and Kurisu 2000c). The tenet of lexicon optimization is that the most harmonic input to the output should be selected as the real input. With this notion, the analysis assuming that the relevant morphosyntactic category is phonologically contentless is clearly eliminated due to its excessive violation of Dep. But this is not a valid argument. Behind lexicon optimization, richness of the base exists as a more fundamental principle (Prince and Smolensky 1993; Smolensky 1996; Kurisu 2000c),

the principle which is also known as freedom of the input. OT is output-oriented such that the system does not allow for restrictions on inputs. Lexicon optimization is merely a strategy to make the lexical organization simpler at some point of the language acquisition process, but crucially, it does not preclude the possibility of maintaining richness of the base. Nothing thus excludes languages from employing morphological epenthesis. Indeed, as will be discussed in section 4.3, Upriver Halkomelem does take advantage of schwa epenthesis to denote the continuative aspect under a certain circumstance.

This argumentation contradicts with Consistency of Exponence (McCarthy and Prince 1993b:20-21). Consistency of Exponence maintains that no changes in the exponence of a phonologically-specified morpheme are permitted, and in particular, that epenthetic segments posited by *Gen* do not have any morphological affiliation under any circumstances. According to McCarthy and Prince, this principle is underlying as a universal property of *Gen*, and therefore, *Gen* does not produce any candidate which infringes on Consistency of Exponence. However, given cases where epenthesis of a default segment denotes some morphosyntactic information, Consistency of Exponence is empirically invalidated.

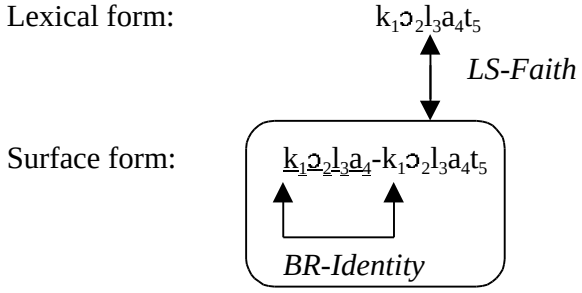
Second, infixation is clearly one type of affixations but can be subsumed under the family of nonconcatenative morphology from the perspective that it incurs a faithfulness violation. A single stem is split up into two chunks in infixation, resulting in a violation of Contiguity. Although this is one possible way of grouping infixation in the class of nonconcatenative morphology, it is not clear whether this categorization has any empirical and/or theoretical consequences. There is no literal prefix, infix, or suffix in OT. Rather, the exact position of an affix is determined by

independent constraints such as alignment. As for infixation, it is unlikely that infixation is required solely for morphological reasons. In Tagalog and Toba Batak, the verbal affix *um* manifests itself either as a prefix or as an infix depending on the phonological shape of the stem it is attached to: *um* is prefixed when a stem begins with a vowel (e.g., um-akyat 'teach') whereas it is infixed right after the first onset if the stem begins with a consonant (cluster) (e.g., k-um-uha 'get') (see Blake 1925; Alejándro 1963; Ramos 1974; French 1988; McCarthy and Prince 1993ab; Prince and Smolensky 1993 for Tagalog, and Nababan 1981; Percival 1981; Crowhurst 1998 for Toba Batak). It might be hasty to draw a definite conclusion from these two languages, but the same pattern is widespread across Malayo-Polynesian languages such as Chamorro (Topping 1973), Yogad (Davis, Baker, Spitz and Baenk 1996), and Ilokano (Davis 1995), so it is highly probable that infixation is a reflex of some phonological influence that forces an alignment infringement, as argued by Prince and Smolensky (1993) and McCarthy and Prince (1993ab). This indicates that purely morphological infixation is unlikely to exist, casting a suspicion that the reason why infixation is nonconcatenative is phonological. Whether this generalization is true or not, the following argument is not affected since the proposal made later in section 2.3 covers both concatenative and nonconcatenative morphology in an integrated manner.

Finally, I assume that each reduplicative segment incurs an Integrity violation. McCarthy and Prince (1995) and many subsequent works on reduplication assume that reduplicated segments are exempted from IO-faithfulness constraint violations. Given the fact that the concrete segments are absent from the input specification of the reduplicant, one might maintain that a reduplicated segment would be charged a

Dep violation. But creation of reduplicated segments is quite different in nature from phonologically motivated epenthesis. The crucial observation is that regular epenthesis is conditioned by phonological factors (e.g., syllable structure optimization). Thus, an epenthesized element is totally unrelated to other input/output segments in light of correspondence. Spaelti (1997:72) proposes a reduplication model in which the underlying form is in correspondence with both the reduplicant and the base, that is, with the whole reduplication form, as in (4).

(4) The Reduplicate! model of correspondence (Spaelti 1997:72)



Within this model, both the reduplicant and the base are realizing segments in the underlying representation, so there are two chances to realize an underlying segment. Spaelti argues that multiple exponence of a single underlying element violates biuniqueness, or more accurately, Integrity which militates against a configuration in which a single input element stands in a correspondence relation with more than one output element tokenwise (McCarthy and Prince 1995:372). Following his argument, I assume that an Integrity violation is invoked by each reduplicated segment (see also Buckley 1998 and Struijke 1998 for other works that make the same assumption). Considered this way, reduplication also exhibits the same character as other obvious nonconcatenative morphological processes such as subtractive morphology, namely faithfulness violations.

2.3 Characterizing "Realize Morpheme"

In this section, I explore the nature of the Realize Morpheme constraint (RM) and argue that it is the key constraint to account for various nonconcatenative morphological processes as well as concatenative morphology. Hence, it plays a central role in RMT proposed here. Versions of RM have been proposed and employed in a variety of contexts with different names in the earlier literature, including Samek-Lodovici (1993), Akinlabi (1996), Gnanadesikan (1997), Rose (1997), Walker (1998, 2000), Piggott (2000) and Kurisu (1999, 2000ab, 2001, to appear). Although the focus of this work is on nonconcatenative morphology, close attention is paid to concatenative morphology too to achieve a comprehensive understanding of morpheme realization.

RM is descriptively defined as a constraint which requires every underlying morpheme to receive some phonological exponence. Since the only explicit and visible way of morpheme manifestation is phonological, the precise formalization of RM must be doubtlessly cast from a phonological perspective. In the various works, the role of RM has been considered in the context of morphological gemination, featural morpheme expression, reduplication and so on. The common property of these phenomena is that some visible phonological element appears on the surface. They are in this sense akin to affixational word formations. In these cases, RM can be understood as a function mapping each morpheme onto some phonological substance with which it is affiliated (cf. Walker 2000).

A serious problem of the definition based upon a mapping between a morpheme and visible phonological content is that it is not sufficient for nonconcatenative morphological operations considered here. Consider subtractive

morphology, for instance, where part of the base is deleted to obtain a derived morphosyntactic category. No visible phonological substance exists in such cases, and RM would be violated. Morphemes are frequently expressed nonconcatenatively without any phonological material independent of the base, so we need to reexamine the formal definition of RM.

In order to achieve a satisfactory understanding of RM, it is an essential question at this point to address what morphology is for. A simple but non-trivial answer is that morphology maintains contrasts among various morphosyntactic functions (Bloomfield 1933; Bat-El 2000). Suppose that morphemes are atomic morphological units that motivate various morphological contrasts. Given the definition of RM that every single morpheme needs to enjoy some overt phonological exponence and given morphemes as primitive units of morphology, it follows that RM is satisfied iff the outcome has some phonological property (but not necessarily phonological substance) which distinguishes it from the base form.

The existence of the newly introduced morpheme is denoted by affixal segments in concatenative morphology because the affix promises the phonological non-identity between the base and the derived forms as in the plural formation in English (e.g., [kæt]≈[kæts]). On the other hand, in nonconcatenative morphology such as subtractive morphology and morphological metathesis, the absence and segmental reversal of some underlying element convey the presence of the given morphosyntactic information respectively (see (3) for subtractive morphology). Thus, independent phonological material does not always exist as the expression of a morphosyntactic function. Despite this difference in the surface implementation of morphological expressions, concatenative and nonconcatenative morphology share

the same spirit. Given this consideration, RM can be now formulated as in (5). It is worth noting that β is essentially associated with a morphosyntactic category but α does not have to be so. This point will be justified shortly below.

(5) Realize Morpheme (RM):

> Let α be a morphological form, β be a morphosyntactic category, and F(α) be the phonological form from which F(α+β) is derived to express a morphosyntactic category β. Then RM is satisfied with respect to β iff F(α+β)≠F(α) phonologically.

