The Linearization of Morphological Weight

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Abstract

Affixation of moras is a standard analysis for many types of non-concatenative morphology (e.g. Lombardi and McCarthy 1991, Samek-Lodovici 1992, Davis and Ueda 2002*a*, Grimes 2002*b*, Davis and Ueda 2006, Álvarez 2005, Stonham 2007, Yoon 2008, Haugen and Kennard 2008). However, some basic questions about the nature of mora affixation have never been properly addressed, one of them being the question how moraic (and more generally prosodic) affixes are linearized with respect to their base. Based on a typological survey of mora affixation, we argue that morphological moras are assigned to a fixed position on their tier by morphology and cannot be dislocated by later processes. They are prefixed or suffixed to specific peripheral or prominent elements of their morphological bases on an affix-specific (i.e. phonologically arbitrary) basis. We thus extend the model of segmental affixation in Yu (2002, 2007) (cf. also Fitzpatrick 2004) where affixation targets a specific member of a set of crosslinguistically possible anchor points by lexical subcategorization to prosodic affixation. An important empirical prediction of the subcategorization-based system is that affix moras cannot move to different linear positions under the pressure of phonological constraints. We show that this prediction is correct and argue that apparent counterevidence in Keley-I gemination under the analysis of Samek-Lodovici (1992) is due to a morphological misinterpretation of the data. The alternative approach to the linearization of mora affixes based on the assumption of phonological morpheme dislocation suffers from a severe lack of empirical adequacy: it overgeneralizes and predicts pattern of mora affixation that are unattested and undergeneralizes since it cannot predict all existing patterns of mora affixation.

1. Introduction

One of the major assets of Autosegmental Phonology is that it allows to reduce procedural techniques of morphological exponence to a simple generalized

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concept of concatenation. In particular, the moraic approach to phonological length (Hayes 1989) gives rise to a maximally simple account of morphologically triggered gemination, vowel lengthening, and coda epenthesis: as affixation of a μ. Although mora affixation is a standard assumption in the literature on nonconcatenative morphology, some basic questions about the nature of mora affixation have never been properly addressed, one of them being their linearization.

In this paper, we argue that prosodic nodes are assigned to a fixed position on their tier by the morphology and cannot be dislocated by later processes. Prosodic nodes are prefixed or suffixed to specific peripheral or prominent elements of their morphological bases on an affix-specific (i.e. phonologically arbitrary) basis. We therefore extend the assumptions about segmental affixation in Yu (2002, 2007) (cf. also Fitzpatrick 2004) that affixation targets a specific member of a set of crosslinguistically possible anchor points by lexical subcategorization to prosodic affixation. An important empirical prediction of the subcategorization-based system is that the linearization of affix-μ's happens in a single step and it is impossible that an affix-μ moves to a different linear positions under the pressure of phonological constraints after the morphology has linearized it to a specific position in its base. Based on a typological survey of μ-affixation, we argue that this prediction is true and argue that apparent counterevidence such as Keley-I gemination under the analysis of Samek-Lodovici (1992) is due to a morphological misinterpretation of the data.

We proceed as follows: In section 2, we discuss the two major classes of affix linearization, one allowing the interaction/ordered application of morphological and phonological demands to linearize an affix, the other neglecting any affix dislocation to optimize phonological structure. An empirical survey lengthening morphology is presented in section 3 where we conclude that a fixed set of affixation pivots is able to predict all attested cases of μ-affixation. Several arguments against the alternative assumption that μ-affixes are linearized in a two-step procedure and can be dislocated under phonological pressure are presented in section 4. It is shown that such an approach overgeneralizes and undergeneralizes at the same time. We conclude in section 5.

2. Rule Ordering and Affix Linearization

2.1. Segmental Affixes

Theories for affix linearization can be divided into two major classes: **Phonological Dislocation** theories and **Morphological Pivot Affixation** theories. The former assume that affixes are prefixed or suffixed to their base but may infix under the pressure of phonological constraints (Moravcsik 1977, Prince and Smolensky 1993/2002, Stemberger and Bernhardt 1998, Halle 2003, Horwood 2002, Klein 2005) and the latter are based on the assumption that affixes are prefixes or suffixes to specific base positions (='pivots') and cannot be dislocated by phonological processes (Yu 2002, 2007). A classic instantiation of a phonological dislocation theory can be found in Prince and Smolensky (1993/2002) where it is argued that infixation in Tagalog (Bloomfield 1933, McCarthy and Prince 1993, Zoll 1996, Orgun and Sprouse 1999, Halle 2003, Klein 2005) is an instance of phonologically-motivated dislocation. The generalization for the placement of the actor focus affix –*um* is that it precedes all segmental material of a V-initial base (=*Prefixation*, (1-a)) but follows the first onset consonant for C-initial bases (=*Infixation*, (1-b)).

(1) *Tagalog* um-*Infixation* (Prince and Smolensky 1993/2002, Orgun and Sprouse 1999)

	Base	Actor Focus	
a.	abot	'reach for'	**um**abot
	aral	'teach'	**um**aral
b.	sulat	'write'	s**um**ulat
	gradwet	'graduate'	gr**um**adwet

The analysis for these facts in Prince and Smolensky (1993/2002) is based on the assumption that –*um* is a prefix that may dislocate inside its base in order to avoid the creation of additional marked coda consonants. The OT-implementation of this intuition is briefly illustrated in the tableau (2). A morpheme-specific Edgemost (or Align in, for example, McCarthy and Prince 1993, Zoll 1996, Orgun and Sprouse 1999) constraint demands that the affix *um*– must be realized as a prefix and is violated by any segment intervening between the *um*– and the left edge of the word. The markedness constraint *NoCoda penalizes any coda consonant and since it is ranked higher, dislocation of the affix (2-b) is predicted if it avoids an additional coda consonant.

(2) *Infixation as phonological dislocation* (Prince and Smolensky 1993/2002)

a. *V-initial Base*

um, abot		NoCoda	Edgemost(um,L)
☞	a. **u.m**a.bot	*	
	b. a.**um**.bot	**!	*
	c. a.b**u.m**ot	*	*!*

b. *C-initial Base*

um, tawag		NoCoda	Edgemost(um,L)
	a. **um**.ta.wag	**!	
☞	b. t**u.m**a.wag	*	*
	c. ta.**um**.wag	**!	**

This dislocation theory is crucially based on the simultaneous interaction of phonological and morphological rules/constraints that determine the place in the base where an affix is realized. Another implementation of phonological dislocation is the assumption that morphology linearizes an affix as prefix/suffix and that phonology applies afterwards, potentially dislocating the affix (Horwood 2002). An implementation of the Tagalog facts would be similar to the one in (2), with the only difference that the Edgemost/Align constraint is replaced with a Linearity constraint ensuring that the affix remains faithful to the underlying linearization as a prefix as can be seen in (3).

(3) *Infixation as Affixation und subsequent Phonological Dislocation* (Horwood 2002)

a. *V-initial Base*

um-abot		NoCoda	Linearity
☞	a. **u.m**a.bot	*	
	b. a.**um**.bot	**!	*
	c. a.b**u.m**ot	*	*!*

b. *C-initial Base*

um-tawag		NoCoda	Linearity
	a. **um**.ta.wag	**!	
☞	b. t**u.m**a.wag	*	*
	c. ta.**um**.wag	**!	**

Horwood (2002) argues that this account is superior to an EDGEMOST/ALIGN-based account since it avoids the misprediction of 'morphemic bitropism' where one morpheme can be forced to be aligned with the left and right edge of its base at the same time. In addition, typological tendencies about affix ordering (e.g. the preference for number markers to be more stem-inwards than case markers; Greenberg 1963) remain 'at best an accident, with cross-linguistically rerankable constraints in the phonological component positioning morphemes independently of any morphosyntactic or semantic principles' (Horwood 2002: 6+7).

