

# A Ternary Model of Morphology-Phonology Correspondence\*

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## 1. Introduction

In the traditional version of Correspondence Theory (McCarthy & Prince 1995), input-output (IO) faithfulness characterizes mappings between the phonological structure of an input and its output, as in (1).

$$(1) \quad \begin{array}{ccc} / \text{ Phonological Input } / & & \\ \updownarrow & \text{Faith-IO} & \\ [ \text{ Phonological Output } ] & & \end{array}$$

In this paper, we propose a system of relations that we call the Ternary Model of Morphology-Phonology (MP) Correspondence. This model extends to incorporate input-output mappings involving morphological structure, and it regulates mappings (i.e. indexing) *between* phonological and morphological structure in an output.

We begin with three phonology-sensitive phenomena that involve mappings which reference morphology. Such mappings, we propose later, are formalized in terms of correspondence constraints referring to morphological structure.

**Morpheme Realization.** In Zoque (Zoquean; Wonderly 1951), a nasal pronominal prefix /N-/ assimilates in place to a following stop, as shown in (2a).<sup>1</sup> However, the prefix deletes before a fricative, as seen in (2b), because the nasal fails to assimilate to a continuant (Padgett 1995). Nevertheless the meaning that the prefix carries is preserved in the resulting word.

(2) a.	pama	‘clothing’	/N-pama/ → [mbama]	‘my clothing’
	tatah	‘father’	/N-tatah/ → [ndatah]	‘my father’
	gaju	‘rooster’	/N-gaju/ → [ŋgaju]	‘my rooster’

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1. A separate phenomenon of post-nasal voicing is also apparent in these data.

- |    |      |         |                   |            |
|----|------|---------|-------------------|------------|
| b. | faha | ‘belt’  | /N-faha/ → [faha] | ‘my belt’  |
|    | sik  | ‘beans’ | /N-sik/ → [sik]   | ‘my beans’ |

The forms in (2b) contravene morpheme realization: there is a morpheme (first person possessor) whose meaning is contained in the output but which lacks a phonological exponent. Phenomena sensitive to morpheme realization have previously been analyzed using some form of REALIZE-MORPHEME constraint (e.g., Samek-Lodovici 1993, Gnanadesikan 1997, Walker 1998, cf. Rose 1997, Urbanczyk 1998, Kurisu 2001).

**Ineffability.** In Mandarin Chinese a reduplicative affix marks the distributive form of classifier nouns. This is illustrated in (3a) in a word with a monosyllabic base. It is noteworthy that the reduplication in (3a) also augments the form to the language’s preferred two syllable minimal word size (Chen 2000). In forms where augmentation is not called for, distributive reduplication is blocked, as shown in (3b), with the result that polysyllabic bases do not have a distributive lexical form.

- |        |        |          |               |                      |
|--------|--------|----------|---------------|----------------------|
| (3) a. | dun    | ‘ton’    | dundun        | ‘every ton, tons of’ |
|        | jialun | ‘gallon’ | *jialunjialun |                      |

The example in (3b) demonstrates ineffability. There is a morpheme (distributive) whose meaning fails to be expressed in combination with a certain type of base. This could be regarded as loss of that morphological content in an output’s formation. Phenomena involving gaps or ungrammaticality have previously been analyzed using the M-PARSE constraint (Prince & Smolensky 1993, Raffelsiefen 1999; cf. Orgun & Sprouse 1999).

**Double Affixation.** In English, the *-er* suffix attaches to verbs to form nouns, with the meaning ‘one who Xs’, as in (4a). When attaching to constructions consisting of a verb plus particle, this suffix is attached twice or “double affixed”, as in (4b). However, its meaning is interpreted once, i.e. as ‘one who Xs’, where X=[Verb+Particle]. The issue presented here is that a single morpheme has duplicate expression in the output.