In the deverbal noun formation in Icelandic in (6) (repeated from (3)), infinitives and deverbal nouns correspond to α and β respectively since infinitives serve as the bases of corresponding deverbal noun forms. $[klifra]_{Inf.}$ and $[klifr]_{DVN}$ are phonologically non-identical by virtue of the fact that the deverbal noun form lacks the final segment [a] contained in the infinitive form. This means that $[klifr]_{DVN}$ satisfies RM with respect to the deverbal noun morpheme. By contrast, an incorrect deverbal noun form $*[klifra]_{DVN}$, which would be a plausible candidate produced by *Gen*, violates RM since this form is phonologically identical to $[klifra]_{Inf.}$. This is an instance of morphological elision, but phonological non-identity can be accomplished in various other ways. In other words, RM is satisfied as long as the candidate is not perfectly faithful to the form with which it is compared, where phonological non-identity is exactly what represents morphological contrasts (cf. works on Dispersion Theory such as Flemming 1995 and Padgett 2001).

(6)

Infinitive	*Gloss*	*Deverbal Noun*	*Gloss*
klifra	climb	klifr	climbing
kumra	bleat	kumr	bleating
grenja	cry	grenj	crying
söötra	sip	söötr	sipping
puukra	conceal	puukr	concealment
kjöökra	wail	kjöökr	wailing

The formulation in (5) is not yet satisfactory, however. An important question is what serves as the input of a morphosyntactic category. In the Icelandic case above, there is strong evidence that deverbal nouns are derived from infinitives (see section 3.2.3), but it is often the case that there is no such phonological evidence. It is frequently assumed with no justification that singulars are more basic than plurals, and therefore, that singulars serve as the inputs of plurals. But there are cases which do not receive a straightforward descriptive generalization under such an idea. Singular-plural pairs in Aka, a Bantu language spoken in Central African Republic, are good examples. As exemplified in (7a, b), where tonal specifications are omitted, the feature [voice] is the singular (class 5) marker whereas the plural (class 6) is denoted by the prefix *ma-* (Akinlabi 1996:285-286). Thus, if the initial consonant of a stem is voiceless, it is voiced in the singular formation (7a) while no voicing change takes place if the stem-initial consonant is originally voiced (7b). This generalization is confirmed by the fact that class 9 singular forms do not exhibit the stem-initial voicing alternation but their plural forms (class 6) still take the prefix *ma-*. Since the plural morpheme is manifested by the prefix *ma-*, no voicing change is involved, as can be seen from the plural forms in (7c).

(7)

	Singular (Class 5)	*Plural (Class 6)*	*Gloss*
a.	deŋge	ma-teŋge	piercing tool
	dɔtɔ	ma-tɔtɔ	cartridge
	gasa	ma-kasa	palm branch
	gini	ma-kini	fly
	boki	ma-poki	arch of the eyebrows
	bapulaka	ma-papulaka	lung
	βɔndu	ma-ɸɔndu	goiter
	βoko	ma-ɸoko	hole
b.	gɔala	ma-gɔala	game of imitation
	belele	ma-belele	sound of a waterfall
	dʒamba	ma-dʒamba	mud

c.

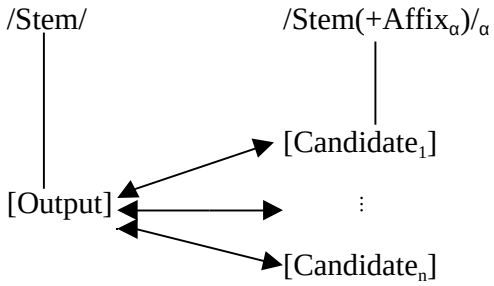
Singular (Class 9)	*Plural (Class 6)*	*Gloss*
tɔŋgu	ma-tɔŋgu	navel
kuŋga	ma-kuŋga	body hair
kombo	ma-kombo	name
seɓa	ma-seɓa	horn
sɔpɔ	ma-sɔpɔ	earth
ɸuma	ma-ɸuma	house

The singular forms cannot be assumed as the underlying representations which serve as the bases of their plural counterparts. Were the plural forms derived from the singular forms, stem-initial devoicing must be posited in (7a), but this does not account for the plural examples in (7b) where the stem-initial consonants remain voiced. Moreover, this kind of devoicing process is not motivated at all both language-internally and crosslinguistically. Rather (7) can be straightforwardly accounted for by hypothesizing that the bare stems (i.e., plural forms minus the prefix *ma-*) are the inputs to the singular and the plural forms. Voicing of the initial consonant of a bare stem characterizes the presence of the singular morpheme while prefixation of *ma-* signals the plural morpheme. The important lesson is that the normally assumed basic-derived notion does not universally hold. Many cases where the singular serves as the basis of the plural do not give rise to any descriptive discrepancy are examples where singular forms incidentally coincide with stems. Given the Aka case, I claim that stems lack morphosyntactic information. They consist only of phonological, syntactic, and semantic information.

Given bare stems as inputs for various morphosyntactic categories, is it possible to compare those bare stems with output candidates for the purpose of RM evaluations? The answer is negative. In tandem with the output orientation of the theory, OT maintains richness of the base as a fundamental slogan, which grants any freedom to the input (Prince and Smolensky 1993; Smolensky 1996; Kurisu 2000c).

It is therefore impossible to restrict the phonological representation of the input to a unique form. This in turn suggests that the output candidates do not reliably possess a single phonological input form with which they are compared to compute the satisfaction/violation of RM. Only an output reliably has a fixed phonological representation. This indicates that we need to establish an output-output mapping strategy for the calculation of RM violations. My proposal is that the grammar evaluates the optimal form of the bare stem on the basis of the constraint hierarchy independently motivated by the phonology of the language. The bare stem output is therefore not necessarily an actual surface form in the language. Output candidates bearing a morphosyntactic category are then compared with it, as in (8).

(8)



Given this conceptualization, RM is satisfied if the candidate is non-identical to the output of the bare stem whereas the constraint is violated if they have exactly the same phonological representations, as schematically exemplified in (9). The non-identity required for the satisfaction of RM is not confined to any specific phonological deviance from the base. As will be discussed in the next section, the specific phonological instantiation of morpheme realization is determined by the faithfulness constraint ranked below RM, and therefore, RM itself does not require any particular phonological realization of a morpheme.

(9)

	Bare stem output	Candidate	RM	Remark
a.	[ABC]	$[ABC]_{\alpha}$	violated	*no change*
b.	[ABC]	$[ABCD]_{\alpha}$	satisfied	*affixation*
c.	[ABC]	$[AB]_{\alpha}$	satisfied	*deletion*
d.	[ABC]	$[ACB]_{\alpha}$	satisfied	*metathesis*

First, (9a) represents the case where RM is violated. Comparing the output of the bare stem and that of the derived form which carries some morphosyntactic category denoted by α, they are exactly the same (i.e., [ABC]), as in (10a). This identity means that morpheme α attached to the bare stem does not receive any phonological exponence, resulting in a RM violation. Second, (9b) is concatenative morphology involving suffixation. As illustrated in (10b), the output of the bare stem does not contain any affix, but the output of the derived category bears a suffixal segment *D*. [ABC] and $[ABCD]_{\alpha}$ are phonologically different: RM is satisfied. Finally, (9c) and (9d) are subtractive morphology and morphological metathesis respectively. RM is fulfilled by eliding a segment *C* (9c) or by reversing the order of two segments (9d). As shown in (10c) and (10d), RM is satisfied in these cases.

(10) a. /ABC/ — $/ABC/_{\alpha}$
[ABC] = $[ABC]_{\alpha}$
*RM

b. /ABC/ — $/ABC\text{-}D_{\alpha}/_{\alpha}$
[ABC] ≠ $[ABCD]_{\alpha}$
✓RM

c. /ABC/ — $/ABC/_{\alpha}$
[ABC] ≠ $[AB]_{\alpha}$
✓RM

d. /ABC/ — $/ABC/_{\alpha}$
[ABC] ≠ $[ACB]_{\alpha}$
✓RM

In the plural formation in English, for instance, plurals correspond to β in (5), and the relevant bare stems (i.e., input to plural forms) correspond to α in (5). The affixal material /-s/ is associated with the plural morpheme such that $[k^{h}æts]_{Plural}$ is phonologically non-identical to $[k^{h}æt]$, the output of the bare stem, as depicted in (11a). Under the proposed system of RM evaluations, singulars are derived from bare stems as well. As exemplified in (11b), however, $[k^{h}æt]_{Singular}$ is phonologically the same as the output of the bare form, and therefore, RM is violated. In other words, the singular morpheme does not receive any phonological exponence in English whereas plurals do. This point will be significant to the system developed in the next section. An important point to be emphasized here is that the output of a base stem does not have to be an actual output in the language. Rather, it is at least a *possible* output of the language, unlike the definition of the output in the sense of Benua (1997). This is important to differentiate RMT from anti-faithfulness theory, as will be discussed in section 2.5.