Although phonological dislocation analyses capture an intuitive generalization about the Tagalog facts, there are a number of striking counterexamples to the claim that dislocation is phonologically optimizing (Fitzpatrick 2004, Yu 2007). A typical example is the nominalizing infix –*ni*– in Leti, an Austronesian language spoken on the island of Leti. The affix appears consistently after the first consonant of a C-initial base even though this makes syllable structure worse, not better. Thus the putative form ***ni**-*ka:ti* avoids the complex onset of *k*-**ni**-*a:ti*, and has otherwise the same amount of codas and onsets. Since complex onsets are well-established cases of phonologically marked structure, a phonological dislocation approach predicts that the Leti marker should not infix – contra to fact.

An alternative to phonological dislocation theories is the assumption of morphological pivot affixation as in Yu (2007). The only necessary assumption for an analysis of Tagalog is here that the affix is a prefix to the first base vowel. This simple subcategorization statement predicts the correct linearization of –*um* for all contexts.

(4) um ↔ $_{\text{Base}}[\ \ldots \_\_\_ \ \text{V}$

A crucial feature of pivot theories is that the set of pivots is strictly limited. The exhaustive list of pivots that are assumed in Yu (2007) is given in (5) (see Fitzpatrick 2004 for a slightly different inventory of anchor points).

(5) *Possible pivots for affixation* (Yu 2007)

a. **Initial pivot**
   - (i) First consonant/onset
   - (ii) First vowel/nucleus
   - (iii) First syllable

b. **Final pivot**
   (i) Final vowel/nucleus
   (ii) Final syllable
c. **Prominence pivot**
   (i) Stressed syllable
   (ii) Stressed vowel/nucleus

It has to be noted, though that the assumption of base-internal morphological pivots as a source of infixation is in principle independent of the possibility that in addition morphological prefixes and suffixes dislocate (infix) later due to phonological mechanisms. Yu (2007) explicitly rejects any phonological dislocation (or 'phonological readjustment') to account for infixation, and we think, with good reasons since a theory combining morphological *and* phonological infixation would not make any interesting empirical predictions. On the other hand, understanding morphological and phonological infixation as mutually exclusive theoretical options makes the morphological linearization of affixes an empirical area which provides evidence on the question whether morphological operations are carried out in parallel interaction with standard optimization (Wolf 2008, 2013), or are independent and derivationally prior to phonological optimization (Arregi and Nevins 2012). Whenever we refer in the following to morphological pivot affixation theories, we imply a restrictive theory of affixation that disallows any further dislocation at a later stage in the derivation.

The two major classes of affix linearization discussed above can be summarized as in (6) where the abbreviation 'P/S' stands for the morphological placement of an affix before or following all base material.

(6) *Theories of affix linearization*

Phonological dislocation		**Pivot affixation**	
P/S to the base	Preference for P/S + displacement	P/S to a pivot	Morphology
↓			
displacement			Phonology

In the domain of segmental affixation, Yu (2007) has argued convincingly for the morphological pivot affixation theory and against a phonological dislocation approach. In this paper, we investigate the linearization of affixes whose linearization properties are scarcely discussed in the theoretical literature: morphological μ's.

2.2. μ-Affixes

A striking argument for prosodic affixation in general and μ-affixation in specific is the existence of non-concatenative allomorphy, defined as the phenomenon that one morphological category is expressed through different non-concatenative operations. An instance of non-concatenative allomorphy can be found in the Shizuoka dialect of Japanese where the emphatic adjective is formed through either gemination (7-a), vowel lengthening (7-b), or insertion of an epenthetic nasal (7-c). The choice between these different allomorphs is phonologically predictable as is analyzed in detail in section 4.3.

(7) *Emphatic adjectives in Shizuoka Japanese* (Davis and Ueda 2006)

	Adjective		Emphatic Form			
a.	katai	'hard'	ka**t**ːai			
	osoi	'slow'	o**s**ːoi	CV.C̥. . .	⇒	CV.C̥ː. . .
	takai	'high'	ta**k**ːai			
b.	hade	'showy'	ha**n**de			
	ozoi	'terrible'	o**n**zoi	CV.C̬. . .	⇒	CV**N**.C̬. . .
	nagai	'long'	na**ŋ**gai			
c.	zonzai	'impolite'	z**o**ːnzai			
	supːai	'sour'	s**u**ːpːai	CVC.C. . .	⇒	CVːC.C. . .
	okːanai	'scary'	**o**ːkːanai			

The striking observation about the non-concatenative allomorphy in Shizuoka Japanese is now that all these three different strategies add prosodic weight to the first syllable: it is light in the normal adjective form but heavy in the emphatic adjective. The straightforward analysis for the Shizuoka Japanese emphatic adjective formation and similar patterns of length-manipulation is therefore the affixation of a morphological μ that must be realized through integrating it in the prosodic structure of its base Davis and Ueda (2002*b*, 2006).

Although there are numerous theories assuming μ-affixation (e.g. Lombardi and McCarthy 1991, Samek-Lodovici 1992, Davis and Ueda 2002*a*, Grimes

2002*b*, Davis and Ueda 2006, Álvarez 2005, Stonham 2007, Yoon 2008, Haugen and Kennard 2008), there is no consensus about the mechanism ensuring where in its base such an additional μ is realized. Even worse, the question of how the μ-affix is linearized is hardly ever explicitly discussed in detail with all its typological predictions. Before we undertake such a thourough discussion of the attested linearizations for μ-affixes in section 3, we briefly discuss the two major positions that exist in the literature to restrict a μ-affix to the position in its base where it is realized.

In the first analysis of morphological lengthening that assumed a μ-affix (Samek-Lodovici 1992), a version of a phonological dislocation theory for the μ-affix is assumed that is quite similar to the one in Prince and Smolensky (1993/2002) for segmental affixes. A constrain Left ensures that the μ is realized as close to the left edge of the word as possible: it is violated by every syllable intervening between the syllable that integrates the affix-μ and the left edge of the word. Similar implementations of phonological dislocation theories for μ-infixation can be found in the analysis for Shizuoka Japanese given in Davis and Ueda (2002*b*) and in Grimes (2002*a*) for gemination in Muskogean. Note that these Align-constraints, for example the definition in (8) from Davis and Ueda (2002*b*), are morpheme-specific.

(8) Align(μ_C,Wd) (Davis and Ueda 2002*b*: 4)
Align the emphatic mora with the beginning (left edge) of the word.

A slightly different version of μ-Align is sketched in the analysis for Hiaki in Haugen and Kennard (2008). A morphologically indexed constraint Affix-Left is violated by every segment between the segment dominated by the morphological μ and the left edge of the word. This is therefore a more restrictive dislocation approach since the constraint counts segments intervening between the μ and the word edge, not only syllables.

The theory of prosodic circumscription (Lombardi and McCarthy 1991, McCarthy and Prince 1990, McCarthy 2000), on the other hand, can be interpreted as a version of morphological pivot affixation in that affixes prefix or suffix to a specific anchor point in their base and this anchor point is potentially inside the base. The crucial assumption is that bases can be (recursively) delimited to certain prosodically defined portions and both parts (the 'outparsed' portion and the (extraprosodic) 'remainder') can then be targetted by further (morphological) operations. In the analysis of medial gemination in Choctaw in Lombardi and McCarthy (1991), a μ-affix is prefixed to a base form that is created through making the first μ of the base extraprosodic.