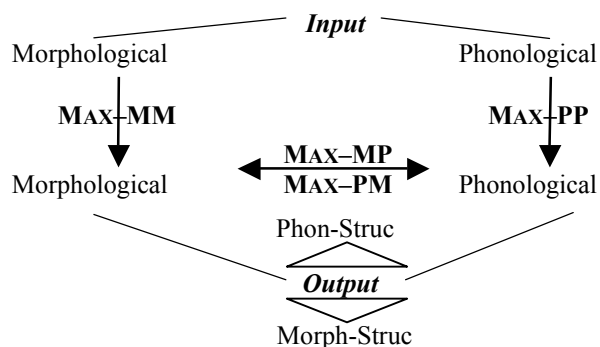
- |        |                        |
|--------|------------------------|
| (4) a. | work / worker          |
|        | run / runner           |
| b.     | pick up / picker-upper |
|        | rip off / ripper-offer |

In previous work, phenomena like those illustrated in (2-4) have been handled by isolated constraints or approaches, if at all. Moreover, the status of the constraints that have been employed is unclear. For example, in the area of morpheme realization, Samek-Lodovici (1993) proposes the constraint, AFFIX REALIZATION, which requires that an affix be realized “in an overt and detectable manner”, that is, it must be phonologically expressed. This suggests the existence of an indexing or relation between

morphological and phonological structure (see also Gnanadesikan 1997 and Walker 1998). However, the constraint fails to make use of correspondence, a mechanism available to formalize and track relations between structures. Another constraint, M-PARSE, which requires “the structural realization of morphological properties” (Prince & Smolensky 1993), has been utilized for cases of ineffable constructions. As a member of the PARSE constraint family, it qualifies as a faithfulness constraint; however, it has thus far escaped implementation within correspondence theoretic modeling. We propose to integrate phenomena like those in (2-4) into a unifying model of MP correspondence. As we will show, this not only captures data previously motivating the above-mentioned constraints, but it also encompasses other cases, such as double-affixation.

In the MP model, input-output correspondence relations exist not only for a form’s phonological structure, but also for its morphological structure. Moreover, correspondence relations exist between morphological and phonological structure. Building on Walker (2000), we posit three mapping types, schematized in (5): (i) Phonological IO relations, which we label PP correspondence (these cover phonological correspondence already established in the work of McCarthy & Prince 1995), (ii) Morphological IO relations, which we label MM correspondence, and (iii) Morphological-Phonological relations in an output, labeled MP and PM correspondence.<sup>2</sup> MP and PM relations regulate indexing between morphological and phonological representations, such as whether a morpheme is indexed with a segment in the output or vice versa.

(5) Ternary Model of MP Correspondence



The input in (5) contains phonological and morphological information. Decomposing this, the morphological content is shown at the left and

2. See also Wunderlich (2001), who applies correspondence to morphological features. In addition, Downing (1997, 1998) employs correspondence to evaluate mismatches between a morphological stem and morpho-prosodic stem in an output.

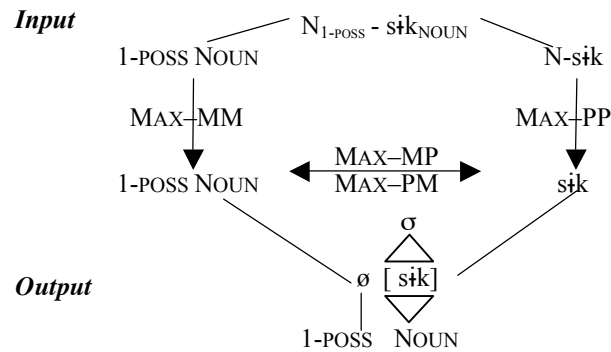
phonological content at the right. MAX-MM constraints regulate the retention of morphological content in the output, and MAX-PP constraints regulate retention of phonological content. Like the input, the output contains phonological and morphological information. Relations exist between an output's phonological and morphological structures, potentially altered from the input. MAX-MP constraints mandate that every morpheme whose meaning (i.e. semantic content) is contained in the output have a corresponding phonological element. Conversely, MAX-PM requires that every phonological element in an output be affiliated with a morpheme.