(11) a. $/kæt/_{Bare}$ $/kæt\text{-}s/_{Plural}$ b. $/kæt/_{Bare}$ $/kæt\text{-}s/_{Singular}$

$[k^{h}æt]_{Bare} \neq [k^{h}æts]_{Plural}$ ✓RM

$[k^{h}æt]_{Bare} = [k^{h}æts]_{Singular}$ *RM

By contrast, RM directly compares the input and the output when the input is already an independent output form like Icelandic infinitives, as shown in (12). The direct input-output comparison for the purpose of calculating RM violations is possible because compared forms are independent output forms which reliably have a unique phonological representation. It is important to note here that the output of a bare stem does not play any role in the evaluation of RM violations in such cases. This is because bare stems play a role only when they serve as the inputs of a given

morphosyntactic category (i.e., when the relevant morphosyntactic category is not derived from another full-fledged output form).

(12) /klifr/$_{\text{Bare}}$

[klifra]$_{\text{Inf.}}$ ≠ [klifr]$_{\text{DVN}}$
✓RM

The notion of the bare stem output has a further extension. Itô and Mester (1998) discuss productive truncation in modern German. As given in (13), the output is a single syllable followed by the suffix *-i* (Itô and Mester 1998:52).

(13) a. Personal names

Base forms	*Truncation forms*
Gàbriéle	Gábi
Wáldemar	Wáldi
Stéfanìe	Stéffi
Úlrich	Úlli
Ótto	Ótti

b. Surnames

Base forms	*Truncation forms*
Górbatschòw	Górbi
Hónecker	Hónni
Schimánsky	Schímmi
Klínsmànn	Klínsi
Schláppner	Schláppi

c. Common nouns

Base forms	*Truncation forms*	*Gloss*
Àlkohóliker	Álki	alcoholic
Àmerikáner	Ámi	American
Schátz	Schátzi	darling
Mútter	Mútti	mother
Pròletárier	Próli	proletarian

The crucial observation here is that [gorb], for instance, is not a constituent of some input, actual surface form itself, constituent of the base form (cf. [gor.ba.tʃof]),

or constituent of the truncation form (cf. [gor.bi] vs. *[gorb.i]). In effect, [gorb] is not a constituent at any level of representation. Itô and Mester (1998) claim that the single syllable found in truncation is rather a maximal *possible* syllable in German. They employ sympathy theory (McCarthy 1999) such that the maximal possible syllable is selected as the sympathy candidate and that the non-surface constituent becomes visible to the evaluation of the eventual output.

Given the notion of bare stem output, another way of considering the relevant examples is to regard the truncated stem forms as possible stems in German. Calling them truncatory stems, they are potentially available for morphological operations. For the case at hand, hypocoristic formation, for instance, is relevant. Given the eligibility of [gorb] as a possible stem in German, then the hypocoristic formation seen in (13a, b) is simply an issue of suffixation. This idea and the notion of the bare stem output share the property that some kind of non-surface forms plays a central role in natural languages.

Summarizing thus far, RM requires every input morpheme to receive some phonological exponence. The satisfaction or violation of RM is based on output-output comparisons. Output candidates yielded by *Gen* are compared with the output form of a bare stem when the bare stem serves as the input, but RM compares output candidates and the input when the input is already an output form which carries some morphosyntactic information.

The formalization of RM in terms of output-output comparison has a clear advantage besides the theoretical need in the framework of OT. Consider the word-final devoicing process in German illustrated in (2). As aforementioned, this is an automatic phonological process which takes place across the board regardless of

morphological conditions. Given the assumption that bare stems are free from morphosyntactic categories, they serve as the inputs of singular forms. Given the voicing alternation shown in (2), where a final obstruent is realized as a voiced segment when followed by a vowel-initial suffix, the final segment should be voiced in the underlying representation. Obviously, the singular outcome is phonologically non-identical to the input (of the bare stem) due to word-final devoicing, but the question is whether this voicing change counts as valid to satisfy RM. The answer is negative. RM needs to be satisfied for morphological reasons, but the devoicing process has nothing to do with morphology. But how can RM distinguish morphologically induced phonological changes from purely phonological ones? There is no principled answer to this because RM merely requires a phonological distinction between two forms. But if the output of the bare stem is computed against the constraint ranking independently needed in the phonology of German (i.e., WFD » Ident-IO-[voi]), the optimal bare stem form should carry a voiceless obstruent word-finally (e.g., [kɪn**t**] 'child'). The candidates produced by *Gen* are compared with this form for the purpose of evaluating the satisfaction/violation of RM. The optimal singular form derived from /Kɪn**d**/$_{\text{Singular}}$ (i.e., [kɪn**t**]$_{\text{Singular}}$) is phonologically identical to the optimal bare stem form, resulting in a violation of RM, as illustrated in (14). Thus, the calculation of the best form of a bare stem also enables the computation of the RM satisfaction/violation to be purely morphologically grounded.

(14)

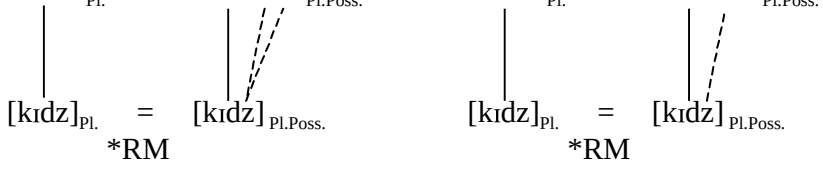
/kɪnd/$_{\text{Bare}}$		/kɪnd/$_{\text{Singular}}$
|		|
[kɪnt]$_{\text{Bare}}$	=	[kɪnt]$_{\text{Singular}}$
	*RM	

An important theoretical implication of the conceptualization of RM here is that zero morphs entirely lose their place in the system of morphology. Given productive *s*-suffixation in the plural formation in English, for instance, it has been assumed quite extensively that plural forms without any singular-plural distinction actually contains an invisible empty suffix -Ø (e.g., $[fɪʃ]_{Singular} \approx [fɪʃ\text{-}Ø]_{Plural}$ 'fish'). Under RMT developed here, RM is satisfied if and only if some overt phonological difference is found, and thus, empty morphs have no room to play a role for the satisfaction of RM. The existence of zero morphs has been advanced on an analogical basis, but it would be nothing more than a theoretical artifact given the system where they do not contribute to morphological contrasts. Although the earlier literature often claims that morphological zero is categorially meaningful absence, how phonological absence can be computed in isolation forms (e.g., [fɪʃ]) is totally unclear. The singular-plural pairs like *fish* can be unambiguously interpreted only when an appropriate context is given. Zero morphs carry no substantive role at the word level with which morphology is concerned. In addition, independent arguments have been developed against zero morphs on various empirical and conceptual grounds (cf. Sanders 1988; Pullum and Zwicky 1991). The total abolishment of zero morphs is presumably desirable in terms of transparency in language processing too.

Closely related to this first implication, another case where a RM violation is potentially incurred is morphological haplology or fusion, where the phonological element belonging to separate morphemes are fused on the surface (see Russell 1995, Plag 1998 and de Lacy 1999 for recent work on haplology within the framework of OT). A simple example is the cooccurrence of the plural and possessive morphemes in English (e.g., /kɪd-z-z/ 'kid-Pl.-Poss.'). Due to the OCP effect against the two

adjacent identical obstruents, the ultimate output should be $[kɪdz]_{Pl.Poss.}$ rather than *$[kɪdzz]_{Pl.Poss.}$. The most standard and widely accepted analysis is that the two homophonous morphemes are both phonologically realized as a single segment. Given the formulation of RM as defined here, RM is clearly violated by $[kɪdz]_{Pl.Poss}$ since this output form is phonologically the same as the form without the possessive morpheme (or equivalently, the form consisting only of the bare stem and the plural morpheme), as in (15a). Dotted lines represent morpheme-phonology mapping. The reason why RM is violated here is that RM is strictly phonologically defined. Although $[kɪdz]_{Pl.Poss.}$ is structurally different from $[kɪdz]_{Pl.}$ if the morpheme-phonology mapping is considered, it plays literally no role for the computation of RM violations. This point becomes clearer if we hypothesize another possibility that the phonological substance of the possessive morpheme (i.e., the second /z/) remains unparsed, as in (15b). The plural possessive form in (15b) violates RM in addition to Max, and the plural possessive form in (15a) is the same as that in (15b) as far as their phonological representations are concerned. The identity of the two plural possessive forms in (15a) and (15b) suggests a RM violation of $[kɪdz]_{Pl.Poss.}$ in (15a).