In the following sections, we explicitly argue against a phonological dislocation theory for μ-affixation (Samek-Lodovici 1992, Grimes 2002*a*, Davis and Ueda 2002*b*) where a morphological μ can dislocate inside its base in order to optimize phonological structure. The general prediction of a phonological dislocation approach to affixation is highly heterogeneous variation in the linearization options of single affixes, different affixes in specific languages and across languages since every combination of a high-ranked markedness constraint with bases and affixes of different phonological shape might lead to substantially different patterns of affix linearization. Thus constraints on vowel harmony might steer an infix containing a vowel to a position after a harmonizing syllable under affixation to a disharmonic base, whereas the same affix might undergo local dislocation due to syllabic well-formedness when attached to a harmonic base. We argue in section 4 that these predictions are problematic. In contrast, we argue for a morphological pivot affixation theory assuming a rather small set of possible pivots for μ-affixation and excluding any subsequent dislocation of affixes in the phonology. This predicts that infixation is rather stable inside and across languages. Neither the prosodic circumscription theory of Lombardi and McCarthy (1991) nor the ALIGNMENT-based theory of Davis and Ueda (2002*b*) make any predictions about *im*possible infixation patterns. Can a μ prefix/suffix to any prosodically delimited base? Can the ALIGNMENT constraint (8) refer to any prosodic constituent in the base?

The patterns of μ-affixation in the languages of the world are severely restricted to certain patterns and a theory allowing unrestricted infixation suffers from a serious overgeneralization problem as is discussed in the next section 3.

3. A Typology of Mora Affixation

In this section, we present an empirical survey of μ-affixation cases and conclude that a fixed set of pivots allows to predict all and only the attested cases of μ-affixation in the languages of the world.

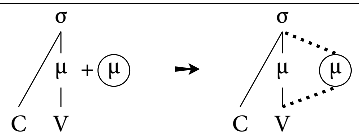
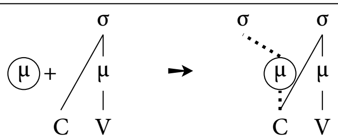
There are basically two types of morphological μ's. *First*, there are instances like Shizuoka Japanese where the augmentation of a μ is the sole exponent of a morpheme. *Secondly*, there are instances in the languages of the world where a segmental affix is always accompanied by lengthening of a base segment that is not phonologically predictable. An example is the plural suffix *–weʔ* in Zuni (9), that is always accompanied by lengthening of the preceding base vowel. This lengthening is not found in similar contexts with other suffixes and can therefore not be regarded as phonological process.

(9) *Plural suffix /–weʔ/ in Zuni* (Newman 1965, Saba Kirchner 2007)

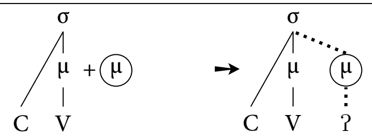
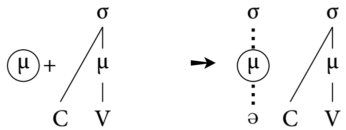
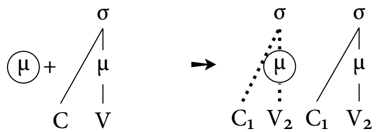
Base		Plural
lupa	‘box of ashes’	lup**aː**weʔ
homata	‘juniper tree’	homat**aː**weʔ
toːʃo	‘seed’	toːʃoːw
kʔapa	‘a deep container	kʔapaːw

For our empirical survey of the linearization of affix-μ’s, we ignore such instances of lengthening-triggering segmental affixes and only concentrate on the former type of affix-μ’s that constitute a morpheme on their own. For such an undertaking, a first obvious criterion is to classify the phenomenon in question as morphological and exclude any phonologically predictable reason for the lengthening. An empirical survey of μ-affixation is obviously a non-trivial task since the affixation of a μ as an abstract timing unit can result in different surface effects while not all specific surface outputs that may result from μ-affixation are necessarily the effect of a morphological μ. There are in principle five phonological strategies to realize an additional μ: vowel lengthening (10-a), consonant gemination (10-b), (coda) consonant epenthesis (10-c), vowel epenthesis (10-d), and reduplication (10-e).

(10) *Realization of a μ-affix (to be continued)*

a.	**Vowel lengthening**	
b.	**Gemination**	

(10) *Realization of a μ-affix (continued)*

c. C-Epenthesis	
d. V-Epenthesis	
e. Reduplication	

We classify vowel lengthening and consonant gemination as 'strictly μ-induced operations' since both trigger the longer realization of an underlying segment: inside a standard moraic theory, there is simply no other option than to represent those segments as augmented by an additional μ. Epenthesis and reduplication, however, are only 'potentially μ-induced' since additional segments are realized that were not present underlyingly. This actually opens up reasonable alternative theoretical explanations for these strategies that do not involve the addition of a μ. *First*, vowel-epenthesis and reduplication of at least one vowel could very well be the consequence of σ-affixation rather than μ-affixation (cf. Saba Kirchner 2010 for a recent discussion). And *second*, if a morphological category is expressed via segmental 'epenthesis' in all contexts, there is no way to distinguish these epenthetic segments from a 'normal' segmental representation for the morpheme in the lexicon. Since we wanted to reduce the empirical survey to cases where a μ-affixation analysis is one highly plausible theoretical account, we decided to include only those phenomena where at least one of the phonologically predictable allomorphs of a morpheme are 'strictly μ-induced' or where at least two 'potentially μ-induced' operations are phonologically predictable allomorphs of a morpheme. An example for an instance conforming to the former criterion would be Shizuoka Japanese (7) where a 'potentially μ-induced' process (coda epenthesis) alternates with two 'strictly μ-inducing' processes (gemination and vowel-lengthening); hence it is highly plausible to ascribe all of them to the affixation of a μ. Saanich, on the other hand is an example where multiple 'potentially μ-induced' allomorphs cooccur. The continuative is formed through ʔ-insertion and CV reduplication as can be seen in (11)[1] – one of these 'potentially μ-induced' allomorphs would not have been sufficient to include it in the sample but the coexistence of both qualifies it as plausible μ-affixation example.

(11) *Continuative allomorphy in Saanich* (Turner 2007, Kurisu 2001)

	Non-Continuative		Continuative
a.	*Reduplication*		
	'k^{w}ey	'to get hungry'	'k^{w}e'k^{w}ə'y
	'ta'k^{w}	'to go home'	'ta'tə'k^{w}
	k^{w}ečəŋ	'to yell'	k^{w}ə k^{w}ečəŋ'
b.	*ʔ-insertion*		
	weqəs	'to yawn'	weʔqes
	hes-əŋ	'to sneeze'	heʔsəŋ'
	ʔiɬən	'to eat'	ʔiʔɬən

Cases of templatic morphology where a whole base is adjusted to conform to some C/V-template are ignored for this survey as well although they may involve lengthening, gemination, and/or segment insertion and μ-affixation may ultimately be (part of) the correct analysis for these data.[2] As for reduplication and/or epenthesis, alternative theoretical accounts involving the affixation of larger prosodic units than the μ are reasonable and in most cases even required for templatic morphemes. We also excluded languages where the length-manipulation affects the vowel in monosyllabic bases since nothing interesting about the linearization of a μ-affix can be deduced from such facts: every vowel is the first and the last of its base at the same time. An example for such excluded facts are length-manipulation in various Western Nilotic languages where bases are systematically monosyllabic.

The three criteria for the empirical survey of μ-affixation discussed above are summarized in (12).

[1] There are other continuative allomorphs in Saanich, one of them being a lexically listed ablaut pattern (Montler 1986, Turner 2007, Leonard and Turner 2010).

[2] For a recent discussion, see, for example, Bye and Svenonius (2012).