The remainder of this paper is organized as follows. In §2 we define and demonstrate constraints of the MP model with application to Zoque. §3 presents a case study of reduplication patterns in Mandarin Chinese and develops an MP correspondence account. In §4 we discuss implications for the Consistency of Exponence Principle (McCarthy & Prince 1993a), with exemplification from Anxiang. §5 presents the conclusion.

## 2. The Ternary Model of MP Correspondence

Recall that in Zoque a nasal prefix deletes before fricatives, but its meaning (first person possessor) is retained, e.g., /N-sɨk/ → [sɨk] 'my beans' (see (2)). The figure in (6) illustrates the correspondence relations involved in this word.

### (6) MP correspondence mappings in [sɨk] 'my beans'



The input contains the underlying phonological structure /N-sɨk/ together with the underlying morphological indexing or affiliation of each phonological element. The nasal is indexed with the first person possessor affix, and /sɨk/ is indexed with the noun meaning 'beans'. As Walker (2000) notes, indexing of this kind is also implicit in any approach that assumes the Consistency of Exponence Principle (and see McCarthy & Prince 1995 on the notion of a segment or autosegment as a "Morpheme Associate"). The morphological structure in the input consists of a noun

plus 1 poss. prefix, shown on the left in (6). The input's phonological content, on the right, consists of the phonemes /N-sɪk/. As mentioned previously, the output likewise consists of phonological and morphological structure and contains information about their cross-indexing. We posit that this indexing is improvised by Gen, and it is evaluated by correspondence constraints.

The right side of the figure in (6) reveals a change in phonological structure: the nasal is deleted. This violates MAX-PP, in (7), which regulates phonological input-output mappings. It replaces traditional MAX-SEG-IO. On the other hand, the morphological structure, on the left side of (6), remains the same: it continues to consist of the noun plus 1 poss. This satisfies MAX-MM, in (8), which, we suggest, stands in place of M-PARSE.<sup>3</sup>

- (7) MAX-PP: Every segment in the input has a correspondent segment in the output.
- (8) MAX-MM: Every morpheme in the input has a correspondent morpheme in the output.

As shown at the bottom of (6), the 1 poss. morpheme lacks an indexed phonological element in the output. This violates MAX-MP, in (9), which obviates constraints such as REALIZE-MORPHEME or AFFIX REALIZATION.<sup>4</sup> However, the output obeys MAX-PM, in (10).

- (9) MAX-MP: Every morpheme in the output is indexed with some phonological element in the output.
- (10) MAX-PM: Every phonological element in the output is indexed with some morpheme in the output.

MAX-PM is violated elsewhere in Zoque. The genitive suffix is /-ʔs/. In (11a) it attaches to vowel-final /jomo/ 'woman'. It attaches to consonant-final /pɪn/ 'man' in (11b). Here [i] is inserted to facilitate syllabification. ((11b) also shows metathesis of /n/ and /ʔ/.) The inserted [i] presents a case of phonological structure in the output with no corresponding morpheme. MAX-PM replaces DEP-SEG-IO. This approach is consistent with Struijke's (2000) claim that Faith-IO is unidirectional, preserving input material only.

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3. Although we suggest that MAX-MM replace M-PARSE, we do not claim they are identical. M-PARSE, as interpreted by Prince and Smolensky (1993), is violated by an output that receives what they call the morphological "Null Parse", whereas MAX-MM is violated by any output for which an input morpheme has been deleted.

4. MAX-MP obviates constraints requiring a morpheme to have a phonological exponent in an output. It does not address subtractive morphology, discussed by Kurisu (2001). How such patterns are to be addressed awaits further research.