(15) a. $/kɪd\text{-}z/_{Pl.}$ $/kɪd\text{-}z\text{-}z/_{Pl.Poss.}$ b. $/kɪd\text{-}z/_{Pl.}$ $/kɪd\text{-}z\text{-}z/_{Pl.Poss.}$

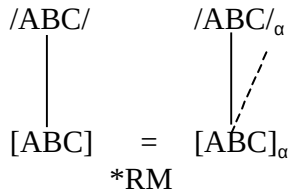


Note that haplology does not always fail to satisfy RM, however. Suppose that $/CV_1CV_2/$ is given as a bare stem and that the output form of this is $[CV_1CV_2]$. Provided that morpheme α is attached to the bare stem to express some morphosyntactic function and that vowel haplology is employed as the specific

strategy of morpheme realization, the outcome is [$CV_{1,2}C$]. In this case, [$CV_{1,2}C$] is clearly phonologically different from [CV_1CV_2] (e.g., the syllable count is different), and thus, RM is satisfied. Indeed, this state of affairs is actually attested, as will be discussed in section 4.5. Feature values are often affected even in those cases where haplology occurs between two adjacent segments: haplology does not necessarily invoke a violation of RM.

The strictly phonological orientation of the definition of RM has a further theoretical implication. Morphemes without any phonological content receive their phonological realization through some stem modification, but another possibility is merely positing the morpheme-phonology mapping of the kind demonstrated in (16) below, where no stem modification occurs but the morpheme α is affiliated with or parasitic on a stem segment. This strategy is in a sense more harmonic than any forms which undergo some phonological reshaping of the stem because no phonological faithfulness violation is incurred in (16). Furthermore, the candidate in (16) should also be better than those candidates with some stem modification in terms of phonological markedness since morphologically induced phonological processes normally create a phonologically more marked representation or structure, as discussed in section 2.2. Thus, the kind of morpheme-phonology mapping in (16) cannot be ruled out by faithfulness or markedness constraints. (16) is eliminated by RM instead because the output of the bare stem and that of morphosyntactic category α are phonologically identical.

(16)



Comparing $[ABC]_{\alpha}$ with the output of the stem (i.e., [ABC]), they are precisely the same phonologically, however. Under the formalization of RM here, RM is violated by $[ABC]_{\alpha}$. Whether the input of the bare stem surfaces faithfully in the output or not does not impinge on the argument here. Even if the output of the bare stem is unfaithful to the input, it is purely for some phonological factor as in the word-final devoicing process in German. Since no affixation is involved in $/ABC/_{\alpha}$, $[ABC]_{\alpha}$ should be subject to the same phonological change as the bare stem. Since what matters here is the identity between the outputs of /ABC/ and $/ABC/_{\alpha}$, this faithfulness issue is beside the point. This point becomes significant in connection with Consistency of Exponence (McCarthy and Prince 1993b:20-21). It prohibits a phonologically specified morpheme from changing its exponence. Given that RM evaluates the (non-)identity between $[ABC]_{\alpha}$ and the output of the bare stem (i.e., [ABC]), $[ABC]_{\alpha}$ in (16) should fulfill Consistency of Exponence since bare stems are free from any morphosyntactic categories. This means that this kind of candidates can be generated even if Consistency of Exponence is posited as a universal property of *Gen*, and thus, the role played by RM here is essential.

As discussed in chapter 1, the issue of uniform conceptualization of overall word formation was a matter of controversy among structural linguists. As would be clear from the discussion thus far, one assumption made here is that there exist two types of morphemes: those with inherent phonological substance (as in affixation) and those without it (as in nonconcatenative morphology such as subtractive morphology). Put differently, affixation is treated as Item-and-Arrangement while stem changes involved in nonconcatenative morphology are more like Item-and-Process. The mixture of Item-and-Arrangement and Item-and-Process here deserves

some discussion in the context of OT. Given empirical problems that the Item-and-Arrangement model encounters with respect to nonconcatenative morphology such as root-and-pattern morphology and subtractive morphology, Item-and-Process is strongly supported by many current morphologists. The question here is thus whether the position admitting morphemes as entities is valid or not. Russell (1995, 1999) addresses this question, bringing up three potential possibilities: morphemes as representations, morphemes as rules, and morphemes as constraints. The first possibility corresponds to Item-and-Arrangement, regarding morphemes as substantive entities. The other two are derivation-based and constraint-based versions of Item-and-Process respectively. Given the constraint-based theoretical architecture of OT, the position taking morphemes as rules can be ignored here. Comparing morphemes as representations and morphemes as constraints, Russell (1995, 1999) argues for the latter, pushing the Item-and-Process view to the extreme. Eventually, he proposes a model without *Gen*, following Bird (1990), Scobbie (1991), and Russell (1993) (see also Hammond 1995).

Besides cases where a morpheme does not carry fixed segmentism (i.e., reduplication, truncation, subtractive morphology, metathesis etc.), Russell raises a duplication problem as a serious pitfall of the position viewing morphemes as representations. For example, in Ulwa, a language spoken in Nicaragua, the possessive affix *ka* is suffixed to the head foot of the word, as illustrated in (17) (McCarthy and Prince 1990, 1993ab, originally due to Bromberger and Halle 1988 and Hale and Blanco 1989). The essential point of Russell is that, under the model viewing morphemes as representations (or Item-and-Arrangement), encoding the affix *ka* in the lexicon is not sufficient since the precise position of the affix is left

undetermined. In effect, Ulwa needs to posit a constraint like Align($[ka]_{Af}$,L,Ft',R) as done by McCarthy and Prince (1993a:80). Given this alignment constraint, however, the affix encoded in the lexicon seems unnecessary because the affixal information is encoded in the alignment constraint anyway. Expanding the theory of generalized alignment (McCarthy and Prince 1993a), Russell (1995, 1999) advances the idea to eliminate the lexical information, proposing that Align(Affix,Edge,Stem,Edge) makes an exclusive Item-and-Process model possible in the framework of OT. It is crucially important to remark here that any affixation incurs one or more Dep violations since it involves insertion of phonological segments that do not exist underlyingly.

(17)

	Base	*Possessive*	*Gloss*
a.	al	al-ka	man
	bas	bas-ka	hair
	kii	kii-ka	stone
b.	sana	sana-ka	deer
	amak	amak-ka	bee
	sapaa	sapaa-ka	forehead
c.	suulu	suu-ka-lu	dog
	kuhbil	kuh-ka-bil	knife
	baskarna	bas-ka-karna	comb
d.	siwanak	siwa-ka-nak	root
	anaalaaka	anaa-ka-laaka	chin
	karasmak	karas-ka-mak	knee

There are two main virtues of this line of approach to morphology. First, it clearly avoids the duplication problem by getting rid of the lexical storage of affixes. This simplifies the theory. Second, the mixture of Item-and-Arrangement and Item-and-Process is avoided by deriving affixation from constraints.

But this alignment-based formalization of affixation is not valid. Considering the Ulwa examples, Russell's framework correctly accounts for the position of the

possessive affix given Align([ka]$_{Af}$,L,Ft',R), as shown in (18), where the brackets in (18c) represent the head foot.

(18)

	/siwanak/	Align([ka]$_{Af}$,L,Ft',R)
a.	ka-si.wa.nak	*!
b.	si-ka-wa.nak	*!
c. ☞	(si.wa)-ka-nak	
d.	si.wa.nak-ka	*!

A crucial candidate missing here is [si.wa.nak] which does not contain the affix *ka*. Under the standard assumption that alignment constraints are vacuously satisfied when the variables specified in them do not exist in the candidate's phonological representation (e.g., Align(Ft,L,PrWd,L) is vacuously satisfied by [σσσσ]$_{PrWd}$ which contains no foot structure), [si.wa.nak] should be more harmonic than [si.wa.-ka-.nak] since the latter actual form incurs two Dep violations. Max plays no role here since the affix *ka* does not exist in the underlying representation under the full pursuit of Item-and-Process proposed by Russell, as noted above. It appears to be tacitly assumed that the variables in the alignment constraint must show up in the candidates: it is essential that the grammar yield only candidates which contain the variables stated in the alignment constraint. But how is this guaranteed? Given Freedom of Analysis (Prince and Smolensky 1993; McCarthy and Prince 1993b:20), which maintains that any candidates can be permitted to be generated by *Gen*, nothing prevents the grammar from producing candidates without the variables in their representations. To ensure that the variables appear on the surface, some kind of Max must be included. Given the absence of the affixal element in the input, the

input-output Max constraint is clearly irrelevant. Rather, the Max constraint needs to refer to the variables specified in the alignment constraint: the Max constraint needed here refers to $[ka]_{Af.}$ in the alignment constraint. But this constraint is peculiar since it requires mapping between part of a constraint and outputs. Such correspondence is unmotivated, so this move comes at great cost. This shows that the alignment-based approach to affixation is problematic too. Alternatively, for Max-IO to function properly, the affix *ka* must be already present in the underlying representation, but this goes back to the duplication problem which Russell argues against. Essentially, this move is precisely the same as my position taken here, namely classifying morphemes into two groups: those with underlying phonological substance and those without it. Given that the complete abolishment of affixes as entities comes at great expense, I keep the traditional position that affixation (except reduplication) derives from fixed segmentism in the underlying representation.