(12) The set of phonologically predictable allomorphs *A* expresses a morphological category *M*

a. **μ-affixation**
Either (i) or (ii) holds:
(i) a 'strictly μ-induced' operation (gemination, vowel lengthening) is one operation in *A*
or
(ii) at least two different strategies from the set of 'potentially μ-induced' operations (C- or V-epenthesis, μ-sized reduplication) are part of *A*

b. **Exclusion of templatic morphology**
Not all forms expressing *M* through *A* conform to a prosodic shape that is not phonologically predictable.

c. **Relevance for linearization**
At least some bases to which *A* apply are polysyllabic.

Finally, we ensured that the sample is representative and typologically balanced and included a pattern only if there was not already a language belonging to the same language stock in the sample that shows the same non-concatenative pattern. For example, our sample includes a case of initial gemination in Marshallese – a non-concatenative phenomenon that can be found in various other Austronesian languages as well (e.g. in Woleaian and Chuukese; Kennedy 2002) that are not in the sample in order to be typologically balanced. In total, our empirical study contains 26 cases of μ-affixation in 24 languages. All of the languages in the sample are listed in (13) together with their classification according to AUTOTYP (Bickel and Nichols ongoing). It can be seen that the 24 languages are distributed over 19 different language stocks.

(13) *Language sample (to be continued)*

	Language	**Stock**	**Area**	**Continent**
I.	Shizuoka Japanese	Japanese	N Coast Asia	N-C Asia
II.	Alabama	Muskogean	E North America	EN America
III.	Zuni	Zuni	Basin and Plains	EN America
IV.	Lardil	Tangkic	N Australia	Australia

(13) *Language sample (continued)*

V.	Gidabal	Pama-Nyungan	S Australia	Australia
VI.	Arbizu Basque	Basque	Europe	W and SW Eurasia
VII.	Slovak	Slavic	Europe	W and SW Eurasia
VIII.	Hausa	Chadic	African Savannah	Africa
IX.	Asante Twi	Kwa	African Savannah	Africa
X.	Luganda	Benue-Congo	E Africa[3]	Africa
XI.	Aymara	Jaqui	Andean	S America
XII.	Quechua	Quechuan	Andean	S America
XIII.	Guajiro	Arawakan	NE South America	S America
XIV.	Southern Sierra Miwok	Yokuts-Utian	California	WN America
XV.	Nootka	Wakashan	Alaska-Oregon	WN America
XVI.	Diegueño	Yuman	California	C America
XVII.	Saanich	Salishan	Alaska-Oregon	WN America
XVIII.	Upriver Halkomelem	Salishan	Alaska-Oregon	WN America
XIX.	Hiaki	Uto-Aztecan	Mesoamerica	C America
XX.	Shoshone	Uto-Aztecan	Mesoamerica	C America
XXI.	Tepecano	Uto-Aztecan	Mesoamerica	C America
XXII.	Tawala	Austronesian	Oceania	NG and Oceania
XXIII.	Keley-i	Austronesian	Oceania	S/SE Asia
XXIV.	Marshallese	Austronesian	Oceania	S/SE Asia

The leading question in generating the sample was where in its base a μ-affix is realized. In Shizuoka Japanese (7), for example, the additional μ was realized in the first syllable, on the first vowel or the first coda consonant. What are possible other linearizations of μ-affixes in the languages of the world? A very locus for a μ-affix is the final vowel, as in Gidabal (14) where the imperative is marked through lengthening of the final vowel.

[3]This differs from the classification in the AUTOTYP database that lists Luganda as an South African language. This is clearly a mistake since it contradicts all standard classifications of the language, cf., for example, Clements (1986). Thanks to Larry Hyman for pointing this out to us.

(14) *Gidabal* (Geytenbeek and Geytenbeek 1971, Kenstowicz and Kisseberth 1977)

Base		Imperative
gida	'to tell'	gid**aː**
ma	'to put'	m**aː**
jaga	'to fix'	jag**aː**
gaːda-li-wa	'keep on chasing'	gaːdaliw**aː**

Another possible locus for the realization of the additional μ is after its base, i.e. through epenthesis at the right edge. An example can be found in Aymara, where final vowel lengthening and insertion of epenthetic *–ja* predictably alternate, the former occurring whenever two lengthening morphemes are expected to cooccur (15-c).

(15) *Aymara* (Beesley 2000, Hardman 2001, Kim 2003)

a.	sara	'go'	sar**aː**	'(I) will go'
b.	warmi	'women'	warm**iː**	'to be a women'
c.			warmi**jaː**	'I will be a women'

Similarly, there are patterns where a morphological μ is realized on the first vowel (16-a) or its realization alternates between the first vowel and inserted elements preceding the first base segment (16-b).

(16) *Initial vowel lengthening*

a. *Hiaki* (Molina 1999, Haugen 2005, 2008, Harley and Leyva 2009)

stem		habitual
ivakta	'embrace'	**iː**vakta
jepsa	'arrive'	j**eː**psa
wokte	'put on pants'	w**oː**kte

b. *Upriver Halkomelem* (Elmendorf and Suttles 1986, Galloway 1993, Suttles 2004, Shaw 2004)

non-continuative		continuative
i. Vowel lengthening		
ʔiməç	'walk'	ʔ**iː**məç
hilt	'roll sth. over'	h**iː**lt
hɛkʼʷələs	'remember sth.'	h**ɛː**kʼʷələs

c.

NON-CONTINUATIVE		CONTINUATIVE
ii. CV-reduplication		
q'isət	'tie sth.'	**q'i**q'əsət
jiq	'fall (of snow)'	**ji**jəq
mat'əs	'point, aim'	**ma**mət'əs
iii. CV-epenthesis		
məq'ət	'swallow sth.'	**h**əmq'ət
$wəq'^{w}$	'drift downstream'	**h**əwq'^{w}
$jəq^{w}$	'burn'	**h**ɛjq^{w}

And finally, gemination can be located on the first consonant (17-a), the first coda consonant (17-b) or the final onset (17-c) or coda (17-d) consonant.

(17) *Loci for gemination*

a. *Luganda* (Clements 1986, Hyman and Katamba 1990, Kawahara 2007)

STEM		CLASS 5
kubo	'path'	**kː**ubo
daːla	'step'	**dː**aːla
fumu	'spear'	**fː**umu

b. *Shoshone* (McLaughlin 1982, Crum and Dayley 1993, Haugen 2008)

STEM		DURATIVE
katɨ́	'sit'	ka**tː**ɨ
jɨkwí	'sit.pl'	jɨ**kː**wi
nemi	'travel'	ne**mː**i

c. *Alabama* (Montler and Hardy 1988, Lombardi and McCarthy 1991)

STEM		IMPERFECT
balaː-ka	'lie down'	bá**lː**aːka
cokoː-li	'sit down'	có**kː**oːli
ilkowat-li	'move'	ilkó**wː**atli

d. *Asante Twi* (Paster 2010)

BASE		PAST (+OBJ)
nom	'to drink'	no**mː**

The table in (18) now summarizes all the different loci of μ-realization in our sample. The ∎ indicates on which or between which segments the length manipulation is visible; if there is more than one ∎ present in one line, this simply indicates that a μ-affix is realized through different non-concatenative allomorphs, the choice between them being phonologically predictable. Multiple listings of the same language simply encode the fact that some languages employ different μ-affixes. Note that according to the definition in (12), lexically listed allomorphs of one morpheme are regarded as patterns of their own as well, a pattern that appears in Hiaki.