- (11) a. teʔ-jomo-ʔs tʰik 'the woman's house'  
 b. teʔ-pʰʔnis tʰik 'the man's house' (-pʰn-ʔis → pʰʔnis)

### 3. Case Study: Mandarin Chinese

In this section, we examine applications of the MP correspondence model in Mandarin Chinese, an isolating language wherein it is usually the case that each morpheme is one syllable and each syllable is one morpheme. The effect of morphology in certain patterns is therefore easily visible. The patterns we investigate involve reduplication: the distributive forms of classifiers, mentioned in §1, and double affixation in intensified adjectives.

#### 3.1. Distributive forms of monosyllabic and disyllabic classifiers

In Chinese, a difference exists in the availability of reduplication in forming distributives from monosyllabic vs. disyllabic bases. The data in (12a) show that monosyllabic classifiers are reduplicated to produce the distributive form, while the data in (12b) demonstrate that disyllabic classifiers do not undergo distributive reduplication. Consider the first example in (12a): the classifier *dun* means 'ton' and *dundun* means 'every ton, tons of'. The reduplication thus creates a distributive form for the classifier. However, for disyllabic classifiers like *jialun*, there does not exist a reduplicated form to denote the distributive meaning.

- (12) a. *dun* 'ton'                      *dundun* 'every ton, tons of'  
           *bei* 'cup'                        *beibei* 'every cup, cups'  
           *ping* 'bottle'                    *pingping* 'every bottle, bottles of'
- b. *jialun* 'gallon'                \**jialunjialun*  
           *chabei* 'teacup'                \**chabeichabei*  
           *jiuping* 'wine bottle'            \**jiupingjiuping*

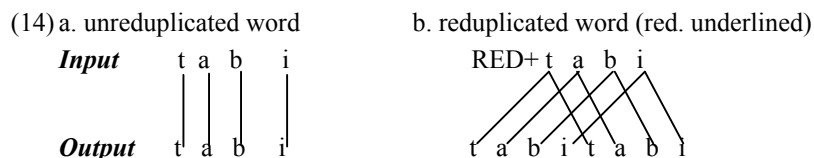
We observe that the reduplicative affixation also serves to augment a monosyllabic word to a disyllable. The preferred word minimum in Chinese is two syllables. Despite the fact that morphemes are generally one syllable in size, Chinese *words* are typically at least two syllables. The preference for disyllabicity in Chinese words has been discussed by many researchers. See Chen (2000) for a review of evidence supporting this tendency.

Based on the trend of disyllabification of Chinese, the constraint on minimal word size, MINWD, in (13), is at work (Feng 2003).

- (13) MINWD: Words are at least two syllables long.

Following Struijke (2000), we assume that reduplication involves correspondence of an input segment with multiple output segments. The

configuration in (14) illustrates. For unreduplicated words shown in (14a), segments of the input and output are in one-to-one correspondence. For reduplicated forms, we assume that segments of the input that undergo copy have multiple correspondents in the output, as shown in (14b).



This approach regards reduplication as violating INTEGRITY-PP, in (15), which forbids multiple correspondence between the phonological input and the phonological output (McCarthy & Prince 1995).

- (15) INTEGRITY-PP: No phonological element of the input has multiple phonological correspondents in the output.

Distributive reduplication is limited to monosyllables alone. We suggest that it is the concomitant need to satisfy the minimal word constraint which compels violation of INTEGRITY-PP here. The tableau in (16) illustrates how ranking MINWD over INTEGRITY drives reduplication in monosyllabic classifiers.

(16) Monosyllabic classifier reduplication: MINWD >> INTEGRITY-PP

dun, RED <sub>DIST</sub>	MINWD	INTEGRITY-PP
☞ a. dundun		***
b. dun	*!	

In (16a), the distributive affix is realized through reduplication in the optimal candidate, satisfying MINWD and violating INTEGRITY-PP.<sup>5</sup> In (16b), INTEGRITY-PP is obeyed, but there is a fatal violation of MINWD. We note that MINWD is not top-ranked in Chinese. It will be dominated by another constraint to prevent augmentation outside of reduplicative affixation. See Feng (in prep.) for a complete analysis.