In summary, I have examined the nature of RM and discussed how it should be conceptualized and formalized in order to achieve a comprehensive understanding of concatenative and nonconcatenative morphology. Given that making explicit various morphosyntactic functions is the primary role of morphology and that morphemes are primitive morphological units to substantiate this role, I argued that RM is the constraint which demands some overt phonological manifestation of every morpheme contained in the underlying representation. In other words, RM is the constraint which is responsible for maintaining morphological contrasts. RM merely requires morphemes to receive some surface phonological manifestation but does not specify what it should be. The formal mechanism to obtain a specific phonological exponent for morpheme realization is the topic to be addressed in the next section.

Given the richness of the base principle as a fundamental property of OT, RM needs to compare output forms. I proposed a model in which candidates competing for the winner are compared against the output of the bare stem which carries no morphosyntactic function. It is crucial that the output form of the bare stem be at least a possible form rather than an actual independent word of the language. This does not preclude the possibility that a certain morphosyntactic category is derived from another morphosyntactic category although this is restricted to cases where there is some phonological evidence for the output-output correspondence. In such a case, the output of the bare stem does not enter the picture. The proposed conceptualization of RM has a number of desirable theoretical consequences as well. Given the model outlined here, morphemes are regarded as primitive morphological entities which must exist in the underlying representation. Reviewing a recent proposal made by Russell (1995, 1999) which abandons Item-and-Arrangement entirely, I argued that this alternative comes at great cost.

2.4 Emergence of Nonconcatenative Morphology

Building on what has been discussed, I propose a general schema of deriving various nonconcatenative morphological processes in this section. I discuss this section with the plural formation examples in German provided in (19). The examples are given orthographically for perspicuity.

(19)

Singular	*Plural*	*Gloss*
Vater	Väter	father
Mutter	Mütter	mother
Bruder	Brüder	brother
Tochter	Töchter	daughter
Acker	Äcker	field

There are three factors important to articulating a general schema of nonconcatenative morphology. First, nonconcatenative morphology involves faithfulness violations by modifying the phonological shape of the base (see section 2.2). Second, morphemes whose phonological manifestation depends upon a stem change have literally nothing as underlying phonological substance (see sections 2.2 and 2.3). Finally, RM plays a central role in the straightforward and integrated understanding of realizational morphology. These points are closely related to one another in the following way: some phonological exponent must appear for a morpheme contained in the underlying representation under duress of RM, but stem modification is the only eligible strategy when the morpheme contains no phonological material as its intrinsic property. In (19), for example, the plural morpheme does not possess any phonological substance, and therefore, the base stem must undergo some phonological reshaping as the signal of the plural morpheme. The specific strategy is umlauting a base vowel. This observation can be captured by ranking RM over Ident-IO-[+back], indicating that the identity constraint must be sacrificed for the satisfaction of RM. Generalizing this observation, faithfulness violations involved in nonconcatenative morphology are motivated by RM » Faith.

Now, an important question arises immediately: why does the base form (from which a form exhibiting nonconcatenative morphology is derived) not undergo any phonological changes triggered by RM? In other words, why is nonconcatenative morphology not so pervasive in a language, taking place anywhere regardless of morphosyntactic categories? Taking the plural formation in German, why do only plural forms (but not singular forms) undergo umlaut? This is a significant issue under my proposal that, without evidence for output-output correspondence,

phonological substance of a stem is independent of any morphosyntactic categories. In the German data in (19), this assumption means that both singulars and plurals are derived from bare stems which are not associated with any morphosyntactic function. The singular and plural morphemes are attached to those bare stems (e.g., /Vater/) when singular (e.g., /Vater/$_{\text{Singular}}$) and plural (e.g., /Vater/$_{\text{Plural}}$) forms are in need. Recall from section 2.3 that RM compares two outputs. In the German case, the output of a bare stem (e.g., [Vater]) is the output to be compared against the output of /Vater/$_{\text{Singular}}$ (i.e., [Vater]$_{\text{Singular}}$) and that of /Vater/$_{\text{Plural}}$ (i.e., [Väter]$_{\text{Plural}}$). Given RM » Ident-IO-[+back], it is unexpected that the output of the singular form does not undergo umlaut. The question is why plural forms are subject to the umlaut process but singular forms are not.

My proposal is that a faithfulness constraint is subdivided into several indexed components. Relevant indexes are morphosyntactic categories. The dispersion of a faithfulness constraint is not unprecedented. Itô and Mester (1999b) develop the idea of stratum-specific faithfulness in their study of the Japanese lexicon (see also Itô and Mester 1995ab for their related work, and also Fukazawa, Kitahara and Ota 1998 for a similar line of argument). The core tenet is that a single faithfulness constraint is indexed with respect to lexical strata and those indexed faithfulness constraints are ranked differently with respect to markedness ones. The consequence is that distinct lexical strata exhibit different behaviors with respect to the satisfaction/violation of markedness constraints.

My proposal is an extension of this indexation idea to morphosyntactic categories (cf. Benua 1997:chapter 4). Suppose that a bare stem is given and that it serves as the phonological input of two morphosyntactic categories α and β and that

some stem modification occurs only in the output of β. Given this set-up, the distribution of nonconcatenative morphology can be captured by the ranking provided in (20). I call (20) the emergence of nonconcatenative morphology schema. In morphosyntactic category α, preserving the phonological information of the bare stem is more valuable than satisfying RM. By contrast, satisfying RM is more important when the output of morphosyntactic category β is evaluated. Another logical possibility would be RM_{β} » Faith » RM_{α}, relativizing RM instead of faithfulness constraints. I will discuss and reject this alternative in section 3.2.1.

(20) *The Emergence of Nonconcatenative Morphology Schema*

$Faith_{\alpha}$ » RM » $Faith_{\beta}$

"Faith" in (20) is a variable, so a specific faithfulness constraint occupies its position. As encapsulated in (21), various nonconcatenative morphological processes are obtained by replacing the variable with specific faithfulness constraints.

(21)

Morphological Process	Constraint Ranking
Subtractive morphology	Max_{α} » RM » Max_{β}
Umlaut, Suppletion, Mutation	$Ident_{\alpha}$ » RM » $Ident_{\beta}$
Morphological epenthesis	Dep_{α} » RM » Dep_{β}
Metathesis	$Linearity_{\alpha}$ » RM » $Linearity_{\beta}$
Infixation	$Contiguity_{\alpha}$ » RM » $Contiguity_{\beta}$
Reduplication	$Integrity_{\alpha}$ » RM » $Integrity_{\beta}$
Haplology (Fusion)	$Uniformity_{\alpha}$ » RM » $Uniformity_{\beta}$

(22) and (23) illustrate how the emergence of nonconcatenative morphology schema works to explain the German examples in (19). In (19), the plural morpheme

is phonologically realized through umlaut whereas the singular morpheme receives no overt phonological exponence. This suggests that the singular and the plural morphemes correspond to α and β in (20) respectively. Moreover, umlaut causes the change of vowel frontness, so the relevant faithfulness constraint is Ident-IO-[+back]. In (22), Ident-IO-[+back]$_{Singular}$ outranks RM, and therefore, no nonconcatenative phonological change is permitted in the singular. RM is violated by the intended winner here because it is phonologically the same as the output of the bare stem (i.e., [Vater]). By contrast, in plural forms, a violation of Ident-IO-[+back]$_{Plural}$ is demanded since RM outranks this faithfulness constraint, as in (23). Given that the plural morpheme is contentless phonologically, violating Ident-IO-[+back]$_{Plural}$ is the least costly strategy to substantiate the morpheme, assuming that all other faithfulness constraints bearing the plural morphosyntactic marking are ranked over Ident-IO-[+back]$_{Plural}$.

(22)

	/Vater/$_{Singular}$	Ident-IO-[+back]$_{Sg.}$	RM	Ident-IO-[+back]$_{Pl.}$
a. ☞	Vater		*	N/A
b.	Väter	*!		N/A

(23)

	/Vater/$_{Plural}$	Ident-IO-[+back]$_{Sg.}$	RM	Ident-IO-[+back]$_{Pl.}$
a.	Vater	N/A	*!	
b. ☞	Väter	N/A		*

The German examples motivate relativization of a single faithfulness constraint with respect to various morphosyntactic categories. Given the system here, it is potentially possible that both Ident-IO-[+back]$_{Singular}$ and Ident-IO-[+back]$_{Plural}$

outrank RM in a given language when neither of the morphosyntactic categories carries inherent phonological content. Umlaut is expected both in the singular and the plural in this case, leading to ubiquitous front rounded vowels in the language. This is an unlikely situation, but given the markedness hierarchy to prefer unroundedness for front vowels, this situation is pretty unstable. It is likely that the language undergoes internal changes such that those front rounded vowels are unrounded over time by phonological adjustment by oncoming generations of language learners, in effect eliminating the predominant distribution of marked vowels.