(18) *Loci of μ-realization: summary*

	Language	#	(C)		V		C	…	C	V	(C)	#
1.	Saanich	■		■		■						
2.	Tawala	■			■							
3.	U. Halkomelem	■			■							
4.	Luganda		■									
5.	Marshallese		■									
6.	Keley-i I		■									
7.	Hiaki I				■							
8.	Sh. Japanese				■	■	■					
9.	Tepecano						■					
10.	Keley-i II						■					
11.	Shoshone						■					
12.	Hiaki II						■					
13.	Alabama								■	■		
14.	Arbizu Basque									■		
15.	Gidabal									■		
16.	Zuni									■		
17.	Hausa									■		
18.	Diegeño									■		
19.	Slovak									■		
20.	Nootka									■		
21.	Asante Twi									■	■	
22.	Guajiro									■		■
23.	Quechua									■		■
24.	Lardil									■		■
25.	S. Sierra Miwok									■		■
26.	Aymara									■		■

The most important generalization one can draw from this summary is the simple fact that no μ-affix is realized on or between segments that are more inward in its base than the first coda consonant or last onset consonant. The table in (19) gives an overview over the analyses for all the μ-affixation patterns in terms of the pivot to which the μ-affix prefixes or suffixes. The affixed μ is circled in all depictions to distinguish it from the base μ's.[4]

(19) *Loci of μ-realization: pivots*

Language	**Pivot**	*Examples*
Saanich	#μ __	μ (μ) s ə q μ (μ) μ μ w e ʔ q ə s μ (μ) μ q e q ə n
Tawala	#__μ	(μ)μ μ μ t ał t a w a (μ) μ μ g e g a e
Hiaki I	#__μ	(μ)μ μ μ ił v a k t a
Upriver Halkomelem	#μ __	(μ)μ h i l t (μ) μ μ q i q ə s ə t (μ) μ h ə m q ə t
Luganda, Marshallese, Keley-i I	#__μ	(μ) μ μ k u b o
Sh. Japanese	#μ __	μ (μ) μ h a n d e μ (μ) μ k a tł ai μ (μ) μ z o n z ai
Tepecano, Shoshone, Hiaki II, Keley-i II	#__μ	μ (μ) μ j ɨ kł w i
Alabama	__μ #	μ (μ)μ b a l ał μ (μ) μ c o bł a
Gidabal, Zuni, Hausa, Diegeño, Slovak, Nootka	μ __#	μ μ(μ) j a g ał
Asante Twi	μ __#	μ μ μ(μ) o b i s ał μ (μ) n o mł
Quechua, Lardil, S. Miwok, Aymara	μ __#	μ μ μ(μ) j o h k ał μμ μ μ (μ) h ał j a ŋ k ɨ

[4]Note that morphological pivot affixation for μ's presupposes that stems are equipped with a full prosodic structure at the point where affixation occurs. This follows in a theory assuming cyclic optimization (Trommer 2011, Kiparsky 2011, Bermúdez-Otero 2011, in preparation), a background assumption that is implicit in other subcategorizations approaches referring to prosodic structure as well (e.g. Paster 2005).

Our conclusion of this empirical survey is therefore simple: the locus of affix-μ's is restricted in a way that allows to sufficiently describe all and only the attested cases of μ-affixation cases with the two pivots in (20).

(20) *Pivots for μ-affixation*
first μ
last μ

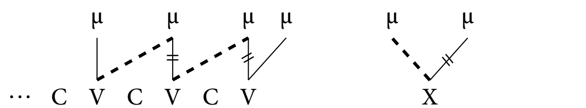
Any dislocation that follows the morphological placement of a μ-affix is excluded in our theory. As was discussed in section 2.1, this ban on phonological dislocation is in principle independent from the adoption of morphological pivot affixation but a crucial part of the original proposal of morphological pivot affixation in Yu (2007). In addition, we take it for granted that reordering is generally impossible on the segmental as well as on the prosodic level, i.e. there is no true metathesis. All surface effects of metathesis are consequently the result of deletion and insertion instead of true reordering (Zimmermann 2009).[5] From these assumptions it follows that the phonological operations triggered by a μ-affix are always located exactly on/adjacent to the μ/σ-pivot to which the μ affixes.

4. Against Phonological μ-Dislocation

In this section, we present several arguments against the alternative approach that linearization of μ-affixes is due to phonological dislocation. We argue that such an approach is too unrestrictive and predicts various instances of μ-affixation that are not attested in the languages of the world (21-a+b) but

[5] A final crucial assumption we make is the general absence of μ-shifting, i.e. configurations where a μ newly associates to a segment X while a μ that was underlyingly associated to X deassociates and associates newly to an adjacent segment Y, depicted in (i-a). We take it for granted that such configurations are generally excluded since Gen fails to generate structures violating the principle of 'No vacuous μ-association' (i-b).

(i) *a. μ-Shifting* *b. No vacuous μ-association*



empirically inadequate at the same time since it fails to predict all attested patterns of μ-affixation (21-c+d).

(21) *Arguments against phonological μ-dislocation*

a. Lack of non-local infixation (subsection 4.1)
b. Lack of variable infixation (subsection 4.2)
c. Cases of fixed infixation (subsection 4.3)
d. Morphologically contrastive μ-affixes (subsection 4.4)

Before we discuss these points in detail, let's briefly recap how a phonological dislocation approach for μ-linearization works. The approaches in Samek-Lodovici (1992), Grimes (2002*a*), Davis and Ueda (2002*b*), and Haugen and Kennard (2008) all assume that a morpheme-specific version of ALIGN demands that a certain morpheme must be realized at the left or right edge but that phonological markedness constraints can be higher-ranked that this preference for being a prefix or suffix. In (22) +(23), two simple exemplifying derivations for phonological dislocation of morphological μ's are given. (22) derives a language as Gidabal (14) with final vowel lengthening and (23) a language as Shoshone (17-b) with gemination of the first coda consonant. The superscript μ in all following candidates is the affix-μ. In the following, we define the morpheme-specific ALIGN as in Haugen and Kennard (2008) meaning that it is violated by every segment between the left/right edge and the segment associated with the μ. In Gidabal, consonant gemination is impossible and thus no available strategy to realize the additional μ – the winning candidate (22-a) consequently realizes the μ on the last vowel under perfect satisfaction of ALIGN(μ_{IMP},R).

(22) *Long vowels in Gidabal*

gida, μ	*Cː	ALIGN(μ_{IMP},R)	*Vː
☞ a. gida$^{\mu}$ [gidaː]		*	*
b. gid$^{\mu}$a [gidːa]	*!	**	

In Shoshone on the other hand, vowel lengthening is excluded by high-ranked constraints and since initial geminates are illicit in the language (high-ranked *#Cː), the affix-μ dislocates insides its base to be realized on the first coda consonant. This strategy (23-c) violates ALIGN(μ_{DUR},R) twice since two segments intervene between the *k* and the left edge of the word.

(23) *Geminates in Shoshone*

μ, maka	*#Cː	*Vː	ALIGN(μ$_{DUR}$,L)	*Cː
a. m^{μ}aka [mːaka]	*!			*
b. ma^{μ}ka [maːka]		*!	*	
☞ c. mak^{μ}a [makːa]			**	*

4.1. Lack of Non-Local Infixation

A first overgeneralization problem for phonological disfixation accounts is that they inherently predict non-local μ-infixation. In section 3, we argued that the pivots first and last μ and first σ are sufficient to describe all attested patterns of μ-affixation. A pattern where a segment further right than the second base vowel or further left than the penultimate vowel is affected by the affix-μ cannot be derived with these four pivots but is predicted in a phonological dislocation account. An example for such an unattested pattern of non-local μ-affixation is illustrated in (24) with the pseudo-language Shoshone′ where it is always the second base vowel that is lengthened in the derived form.

(24) *Non-local gemination in unattested Shoshone′*

BASE	μ-AFFIXED FORM
gadali	gada**l**ːi
pukalimbu	puka**l**ːimbu
sanagumkilte	sana**g**ːumkilte

In the tableau (26) it is shown how such a pattern is predicted in a theory assuming that a morphological μ can in principle dislocate inside its base. It is a well-known fact that some prominent position inside a word are especially resistent against phonological changes, amongst them being the first syllable (Beckman 1997, 1998). If now the positional faithfulness constraint (25) preserves the initial syllable from changing the length-value of all segments inside the first syllable and if in the language gemination is the strategy to realize additional μ's, then a non-local pattern as in Shoshone′ emerges.