In contrast to monosyllables, disyllabic classifiers lack distributive affixed forms. How the grammar handles such cases is open to debate. A possible scenario is that inputs containing a distributive affix and disyllabic classifier map to the classifier alone, that is, with deletion of the distributive morpheme (e.g., /jialun + RED<sub>DIST</sub>/ → *jialun* ‘gallon’).<sup>6</sup> This violates a

5. See Feng (in prep.) for discussion of the fact that when reduplication occurs, it copies the entire monosyllabic base, giving *dundun*, rather than *dundu* or *dudun*.

6. This interpretation of the mapping in phonologically-conditioned gaps shares some similarities with that of Raffelsiefen (1999). Raffelsiefen posits an output in

MAX-MM constraint in the MP correspondence model. We suggest a morpheme-specific version, MAX-MM-DIST, in (17).

- (17) MAX-MM-DIST: A distributive morpheme in the input has a correspondent morpheme in the output.

Under the scenario described above, INTEGRITY-PP will prevent satisfaction of MAX-MM-DIST. The tableau in (18) shows these constraints' interaction. Subscripted numerals notate correspondence among morphemes. The output selected here, in (18a), is *jialun* 'gallon', in which there is no reduplication and the distributive meaning is not expressed. The reduplicated form in (18b) is ruled out because it violates INTEGRITY-PP.<sup>7</sup>

(18) Disyllabic classifiers not reduplicated: INTEGRITY-PP >> MAX-MM-DIST

jialun <sub>1</sub> , RED <sub>DIST,2</sub>	MINWD	INTEGRITY-PP	MAX-MM-DIST
☞ jialun <sub>1</sub>			*
jialun <sub>1</sub> jialun <sub>2</sub>		*!*****	

Importantly, MINWD does not come into play in (18), as it is obeyed by both candidates. The distributive affix thus fails to attach to disyllabic classifiers because augmentation is not needed to meet the minimal word constraint. This distinguishes disyllabic classifiers from monosyllabic ones.

We posit a MAX-MM constraint specific to the distributive morpheme because ineffability does not arise in other reduplicative affixation in the language, such as the adjective intensification discussed in the next section. Since distributive reduplication is the only reduplicative affix that appears solely when driven by the need to satisfy MINWD, its MAX-MM constraint must be ranked lower in the hierarchy. Other research has identified the need for faithfulness constraints referencing specific morphemes or morpheme categories (e.g., Smith 1999, Walker 2000, Iscrulescu 2003). Whether the lower ranking status of distributive morpheme faith in Chinese can be subsumed under a more general ranking of faithfulness for wider morpheme categories is an issue for further study.<sup>8</sup>

In summary, the distributive reduplicative affix in Chinese appears only when it serves to augment the size of the word to meet the minimal

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such circumstances that is the same as the input, with affixes unattached.

7. The classifier *jialun* is monomorphemic, an exception to the tendency for monosyllabic morphemes.

8. As mentioned above, the selected output in (18) is a possible scenario for an ineffable affix. It is also conceivable that an input containing a disyllabic classifier and the distributive affix maps to an ungrammatical form. This might be implemented by locating MAX-MM in Gen and utilizing a constraint in the CONTROL component proposed by Orgun & Sprouse (1999), which contains constraints that must be obeyed by grammatical forms of the language.

word requirement, i.e. only with monosyllabic classifiers. Otherwise, in the case of disyllabic classifiers, reduplication is barred by INTEGRITY-PP.

### 3.2. Double affixation

Feng (2003) proposed ALIGN[ $\sigma$ ] to capture the isolating characteristic of Chinese whereby each morpheme corresponds to one syllable, and vice versa. ALIGN[ $\sigma$ ] requires perfect alignment between morphemes and syllables. It is a cover constraint that collapses the following four alignment constraints (McCarthy and Prince 1993b).