The Aka examples presented earlier in (7a, b) suggest another dimension of faithfulness relativization: a single morphosyntactic category is attached to various different faithfulness constraints. Focusing upon the voicing alternation of the singular forms, the change from [-voi] to [+voi] takes place, but not vice versa. To explain this uni-directionality, mono-dimensional Ident is not sufficient here. I assume featural Max and Dep constraints (Lombardi 1998) (see Pater 1999 for a proposal to decompose a single Ident constraint into two asymmetrical uni-directional subcomponents). As shown in (24) and (25), this relativization plays an important role to block phonological polarity. In (24) and (25), I assume that the class 5 singular morpheme does not contain any phonological material, but Akinlabi (1996) assumes that the featural prefix [voice] is contained as the phonological substance of the morpheme. Under the approach taken here, these two analyses do not make any different prediction as far as the data in (7a, b) are concerned. Given the system advocated here, RM is defined strictly phonologically, and therefore, (24a) violates RM regardless of whether [voice] is specified or not as the phonological material of the morpheme.

(24)

	/teŋge/$_{Singular}$	Max-IO-[voi]$_{Sg.}$	RM	Dep-IO-[voi]$_{Sg.}$
a.	teŋge		*!	
b. ☞	deŋge			*

(25)

	/gɔala/$_{Singular}$	Max-IO-[voi]$_{Sg.}$	RM	Dep-IO-[voi]$_{Sg.}$
a. ☞	gɔala		*	
b.	kɔala	*!		

The idea of relativized faithfulness is obscured in concatenative morphology, however. In English singular-plural pairs as in [k^{h}æt]$_{Singular}$≈[k^{h}æts]$_{Plural}$, there is not any phonological evidence to believe that plurals are derived from singulars, and therefore, they are both derived from bare stems. The fact that singular forms do not exhibit any phonological distinction from bare stems suggests that all singular faithfulness constraints are ranked over RM. This ranking ensures that singular forms sacrifice the satisfaction of RM because of high ranking faithfulness constraints, coupled with the assumption that the singular morpheme is phonologically contentless. The plural morpheme, by contrast, carries the affix /s/ as its inherent phonological substance, and therefore, faithful parsing of the affixal material suffices to satisfy RM. Crucially, parsing the underlying material is an issue of phonological faithfulness, and therefore, faithful parsing covers the role played by RM, suggesting that the ranking between RM and most singular-specific faithfulness constraints remains undetermined on empirical grounds.

But RM is not entirely inactive in concatenative morphology. In German, degemination generally takes place when morpheme concatenation creates a sequence of identical or similar segments (e.g., /tret-t/→[trɪt] 'step', /halt-t/→[hɛlt] 'stop').

However, degemination is blocked under a certain circumstance and a schwa is epenthesized, as in /raɪt-t/→[raɪtət] 'ride, 3sg.' (Wiese 1996b; Klosa, Scholze-Stubenrecht and Wermke 1998). The crucial observation is that degemination occurs when a stem undergoes some phonological change and therefore the relevant morphological information is denoted by it even if the affixal material does not surface. By contrast, schwa epenthesis enters the picture when no such stem change occurs since the affix is the only phonological element to express the relevant morphosyntactic information. More formally, the OCP motivates degemination, but the desire to express underlying morphemes overtly in the surface representation prevents the regular phonological process (Kawahara 2001). In a general vein, this situation is captured by RM (») markedness » faithfulness, as illustrated in (26). The existence of RM is strongly motivated here, and therefore, RM plays a crucial role not only in nonconcatenative morphology but also in concatenative morphology as well.

(26)

	/raɪt-t/$_{\text{Plurral}}$	RM	OCP	Dep
a.	raɪt	*!		
b.	raɪtt		*!	
c. ☞	raɪtət			*

RMT proposed here has an important theoretical repercussion. As shown in (21), truncatory morphology and reduplication are yielded at the expense of Max and Integrity violations respectively. Normally, TRUNC and RED have been assumed as morphemes requiring truncation and reduplication in the earlier literature (see Benua 1995, 1997 for truncation, and McCarthy and Prince 1993b, 1995, 1999; Urbanczyk 1998; Walker 2000 for reduplication). TRUNC and RED specify how they must be

phonologically instantiated, but given RMT, such nonconcatenative morphemes are unnecessary. As a common property of concatenative and nonconcatenative morphology, I pointed out that they share the purpose of maintaining morphological contrasts. I claim that RM is the constraint which reflects this idea, but morphemes themselves do not have their own desire concerning their phonological exponence. Rather, it is determined by how the grammar ranks morpheme-specific faithfulness constraints with respect to other constraints such as RM and markedness constraints. Morphemes such as TRUNC and RED literally do not exist in the system of RMT. Truncation and reduplication surface when violating Max or Integrity is the cheapest faithfulness violations respectively (see later chapters for exemplification). The annihilation of such contentless but process-specific morphemes is empirically preferable because, if such morphemes existed, it is simply an unexplainable accident that the variation of such morphemes is pretty restricted (virtually, only truncation and reduplication). No language needs a morpheme like REVERSE-ONSET-AND-RIME which maintains that the onset and the rime must be reversed in every single syllable for the morpheme to be successfully incarnated phonologically. The only way to guarantee the absence of such unattested morphemes is to prohibit contentless but process-specific morphemes entirely.

This issue is related to the major argument against Item-and-Process. It is the weakness of the morphological model that available morphological processes are not constrained and therefore that Item-and-Process runs into an over-generation problem (Hockett 1954; Anderson 1992). The nature of the issue concerning TRUNC and RED is very similar to the lack of restrictiveness of Item-and-Process since there is no way to guarantee that TRUNC and RED are the only phonologically empty process-

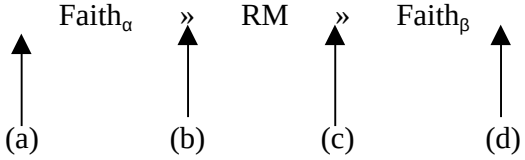
specific morphemes permitted in natural languages. The only way to avoid the unwanted over-generation problem is merely to abolish the existence of such morphemes in Universal Grammar (see Horwood 1999 for a similar argument).

Realizational morphology based upon the emergence of nonconcatenative morphology schema in (20) brings up another important theoretical implication: diacritics and floating features associated with morphemes lose their room. Umlaut in German, for example, was treated by Strauss (1976) such that a diacritic feature [+Umlaut] causes vowel fronting of a stem vowel. In RMT, all nonconcatenative morphology is accomplished by the emergence of nonconcatenative morphology schema, and therefore, at least a majority of diacritics and floating features can be eliminated from linguistic theory. Even cases where a secondary articulation (i.e., labialization, palatalization, velarization and glottalization) denotes the presence of a morphosyntactic category can be subsumed under the generalized schema since they would be successfully captured by positing appropriate Ident constraints. Although diacritics and floating features are convenient devices, any theory resorting to them cannot achieve a unified understanding of overall nonconcatenative morphology. The reason is that there is no reasonable way to establish a diacritic or floating feature that motivates subtractive morphology and metathesis. No new phonological material is added in these word formations, and therefore, any attempt to incorporate them under the rubric of diacritics or floating features would result in assuming an abstract morpheme similar to TRUNC and RED because the morpheme is phonologically contentless but process-specific. As discussed above, however, admitting such morphemes is empirically undesirable. RMT avoids this problem by reducing all nonconcatenative morphological processes to interactions of RM and phonological

faithfulness constraints. This move conforms to the fundamental tenet of OT that sound alternations are surface outcomes of constraint interactions.

To close this section, let us sketch some more general properties of (20) in cases where some phonological constraint C is placed in various locations, anticipating the discussion in the next chapter. All the logical possibilities are given in (27). In (27a), C is fully operative both in α and β, so C must be always obeyed. By contrast, in (27d), C is overridden both by $Faith_{\alpha}$ and by $Faith_{\beta}$, so C cannot compel any faithfulness violations. More interesting are cases illustrated in (27b, c). In these two cases, a phonological constraint C intervenes between the two faithfulness constraints. This is a typical instance of the emergence of the unmarked ranking schema (McCarthy and Prince 1994). In (27b), C crucially dominates RM so that the power of RM is potentially suppressed to fulfill the requirement imposed by C. In (27c), although C » $Faith_{\beta}$ still yields the emergence of the unmarked in β, nonconcatenative morphology is always observed because C cannot block the power of RM. I discussed that morphologically conditioned stem changes result in a more marked phonological representation. This generalization still holds since the stem change itself (e.g., umlaut) produces a phonologically less harmonic representation. Nevertheless, the output form is potentially better than the input phonologically in certain respects. But this does not mean that phonological changes on the stem are phonologically motivated in such cases. This issue will be taken up in section 3.2.1 in the context of subtractive morphology involved in Koasati plural formation.