(25) DEP-AL$_{\#σ}$
Assign a violation mark for every new association line between a segment in the first syllable and a μ.

(26) **Shoshone′*

μ, sanagumkil	*Vː	Dep-AL$_{\#\sigma}$	Align(μ,L)	*Cː
a. sa$^{\mu}$nagumkil (saːnagumkil)	*!	*	*	
b. san$^{\mu}$agumkil (sanːagumkil)		*!	**	*
c. sana$^{\mu}$gumkil (sanaːgumkil)	*!		***	
☞ d. sanag$^{\mu}$umkil (sanagːumkil)			****	*

On the basis of our empirical survey of attested μ-affixation cases (cf. (18)), we claim that this is a serious misprediction since such patterns of non-local μ-infixation are unattested in the languages of the world.

4.2. Lack of Variable Infixation

A second general pattern of μ-linearization that is predicted by phonological dislocation approaches but is unattested in the languages of the world is variable μ-infixation, i.e. the realization of an affix-μ in different positions in its base, depending on the shape of the base. An example for a language displaying variable infixation is given in (27). In this pseudo-language Shoshone″, the leftmost consonant that can be geminated without creating an illicit coda cluster is lengthened.

(27) **Shoshone″*

Base	μ-affixed form
petali	pe**tː**ali
mantaku	manta**kː**u
malkuftika	malkufti**kː**a

The tableau in (29) sketches how such a pattern is predicted under a phonological dislocation approach, in fact it is predicted from the very ranking assumed in (23) for the attested gemination in Shoshone: high-ranked *Vː demands infixation of the μ to a coda consonant, under violation of Align(μ,L) (29-I). This ranking predicts that the affix-μ should dislocate further into its base as soon as it is attached to a base where the leftmost base consonant cannot be geminated without creating an illicit CVCC-syllable (29-II+III). We take it for granted that initial geminates are illicit, as in the real Shoshone (23). *#Cː is therefore again taken as undominated and not included in the tableaux.

(28) *Complex (Kager 1999)
Assign a violation mark for every complex syllable margin.

(29) *Derivation of Shoshone″*

			*Complex	*V:	Align(μ,L)	*C:
I.	μ, petali					
	a. pe$^{\mu}$ta.li	(pet:ali)		*!	*	
☞	b. pet$^{\mu}$a.li	(pet:ali)			**	*
II.	μ, mantaku					
	a. ma$^{\mu}$n.tan.ku	(ma:kantu)		*!	*	
	b. man$^{\mu}$ta.ku	(man:taku)	*!		**	*
☞	c. mantak$^{\mu}$u	(mantak:u)			*****	*
III.	μ, malkuftika					
	a. ma$^{\mu}$l.kuf.ti.ka	(ma:lkuftika)		*!	*	
	b. mal$^{\mu}$kuf.ti.ka	(mal:kuftika)	*!		**	*
	c. mal.kuf$^{\mu}$ti.ka	(malkuf:tika)	*!		*****	*
☞	d. mal.kuf.tik$^{\mu}$a	(malkuftik:a)			********	*

A morphological pivot affixation approach where any dislocation of a morphological μ is impossible, cannot predict such a 'wandering μ' pattern, We argue that this prediction is borne out since no such language as Shoshone″ exists.

A potentially problematic case that apparently exhibits exactly this pattern is morphological gemination in Keley-i under the analysis of Samek-Lodovici (1992). There it is argued that verbs in the language exhibit morphological non-perfect (present and future) gemination of the leftmost consonant that can be geminated, i.e. the first intervocalic consonant in its base. The examples in (30) show cases of gemination in future forms. Note that as in many Philippine languages, Keley-i verbs show inflection indicating whether the clause 'focusses' on a.) the subject, b.) the object or a specific other DPs: c.) 'accessory' focus (=Accs.) indicates focus on instrumentals, d.) 'referent' focus (=Ref) is used for objects 'in a particular region of time or space' (Hohulin and Kenstowicz 1979: 243), and finally there is e.) a 'beneficial' focus.

(30) *Non-perfect gemination* (Hohulin and Kenstowicz 1979)

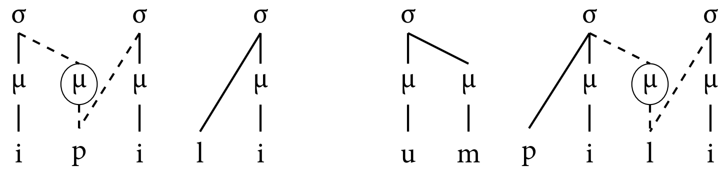
ACCS.FOCUS	BEN.FOC
ʔi-**p**ːili	ʔi-**p**ːili-ʔan
ʔi-**d**ːujag	ʔi-**d**ːujag-an

SUBJ.FOCUS	OBJ.FOCUS	REF.FOC
um-pi**l**ːi	pi**l**ːi-ʔen	pi**l**ːi-ʔan
um-du**j**ːag	du**j**ːag-en	du**j**ːag-an

The examples in (30) indeed suggest the interpretation given in Samek-Lodovici (1992): the leftmost consonant that can be geminated without creating an illicit CVCC-syllable is lengthened in order to distinguish future and present from the past. Whenever the prefix ʔ*i*– precedes a base, the base-initial consonant can be geminated as in ʔ*imːapili* (31-a). However, if a prefix like *um*– ending in a coda consonant is attached to a C-initial base, the base-medial consonant is geminated as in *umpilːi* (31-b) since a structure like **umpːili* is illicit in Keley-i. Such a state of affairs cannot be derived given the assumption of morphological pivot affixation for μ's.

(31) *Gemination in Keley-i*

a. Initial gemination *b. Medial gemination*



A closer look at the morphological system, however, reveals the fact that root-initial and root-medial gemination in Keley-i are two different morphophonological processes (Hohulin 1971, Hohulin and Kenstowicz 1979, Archangeli 1987, Lombardi and McCarthy 1991). Root-initial gemination shows up only immediately after the prefix ʔ*i*–, an affix with a highly heterogeneous distribution in Keley-i. In finite non-stative forms, it is restricted to non-perfect (present and future) verb forms of the accessory and beneficial focus, in imperatives it appears only in the non-perfect accessory focus, whereas it extends to perfect (past forms) in the stative paradigm. Root-initial gemination occurs in a subset of these contexts, the non-past uses of ʔ*i*–.

(32) *Non-perfect root-initial gemination* (Hohulin and Kenstowicz 1979)

	Access.Focus	Ben.Foc	
Fut	ʔi-**p**ːili	ʔi-**p**ːili-ʔan	
Past	ʔim-pili	ʔim-pili-ʔan	'to choose'
Pres	ke-ʔi-**p**ːili	ke-ʔi-**p**ːili-ʔi	
Fut	ʔi-**d**ːujag	ʔi-**d**ːujag-an	
Past	ʔin-dujag	ʔin-dujag-an	'to pour'
Pres	ke-ʔi-**d**ːujag	ke-ʔi-**d**ːujag-i	

Root-medial gemination has a more straightforward distribution and occurs regularly in (stative and non-stative) non-past subject, object and referent focus forms of roots with a single root-medial consonant.