- (19) ALIGN(Morpheme, Left; syllable, Left)  
 ALIGN(Morpheme, Right; syllable, Right)  
 ALIGN(Syllable, Left; morpheme, Left)  
 ALIGN(Syllable, Right; morpheme, Right)

Feng argues that this isolating characteristic shapes the intensifying reduplication of Mandarin Chinese adjectives, which takes the form of an AABB pattern (A and B each refer to one syllable). For example, *ganjing* ‘clean’, a compound which literally means ‘dry and clean’, is reduplicated as *ganganjingjing* ‘clean (intensified)’.

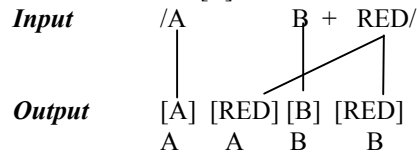
(20) Mandarin intensifying reduplication in adjectives

<u>Base</u>	<u>Lit. translation</u>	<u>Gloss</u>	<u>Reduplicated form</u>	<u>Gloss</u>
a. <i>ganjing</i>	‘dry+clean’	‘clean’	<i>ganganjingjing</i>	‘clean (int.)’
b. <i>mingbai</i>	‘bright+white’	‘clear’	<i>mingmingbaibai</i>	‘clear (int.)’
c. <i>qingsong</i>	‘light+loose’	‘relaxed’	<i>qingqingsongsong</i>	‘relaxed (int.)’
d. <i>piaoliang</i>	‘pretty+bright’	‘beautiful’	<i>piaopiaoliangliang</i>	‘beautiful (int.)’

In the reduplicated forms above, a single reduplicative intensifying morpheme appears twice in the output (Feng, in prep.). We refer to this pattern as double affixation. It is similar to the English *-er* suffixation in §1, which is another example of double affixation. Additional cases are discussed by Inkelas & Zoll (2000) and Kurisu (2001). The claim that reduplication in (20) shows duplicate expression of an input’s single morpheme finds support beyond the language’s isolating property, captured by ALIGN[ $\sigma$ ]. First, the AA and BB sequences in the above data do not exist as independent words, e.g., *gangan* and *jingjing* are not meaningful constituents. Second, reduplication in the AABB pattern denotes a single, unitary meaning: it intensifies the meaning of the entire base compound. Moreover, it has the same interpretation as intensification of a monosyllabic base, e.g., *hong* ‘red’ / *honghong* ‘very red’, in which the RED morpheme unambiguously appears only once.

The input-output correspondence for a reduplicated AABB form is shown in (21). One input RED morpheme appears twice in the output. This obeys ALIGN[ $\sigma$ ], as each syllable is aligned with one morpheme.

(21) Satisfaction of ALIGN[σ] in the AABB reduplication pattern



Although the above configuration shows that ALIGN[σ] is satisfied, the output nevertheless violates another constraint, INTEGRITY-MM. This is because the RED morpheme has multiple correspondents in the output.

(22) INTEGRITY-MM: No morpheme in the input has multiple correspondents in the output.

The ALIGN[σ] constraint is enforced here at the cost of INTEGRITY-MM. The tableau in (23) illustrates with the example of /ganjing+RED<sub>INT</sub>/ together with schematic forms using A and B to denote syllables. Square brackets mark morpheme boundaries, and again, subscripted numerals mark correspondence among morphemes. We simplify by showing just one “\*” for each candidate violating ALIGN[σ], because the first violation is fatal.

(23) Double Affixation: ALIGN[σ] >> INTEGRITY-MM

gan <sub>1</sub> jing <sub>2</sub> +RED <sub>INT,3</sub>	ALIGN[σ]	INTEGRITY-MM
a. [A] <sub>1</sub> [B] <sub>2</sub> [AB] <sub>3</sub> [gan] <sub>1</sub> [jing] <sub>2</sub> [ganjing] <sub>3</sub>	*!	
b. [A] <sub>1</sub> [A[B] <sub>2</sub> B] <sub>3</sub> [gan] <sub>1</sub> [gan[jing] <sub>2</sub> jing] <sub>3</sub>	*!	
☞ c. [A] <sub>1</sub> [A] <sub>3</sub> [B] <sub>2</sub> [B] <sub>3</sub> [gan] <sub>1</sub> [gan] <sub>3</sub> [jing] <sub>2</sub> [jing] <sub>3</sub>		*