(27)



2.5 Against Anti-Faithfulness Theory

Given that nonconcatenative morphology exhibits anti-faithfulness effects, the immediate analytical possibility is to take advantage of anti-faithfulness theory advocated by Alderete (1999). In this section, I give an overview of his proposal and argue against the extension of the theory to the nonconcatenative morphological processes at issue here. Investigating the morphophonology of Yidiŋ, Hayes (1997, 1999) independently suggests the possibility of anti-correspondence which actively requires morphemes to alternate in particular ways. But anti-correspondence is brought to the fore as an ad hoc (or crosslinguistically not well motivated) strategy to deal with alternations impossible to be handled by interactions of markedness and faithfulness constraints. Hayes (1997, 1999) thus regards anti-correspondence as a language-particular brute force acquisitional device rather than integral part of Universal Grammar. Alderete (1999) explicitly argues that anti-faithfulness theory must be incorporated as part of universal principles embedded in the OT system. For this reason, I review only Alderete (1999).

Alderete (1999) motivates and develops anti-faithfulness theory by pointing out empirical difficulties of the standard OT assumption that *Con* consists exclusively of markedness and faithfulness constraints. Phonological polarity (also known as α-switching, flip-flop, or exchange) constitutes important empirical data in support of his proposal. In Luo, a Western Nilotic language spoken in Kenya and Tanzania, nominative singulars serve as the bases of their plural counterparts, as exemplified in (28) (Stafford 1967; Gregersen 1972; Okoth-Okombo 1982; Stonham 1994). The examples receive the following descriptive generalization: (i) a plural suffix *-i* or *-e* (phonetically realized either as [e] or as [ɛ]) is attached, (ii) a word-final vowel of a

singular form is subject to deletion, and (iii) the voicing value of the final consonant is switched (i.e., [-voi]→[+voi], and vice versa). The earlier works regard the voicing alternation as a genuine instance of phonological polarity, leading to Okoth-Okombo's (1982) formulation of the plural formation in terms of the α-notation convention (cf. Chomsky and Halle 1968).

(28)

	Singular	*Plural*	*Gloss*
a.	alot	alode	vegetable(s)
	bat	bade	arm(s)
	luθ	luðɛ	stick(s)
	ruoθ	ruoði	chief(s)
	guok	guogi	dog(s)
b.	kidi	kite	stone(s)
	puoðo	puoθe	garden(s)
	got	gode	twig(s)
	tʃogo	tʃoke	bone(s)
	dɛbɛ	depɛ	debbi(s)

Building on the generalization made in the earlier literature, Alderete (1999) argues that polarity phenomena present a serious challenge to OT. Under the standard premise that *Con* consists only of markedness and faithfulness constraints, the output can never be phonologically more marked than the input, a property called *harmonic ascent* (Prince 1997; Moreton 1999; McCarthy 2000b). Consider a schematic polarity example: /A/→[B] and /B/→[A]. Were *A* phonologically more marked than *B*, *A* could surface as *B* if a markedness constraint militating against *A* is ranked over a competing faithfulness constraint, but *B* is never realized as *A*. The reverse holds when *A* is less marked than *B*. This observation led Alderete (1999) to propose a new family of constraints: anti-faithfulness. For the case at hand, the relevant constraint is obtained through a negation of a faithfulness constraint Ident-OO-[voi]. The negative operator attached to faithfulness constraints is existentially

quantified such that ¬ Ident-OO-[voi] requires at least one pair of correspondent segments to be non-identical for the voicing feature. As demonstrated in (29) and (30), the voicing polarity in Luo is accounted for by giving privileged status to ¬ Ident-OO-[voi] over Ident-OO-[voi].

(29)

	/alot-e/$_{Plural}$	¬ Ident-OO-[voi]	Ident-OO-[voi]
a.	alote	*!	
b. ☞	alode		*

(30)

	/kidi-e/$_{Plural}$	¬ Ident-OO-[voi]	Ident-OO-[voi]
a.	kide	*!	
b. ☞	kite		*

Anti-faithfulness theory is subsequently applied to affix-controlled accent phenomena, where particular affixes affect the underlying accent of a stem in one way or another. Among others, Alderete (1999) discusses dominant affix effects in Japanese. As illustrated in (31), Japanese has three types of dominant affix phenomena: dominance effects, preaccentuation, and accent shift (McCawley 1968; Poser 1984b).

(31) a. *Dominance effect*

Underlying	*Output*	*Gloss*
/kóobe-kko/	[koobe-kko]	native of Kobe
/edo-kko/	[edo-kko]	native of Tokyo

b. *Preaccentuation*

Underlying	*Output*	*Gloss*
/nisímura-ke/	[nisimurá-ke]	the Nishimura family
/yosida-ke/	[yosidá-ke]	the Yoshida family

c. *Accent shift*

Underlying	*Output*	*Gloss*
/kúzu-ya/	[kuzú-ya]	junkman
/toma-ya/	[toma-ya]	mat seller

First, the dominant affix *-kko* requires deletion of the base (underlying) accent, as in (31a). Thus, the entire word is accentless whether the base contains a lexical accent (as in [kóobe]) or not (as in [edo]). Second, (31b) shows examples of preaccentuation. The suffix *-ke* demands that the word accent be placed on the syllable immediately preceded by it. As a result, the base-final syllable carries accent both when the base has an original accent (as in [nisímura]) and when the base is accentless (as in [yosida]). Finally, (31c) illustrates accent shift. The crucial difference between (31b) and (31c) is that no accent insertion takes place in (31c) while it is obligatorily required in (31b). Abstracting away from various details, Alderete's proposal is that prosodic anti-faithfulness constraints are operative. More specifically, ¬Max-OO-Prom, ¬Dep-OO-Prom, and ¬NoFlop-OO-Prom are relevant constraints ranked over their faithfulness counterparts in dominance effects, preaccentuation, and accent shift respectively. ¬Max-OO-Prom actively requires deletion of an underlying accent, ¬Dep-OO-Prom mandates for insertion of an accent not present underlyingly, and ¬NoFlop-OO-Prom demands accent shift. Ranked over their faithfulness counterparts, the relevant accent modification is required, obtaining seemingly unmotivated various kinds of suprasegmental changes. Fundamentally the same basic analytical approach is taken to dominant affix effects in other languages.

Summing up, anti-faithfulness theory is intended to capture various phonological changes which take place on a stem for morphological reasons. In other words, there exists no principled phonological reason behind the voicing alternation in Luo and dominant affix effects in Japanese. They are morphologically conditioned

instead. This suggests that anti-faithfulness theory is supposed to cover largely the same range of linguistic phenomena as those dealt with in this dissertation.

However, anti-faithfulness theory encounters several conceptual and empirical problems. First, admitting anti-faithfulness constraints significantly degrades the explanatory strength and restrictiveness of OT. An attractive tenet of OT is that various interactions of potentially conflictive constraints determine the ultimate output. Various constraints conflict with one another in different manners depending on the phonological configuration of the input. For example, consider a mini-phonology where NoCoda outranks Max. Given the input /CVC/, the coda consonant is elided, but the input surfaces faithfully if the given input is /CV/. The two constraints are under tension only in a particular environment, but they are not incompatible with each other otherwise (i.e., context dependent). The point is thus that constraints themselves are not in conflict intrinsically. By contrast, anti-faithfulness constraints are intrinsically in conflict with the faithfulness counterparts regardless of the context (i.e., context independent). Admitting anti-faithfulness constraints thus reduces the role played by faithfulness constraints and therefore undermines the explanatory power and the restrictiveness of OT. Rather, it is desirable to derive opposing effects without inherently antagonistic constraints.

By contrast, RMT based upon RM does not run into this problem. RM plays a key role in nonconcatenative morphology, but it is important in concatenative morphology as well. As discussed in section 2.4, RM is not incompatible with concatenative morphology where a morpheme contains some phonological material as its innate property. Importantly, RM and phonological faithfulness constraints are not ranked with respect to each other on empirical grounds in such cases. This

indicates that RM and phonological faithfulness constraints are not antagonistic intrinsically.

Related to this point, another advantage of RMT is that the scope of its empirical coverage is wider than anti-faithfulness theory. While anti-faithfulness theory is intended to account specifically for anti-faithfulness effects as described above, RMT is intended to deal not only with stem modifications in nonconcatenative morphology but also with affixal morphology. This unification is not merely desirable from a conceptual point of view, but it turns out that the integrated understanding of the whole realizational morphology is a necessary move. As will be discussed in section 4.4, the actual aspect morpheme in Saanich contains a glottal stop as its phonological content, but it alternates with metathesis and reduplication. In cases where affixation and nonconcatenative stem changes coexist as allomorphs, it is problematic to separate concatenative morphology from nonconcatenative one. Rather, an integrated system should be constructed. RM simply requires every morpheme to receive some surface phonological manifestation, so it is not a constraint special to nonconcatenative morphology.