(33) *Non-perfect root-medial gemination* (Hohulin and Kenstowicz 1979)

	Subj.Focus	Obj.Focus	Ref.Foc	
Fut	um-pi**l**ːi	pi**l**ːi-ʔen	pi**l**ːi-ʔan	
Past	p-imː-ili	p-in-ili	p-in-ili-ʔan	'to chose'
Pres	ka-ʔum-pi**l**ːi	ke-pi**l**ːi-ʔa	ke-pi**l**ːi-ʔi	
Fut	um-du**j**ːag	du**j**ːag-en	du**j**ːag-an	
Past	d-imː-ujag	d-in-ujag	d-in-ujag-an	'to pour'
Pres	ka-ʔum-du**j**ːag	ka-du**j**ːag	ka-du**j**ːag-i	

What generates the appearance that root-initial and root-medial gemination are due to the same affix-μ is their partially complementary morphological distribution. In finite non-stative forms, root-initial gemination is found in the accessory and beneficial focus, and root-medial gemination in the subject, object and referent focus. This is summarized in (34) where the lightly shaded background indicates the cells where initial gemination occurs and the darker shaded background those contexts where medial gemination occurs. Since all Keley-i non-stative verb forms belong to one of these five foci, there seems to be only one gemination process. However in verb forms such as stative non-perfect forms the complementarity of distribution breaks down, and both gemination processes show up. An example for such a contexts is given in (35).

(34) *Morphological analysis for Keley-i*

	Focus					
	Access.	**Ben.**	**Sbj.**	**Obj.**	**Ref.**	stative
Pst						ʔi–
Prs	ʔi–	ʔi–	ʔum–	ke–	ke–	ʔi–
Fut	ʔi–	ʔi–	ʔum–			ʔi–

(35) *Initial and medial gemination in Keley-i* (Hohulin and Kenstowicz 1979)

		Pst	**Prs**	**Fut**
bitu	'to put'	ne-ʔi-bitw-an	ke-ʔi-**bːitː**u-ʔan	me-ʔi-**bːitː**u-ʔan

We can therefore conclude that it is not one μ in Keley-i that is realized in different positions in its base but two morphological μ's with different subcategorization requirements, one prefixes to the initial base-μ, the other suffixes to the first base-σ. The description in Hohulin and Kenstowicz (1979), the only source for morphological facts of Keley-i, is unfortunately rather sketchy and the lexical entries given in (36) for the two different μ's are consequently rather preliminary and include simply the different foci where the respective μ occurs listed as disjunctives.

(36) *There are two μ-affixes!*
I. μ/ [__μ ↔ [−pst, Access ∨ Ben ∨ Stat]
II. μ/ [σ__ ↔ [−pst, Sbj ∨ Obj ∨ Ref ∨ Stat]

As a matter of fact, the present tense forms of subject, benificial, and accessory focus reveals a second fatal problem for Samek-Lodovici's claim that there is a single μ-affix in Keley-i verb forms. As can be seen in the data in (32) and (33), two prefixes are added in these contexts: *ke–ʔi–* and *ka–ʔum–* respectively. Under Samek-Lodovici's analysis that a single affix-μ is simply realized on the first consonant that can be geminated, we would expect that the glottal stop of the prefixes *ʔi–* and *ʔum–* geminates in such forms resulting in, for example, **ke–ʔːi–pili* or **ka–ʔːum–pili* instead of *ke–ʔi–pːili* and *ka–ʔum–pːili*.

4.3. Cases of Fixed Infixation: Shizuoka Japanese

In the last two subsections, we discussed overgeneralization problems that a phonological dislocation approach to μ-affixation faces: it predicts patterns of μ-affixation that are unattested in the languages of the world. In the following two subsections, we argue that such an approach is also empirically inadequate in that it is unable to predict patterns that are attested.

The first argument is that a phonological dislocation approach is unable to predict instances of fixed infixation. A case at hand is μ-affixation in Shizuoka that was already discussed in the beginning of section 2.2. Recall that emphatic adjectives in Shizuoka Japanese (Davis and Ueda 2002*a*, 2006) are marked through one of three different phonological processes targeting roughly the edge between the first and the second syllable of the base: gemination of a voiceless intervocalic obstruent (37-a), insertion of a homorganic nasal coda before a voiced obstruent and after a short vowel (37-b), and lengthening of a vowel preceding a nasal coda or a geminate (37-c).

(37) *Emphatic adjectives in Shizuoka Japanese*Davis and Ueda 2006

	Adjective		Emphatic Form	
a.	katai	'hard'	ka**t**ːai	
	osoi	'slow'	o**s**ːoi	CV.C̥... ⇒ CV.C̥ː...
	takai	'high'	ta**k**ːai	
b.	hade	'showy'	ha**n**de	
	ozoi	'terrible'	o**n**zoi	CV.C̬... ⇒ CV**N**.C̬...
	nagai	'long'	na**ŋ**gai	
c.	zonzai	'impolite'	z**o**ːnzai	
	supːai	'sour'	s**u**ːpːai	CVC.C... ⇒ CVːC.C...
	okːanai	'scary'	**o**ːkːanai	

As was already mentioned in section 2.2, the choice between these three allomorphs to realize an additional μ is phonologically predictable. Whenever the first syllable of the base is closed by a coda consonant, vowel lengthening occurs (37-c). If the first base-syllable is open, the nature of the second onset consonant determines the choice of the allomorph: if the second syllable starts with a sonorant, nasal-insertion takes place (37-b) and if its starts with an obstruent, gemination surfaces (37-a). Before we turn to the linearization of the μ-affix, we briefly illustrate how this choice of allomorphs follows in (a simplified version of) the OT-analysis given in Davis and Ueda (2002*a*). σ-Cond in the following tableaux stands for a constraint stratum in which several standard markedness constraints on syllable structure are ordered; especially the demand that onsets are not moraic ($*_\sigma[C_\mu$), that voiceless obstruents should not be geminates (*C̬ː), and the ban against complex codas ($*CC]_\sigma$).

(38) *Choice between the allomorphs in Shizuoka Japanese*

a. *Gemination*

μ, katai		σ-Cond	*Vː	Dep n	*Cː
☞ a. kat$_{\mu}$ai	(katːai)				*
b. ka n$_{\mu}$ tai	(kantai)			*!	
c. ka$_{\mu}$tai	(kaːtai)		*!		

b. *Nasal insertion*

μ, hade		σ-Cond	*Vː	Dep n	*Cː
a. had$_{\mu}$e	(hadːe)	*C̬ː	*		*
☞ b. ha n$_{\mu}$ de	(hande)			*	
c. ha$_{\mu}$de	(haːde)		*!		

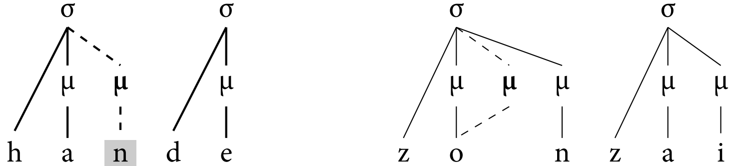
c. *Vowel lengthening*

μ, zonzai		σ-Cond	*Vː	Dep n	*Cː
a. zonz$_{\mu}$ai	(zon.zːai)	*$_{\sigma}$[C$_{\mu}$!	*		*
b. zon n $_{\mu}$zai	(zonn.zai)	*CC]$_{\sigma}$!		*	
☞ c. zo$_{\mu}$nzai	(zoːn.zai)		*		

Now we can turn to question of where this additional μ is realized. Crucially, as shown in (39), the additional mora expressing emphasis appears after the first mora of the base. This becomes especially obvious from the nasal insertion case (39-a) where the vocalic stem mora clearly intervenes between the additional affix mora and the left edge of the base.[6]

(39) *μ-affixation in Shizuoka Japanese (to be continued)*

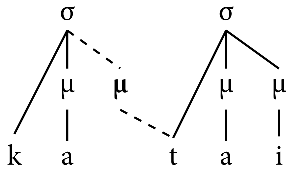
a. *Nasal insertion* b. *Vowel lengthening*



[6]The emphatic cannot be formed by infixation before the final mora of the base since the second syllable sometimes contains one (*hade*) and sometimes 2 moras (*nagai*).