Candidate (23a) is the regular full reduplication candidate where the second AB sequence is considered the realization of the intensifying RED morpheme. It violates ALIGN[σ]. In (23b), the first A and B constituents are the original morphemes in the compound. The second A and B compose a discontinuous reduplicant morpheme. This candidate also violates ALIGN[σ] because the right edge of the second A and the left edge of the second B are not aligned to the corresponding morpheme boundary. The optimal candidate, (23c), as already shown, obeys ALIGN[σ] but violates dominated INTEGRITY-MM.<sup>9</sup> A further detail of the hierarchy not shown

9. Both syllables in the compound are reduplicated because both are morphological heads of the word. This is consistent with other studies finding that faithfulness to morphological heads may be prioritized (Revithiadou 1999). It is also apparent in Mandarin Chinese verb reduplication. In [V+V] verb compounds, both verbs are morphological heads (like in the English noun: singer-songwriter) and

here is that since the reduplication is not driven by MINWD, the constraint, MAX-MM-INT (INT refers to intensification), dominates INTEGRITY-PP to ensure reduplication occurs.

In summary, the AABB pattern in Chinese adjective reduplication involves double affixation driven by ALIGN[σ], which is independently motivated by other phenomena of the language (Feng 2003). Double affixation violates INTEGRITY-MM with the intensifying RED morpheme realized twice.

#### 4. Implications for Consistency of Exponence

We examine next issues surrounding the Consistency of Exponence Principle. We suggest that the MP correspondence model has the capacity to eliminate the need to stipulate this principle, utilizing violable constraints instead. Consistency of Exponence, given in (24), is a major principle in classic OT (McCarthy & Prince 1993a).

(24) Consistency of Exponence: No changes in the exponence of a phonologically-specified morpheme are permitted.

Our observations show, however, that Consistency of Exponence is violable in Anxiang, which is a Chinese dialect spoken in the Hunan Province in central China. Diminutive forms in Anxiang end in [Cəɾ], where “C” is a consonant copied from the stem, as shown in (25) (Da 1996).

(25) <u>Stem</u>	<u>Diminutive</u>	<u>Gloss</u>
p <sup>h</sup> a	p <sup>h</sup> ap <sup>h</sup> əɾ	‘claw’
ke	kekəɾ	‘square’
to	totəɾ	‘pile’
p <sup>h</sup> wu	p <sup>h</sup> wup <sup>h</sup> wəɾ	‘shop’
p <sup>h</sup> au	p <sup>h</sup> aup <sup>h</sup> əɾ	‘bulb’

We suggest it is no accident that the diminutive formation involves adding a full second syllable. Our claim is that this pattern is driven by ALIGN[σ]’s requirement that each morpheme occupy one syllable and vice versa. Underlyingly there is only a diminutive affix /-r/, which is the same form as in other dialects of Chinese (Da 1996). However, attaching /-r/ alone would cause violation of ALIGN[σ]. This constraint can be satisfied by recruiting additional material to augment the suffix. Augmentation is accomplished (in part) by copy of material from the stem. Importantly,

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both are reduplicated. In [V+O] verbs (where “O” is an object), only the verb is the morphological head, and it is reduplicated, but the object is not.

there is no underlying RED<sub>DIM</sub> morpheme.<sup>10</sup> We assume the [ə] is epenthetic, although it is also possible that it too is copied from the stem, and it undergoes reduction. In order to obey ALIGN[σ], the copied consonant must crucially be *part of* the diminutive morpheme; we call this “morpheme affiliate recruitment”. This violates IDENT-MM in our model, as defined in (26).