Another serious conceptual difficulty of anti-faithfulness theory is that it cannot explain the fact that anti-faithfulness effects are always morphologically governed. As aforementioned, the reason why nonconcatenative morphology incurs faithfulness violations is to express the existence of a morpheme on the surface. This cannot be directly captured by the anti-faithfulness approach. Anti-faithfulness constraints simply demand the output to be unfaithful to the input in a certain dimension. This means that they are not sensitive to the source of the driving force which causes faithfulness violations. More concretely, anti-faithfulness constraints

are expected to be active whether the source is phonological or morphological. Anti-faithfulness effects are restricted to cases where some morphological factor enters the picture (Anderson and Browne 1973; Moreton 1999), and therefore, nonconcatenative morphological processes such as subtractive morphology are never expected for purely phonological reasons. Alderete (1999) thus stipulates that anti-faithfulness constraints are active only in the surface-to-surface (or output-to-output) dimension to circumvent unwanted phonological exchanges, where an output is defined as a form which can stand on its own as an independent word in the sense of Benua (1997). Desirably, the system behind this stipulation should be formally understood.

By contrast, RM is sensitive to the existence of morphemes in the underlying representation. RM plays a role only when their phonological realization is at issue. It has nothing to say if no underlying morpheme exists which has not yet received any phonological manifestation. Most importantly, it follows that we do not need to restrict the domain where RM plays a role, avoiding the empirical problem stemming from the surface-to-surface restriction posed on anti-faithfulness constraints.

In addition to the conceptual problems, anti-faithfulness theory encounters an empirical drawback too. Crucial here is the nominative formation in Lardil in (32) (Hale 1973; Itô 1986; Wilkinson 1988; Weeda 1992; Prince and Smolensky 1993; Blevins 1997; Horwood 1999; Kurisu 1999).

(32)

Stem	*Nominative*	*Gloss*
yalulu	yalul	flame
yiliyili	yiliyil	oyster
mayara	mayar	rainbow
kamputa	kamput	pandoanas nuts

The crucial fact is that the stem forms cannot stand on their own as independent words, so they must be subtracted as in nominatives or otherwise

inflected as in accusatives (-*in*). This fact is quite damaging to anti-faithfulness theory which maintains as a central claim that anti-faithfulness constraints operate only in the surface-to-surface (but not in the lexical-to-surface) dimension. Two responses are conceivable at this point. A first possibility is to exclude subtractive morphology from the realm of data that anti-faithfulness theory covers. This possibility is obviously undesirable since it means to give up explaining what it was arguably designed to account for. Indeed, anti-faithfulness theory is directly imported into an analysis of subtractive morphology by Horwood (1999) and Bat-El (2000). A second possible reaction is to eliminate the central stipulation that anti-faithfulness constraints participate only in the surface-to-surface correspondence. The reduced restrictiveness is a priori undesirable, but the relaxation of the key restriction gives rise to new empirical problems, especially in light of phonological polarity. As pointed out above, phonological polarity is stringently restricted to cases where some morphological condition comes into play, and this is indeed true in Luo, as exemplified in (28). Lexical-to-surface anti-faithfulness constraints expect the presence of purely phonological polarity effects, contrary to fact. This shows that neither response is satisfactory, and therefore, the nominative formation in Lardil constitutes quite strong empirical evidence against anti-faithfulness theory. Horwood (1999) applies anti-faithfulness theory to the nominative formation in Lardil, but this point is not discussed.

As articulated in section 2.3, RM is insensitive to the status of the input: it may or may not be an independent output form. This means that cases like Lardil, where base forms do not stand as full-fledged outputs, do not present any empirical problem to RMT. As discussed in 2.3, a bare stem serves as the input when a given

morphosyntactic category is not derived from another category, and output candidates produced by *Gen* are compared against the output form of the bare stem input computed by the phonology of the language for the purpose of evaluating RM violations (see (8)). On the other hand, if the input is already an output in the language, candidates are directly compared with the input. The satisfaction/violation of RM can be computed regardless of the output status of the input (see section 3.2.2 for my analysis of Lardil nominalization).

Furthermore, RMT and anti-faithfulness theory are significantly different in terms of generality/specificity of RM and anti-faithfulness constraints. RM is a very general constraint in the sense that it does not specify how a given morpheme must be phonologically realized in the surface representation. By contrast, anti-faithfulness constraints are much more specific because they specify in what dimension stems undergo modification. For instance, ¬Max requires that the stem change be in the form of deletion, and therefore, any other stem changes are regarded unsatisfactory. RM accepts any particular phonological exponence. This difference gives rise to a fundamental question: are morphemes process-specific in the sense that a particular process is required for the satisfaction of their phonological realization? Given a number of cases where a single morpheme is associated with multiple allomorphs (especially cases where allomorphs are nonconcatenative to be discussed in chapter 4), it is not plausible that morphemes intrinsically specify their phonological instantiation. Rather, a more promising idea would be to consider morphemes as entities whose desire is merely to receive some phonological exponence whatever it is, although phonological substance of affixes must be encoded lexically since it is an unpredictable innate property.

Summarizing the argument in this section, I discussed that anti-faithfulness theory is faced with several conceptual and empirical problems. From the conceptual point of view, it brings analytical redundancy in the theory of OT, and as a result, it reduces the importance of faithfulness constraints and the explanatory power of OT. Moreover, anti-faithfulness constraints fail to capture the fact that faithfulness violations are forced to denote the presence of a morpheme overtly in the surface representation, resulting in a stipulation that anti-faithfulness constraints play an active role only in the surface-to-surface domain. On the empirical side, I argued that the nominative formation in Lardil cannot be handled by anti-faithfulness theory since base forms are not independent output forms. Any attempt to exclude or include the data either results in the loss of explanatory strengths or creates new empirical problems. Given these difficulties, no superficial fix would ameliorate the situation since these problems come directly from the fundamental set-up of anti-faithfulness theory.

2.6 Summary

In this chapter, I investigated the formal characteristics of stem modifications involved in nonconcatenative morphology and outlined the theoretical mechanism to derive them. In the course of discussion, concatenative and nonconcatenative morphology were compared toward a unified understanding of realizational morphology. The most striking property of nonconcatenative morphology which differentiates it from concatenative morphology is anti-faithfulness effects. Anti-faithfulness effects must be distinguished from faithfulness violations in regular phonology because the former are morphologically governed. Theoretically

interesting in the context of OT is the fact that faithfulness violations in nonconcatenative morphology do not improve phonological harmony. Rather, unlike in phonology, they yield a phonologically more marked representation. This is of great significance since nonconcatenative stem changes cannot be explained by interactions of faithfulness and markedness constraints, and therefore, they present an empirical challenge to OT.

I proposed in section 2.3 that RM plays a central role in an integrated understanding of concatenative and nonconcatenative morphology. RM requires all morphemes contained in the underlying representation to receive some phonological exponence. The specific exponent differs from morpheme to morpheme and also from context to context. But RM does not demand a particular phonological realization of a morpheme. Among others, this is a crucial difference between RM and anti-faithfulness constraints. As an evaluation metric of RM, I argued that output-output comparisons need to be established. This is not only conceptually required in OT but also desirable on an empirical basis. Morphosyntactic categories are derived from bare stems when no independent phonological evidence is there for output-output correspondence. In such cases, RM compares output candidates and the output form of the bare stem which is computed by the phonology (i.e., constraint ranking) of a given language. By contrast, when some independent evidence shows the need of output-output correspondence, a morphosyntactic category is derived from another one, and RM directly compares the input and the output candidates. An important underlying assumption in RMT is that morphemes are entities which exist as part of the underlying representation. Assessing an alternative position taking full Item-and-Process OT morphology, I argued that this possibility comes at great cost.

Taking advantage of RM, I developed a general schema in section 2.4 to explain various nonconcatenative morphological operations in a unified and principled manner. They occur because a phonological faithfulness constraint ranked below RM must be sacrificed when a morpheme does not contain any phonological material. Faithfulness constraints are relativized with respect to morphosyntactic categories. By ranking them differently with respect to RM, the presence or absence of stem modification is determined for a given morpheme.

Finally, in section 2.5, I reviewed anti-faithfulness theory articulated by Alderete (1999). It is not a desirable mechanism for nonconcatenative morphological phenomena given an empirical problem presented by Lardil subtractive morphology. I also argued that the theory is vulnerable to many general problems on conceptual grounds. Especially, the stipulation that anti-faithfulness constraints are active only in the output-output dimension and the inability to account for Lardil nominalization are closely interconnected. There would be no principled solution to circumvent both problems. Although anti-faithfulness theory would be an immediate and direct analytical possibility to analyze the range of nonconcatenative morphology phenomena given anti-faithfulness effects exhibited by them, I argued that it is not a viable idea.