- (26) IDENT-MM: Let α be a morpheme in the input, and β be its correspondent morpheme in the output. If α has phonological content φ, then β has phonological content φ, and vice versa.<sup>11</sup>

As in cases of morphological reduplication, having a copied consonant violates INTEGRITY-PP, which evaluates phonological correspondence between the phonological input and output. Hence, ALIGN[σ] must dominate both this constraint and IDENT-MM, as shown in (27). “.” marks syllable boundaries. Again, square brackets signal morpheme boundaries and subscripted numerals show correspondence among morphemes.

(27) Morpheme affiliate recruitment: ALIGN[σ] >> IDENT-MM, INTEGRITY-PP

ke <sub>1</sub> , r <sub>2</sub>	ALIGN[σ]	IDENT-MM	INTEGRITY-PP
a. .[ke] <sub>1</sub> [r] <sub>2</sub> .	*!		
b. .[ke] <sub>1</sub> .kə[r] <sub>2</sub> .	*!		
c. .[ke] <sub>1</sub> . [kəR] <sub>2</sub> .		*	*

The unreduplicated candidate in (27a) is ruled out by ALIGN[σ]. If we compare (27b) and (27c), the only difference between the two candidates is that the [kə] in (27b) does not have any morphological affiliation. But in (27c), the optimal candidate, the copied and inserted material obtains the morphological status of being part of the diminutive morpheme. Another possible candidate that does not copy [k] but rather inserts a default consonant [t] will be ruled out by MAX-PM (which replaces DEP-SEG-IO). The copied material that obtains new morphological affiliation incurs a violation of IDENT-MM. This is forbidden by Consistency of Exponence. However, the Anxiang diminutive affixation pattern, which would be otherwise puzzling, is strongly suggestive that it is indeed violable. Violation of Consistency of Exponence has also been observed in Turkish

10. See Feng (in prep.) for arguments against an underlying diminutive suffix consisting of RED plus fixed /r/.

11. We note that it would not be desirable for IDENT-MM to be violated by the regular construction of prosodic structure. This might be achieved by restricting the phonological content over which it operates to segments and autosegments (e.g., features, tones, possibly moras), but this awaits further research. Thanks to Maria Gouskova for raising this point.

(Karabay, to appear) and in the Jian'ou Chinese dialect (Feng, in prep.).

## 5. Conclusions and Further Research

In conclusion, the Ternary Model of MP Correspondence subsumes and replaces constraints whose status was previously unclear in classic OT, such as REALIZE-MORPHEME and M-PARSE. In addition, the model provides a framework for modeling cases of double affixation, like Mandarin adjective reduplication and English *-er* affixation. Furthermore, it obviates the Principle of Consistency of Exponence with positive results. First, the implicit indexing that the principle necessitates is brought under the umbrella of Correspondence Theory. Second, cases such as the Anxiang dialect suggest that the principle is in fact violable.

The phenomena we have explored here and the approach we propose represent a starting point in bringing together morphological and phonological cross-mappings observed by many phonologists. In future work we foresee exploring several connected research questions involving applications of the MP correspondence model to other phenomena. One area involves identifying the full extent of correspondence relation types within the ternary model. In this direction, the utility of a UNIFORMITY-MP constraint is argued for in work by Feng (in prep.) on Beijing diminutive affixation and by Iscrulescu (2004) on Romanian fast speech. However, it remains to be explored whether all correspondence relation types that exist in PP mappings are also motivated in MM mappings and between M and P structure in the output. We observe that UNIFORMITY-MP duplicates the function of INTEGRITY-PM (and likewise for UNIFORMITY-PM and INTEGRITY-MP), which suggests that only one of the UNIFORMITY / INTEGRITY mappings is needed between M and P structure. In pursuing other relevant phenomena, future research is planned in the area of discontinuous morphemes and also in the rich topic of ineffability. We envision exploring applications and refinements of the MP correspondence model to address other cases of ineffability, such as those discussed by Orgun & Sprouse (1999) and Raffelsiefen (1999).

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