(39) *μ-affixation in Shizuoka Japanese (continued)*

c. *Gemination*



An analysis for these facts under a morphological pivot affixation approach is straightforward: the μ is assumed to suffix to the first μ of its base.

(40) *μ-affix in Shizuoka Japanese*

μ ↔ $_{\text{Base}}$[μ ___

And how are these facts derived under the alternative assumption of phonological dislocation? Basically this question reduces to the placement of the constraint Align(μ,L) demanding a prefix position of the affix-μ. It can easily be demonstrated that the phonological dislocation theories run into a ranking paradox to predict the correct placement of the affix-μ. Let's start with contexts where a nasal is inserted. We know that the affix-μ must dislocate in these cases since it is realized as coda-μ following the first base-μ. Consequently, Align(μ,L) must be ranked below *Vː as can be seen in the comparison between I. and II. in (41).

(41) *Nasal insertion for CVO̯V*

a. *I. Wrong ranking: vowel lengthening is predicted*

μ-hade	σ-Cond	Align(μ,L)	*Vː	Dep n	*Cː
a. had$^{\mu}$e (hadːe)	*C̯ː!	**			*
☞ b. ha n$^{\mu}$ de (hande)		**!		*	
☛ c. ha$^{\mu}$de (haːde)		*	*		

b. *II. Correct ranking: nasal insertion is predicted*

μ-hade	σ-Cond	*Vː	Align(μ,L)	Dep n	*Cː
a. had$^{\mu}$e (hadːe)	*C̯ː!		**		*
☞ b. ha n$^{\mu}$ de (hande)			**	*	
c. ha$^{\mu}$de (haːde)		*!			

However, if we turn to another context, this ranking of *Vː over Lin-μ makes a fatal misprediction. For bases starting with a closed syllable, Lin-μ must be ranked above *Vː to block gemination beyond the first σ (42).

(42) *Vowel lengthening for CVN.OV*

a. *I. Correct ranking: vowel lengthening is predicted*

μ-kata	σ-Cond	Align(μ,L)	*Vː	Depn	*Cː
a. onz^{μ}okutai (on.zːokutai)	$*_{σ}[C_{μ}$!	**			*
a'. onzok^{μ}utai (on.zokːutai)		*!**			*
b. on n^{μ} zai (onn.zokutai)	$*CC]_{σ}$!			*	
☞ c. o^{μ}nzokutai (oːn.zokutai)			*		

b. *II. Wrong ranking: non-local gemination is predicted*

μ-kata	σ-Cond	*Vː	Align(μ,L)	Depn	*Cː
a. onz^{μ}okutai (on.zːokutai)	$*_{σ}[C_{μ}$!		**		*
☛ a'. onzok^{μ}utai (on.zokːutai)			****		*
b. on n^{μ} zai (onn.zokutai)	$*CC]_{σ}$!		*	**	
☞ c. o^{μ}nzokutai (oːn.zokutai)		*			

In their analysis of Japanese, Davis and Ueda (2002*a*) employ a non-standard alignment constraint which fixes the position of the affix-μ to the initial syllable of a base; it is violated if the μ is realized beyond the first syllable. The constraint has a similar effect as fixing the position of the affix-μ with respect to the μ's of the base word. Hence in effect, this constraint amounts to a subcategorization requirement.

(43) Align-L($μ_{e}$,Wd)
Align the emphatic mora with the beginning (left edge) of the word.

4.4. Morphologically Contrastive μ-Affixes

Under a phonological dislocation approach, the realization of an affix-μ follows from the general phonology of the language, for example, from the preference for geminates or long vowels. Under the assumption that there are no morpheme specific mechanisms (indexed constraints Pater 2009, cophonologies Inkelas and Zoll 2005), it follows that any μ that is affixed to a certain base will be realized in exactly the same base. In this section we argue that this is a serious drawback for a phonological dislocation approach since there are indeed languages where different μ-affixes result in different outputs (Guerssel and Lowenstamm 1990, Lowenstamm 2003). A case in point are the first two Binyanim of Classical Arabic.[7] Whereas Binyan II geminates the first non-initial consonant, Binyan III lengthens the first vowel.

(44) *Binyanim in Classical Arabic* (McCarthy 1979, McCarthy and Prince 1990)

	'write'	'do'
Binyan I	katab	faʔal
Binyan II	ka**tː**ab	faʔːal
Binyan III	k**aː**tab	f**aː**ʔal

Under the assumption that all Binyanim are derived from fully vocalized Binyan I forms (Ussishkin 2003, 2005), both Binyan II and III could be captured by μ-affixation (Davis and Ueda 2006). The crucial problem which emerges is why the Binyan II-μ attaches to the consonant and the Binyan III-μ to the vowel. We will call this problem 'Lowenstamm's dilemma', who was the first to clearly notice that the two Binyanim undergo roughly the same type of prosodic augmentation that differs minimally by the attachment of affixal prosody to segmental material which is crucially dependent on the morphological category involved (Guerssel and Lowenstamm 1990, Lowenstamm 2003). There are two standard solutions to Lowenstamm's dilemma: Lowenstamm himself associates the lengthening prosody (which for him is not a μ, but a skeletal CV unit) by morphological stipulation, a move which has become canonical for analyses of templatic morphology in government phonology (e.g. Bendjaballah 2001, Bendjaballah and Haiden 2003, Rucart 2001, 2006, Lahrouchi 2009, Arbaoui 2010).

Davis and Ueda (2002*a*) suggest to capture the fact that the Binyan III-μ associates to a V, not to a consonant (the default option for affixal μ's according

[7] We have excluded templatic morphology from our sample to restrict it to clear-cut cases of μ-affixation. However Semitic verbal root-and-pattern morphology is one of the the areas where an affixational analysis is highly plausible. See Ussishkin (1999, 2003, 2005), Trommer and Zimmermann (2011) for affix-based analyses of vocalic patterns in Modern Hebrew, Trommer (2005) for a mora-affixation analysis of gemination in Amharic, and Davis and Ueda (2006) on a similar proposal for Classical Arabic.

to Davis and Ueda's (2002*a*) assumptions) by positing "that the input mora indicating Form 3 would be subscripted as a vocalic mora" (p.17). Both approaches are conceptually costly since they add technical devices (phonological subscripting and morphological association) to phonological theory which are not motivated outside of nonconcatenative morphology. Under the assumption that μ-affixation is morphological pivot-affixation, however, Lowenstamm's dilemma is completely unproblematic and rather an expected pattern: the affix-μ's in Binyan II and III are simply pronounced in different positions in their base because they are affix to different pivots.

(45) *Two μ-affixes in Classical Arabic*
a. Binyan II ↔ μ / [μ __
b. Binyan III ↔ μ / [__ μ

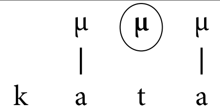
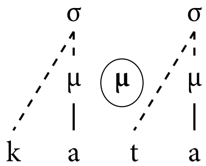
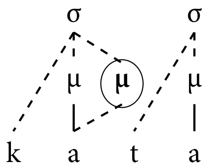
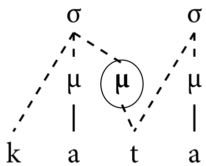
The first μ-affix (45-a) suffixes to the first μ of its base. In this position, it can in principle associate to three segments without crossing association lines: to the first or second base vowel or the coda consonant of the first syllable. We assume that gemination is the preferred option to realize a morphological μ in Classical Arabic, ensured through ranking *Vː higher than *Cː. In the tableau (47), it is shown how this ranking then ensures that the suffixed μ will always result in gemination. We included whole autosegmental representations to illustrate the rather subtle differences between the two μ-affixes and we also added the constraints (46-b+c) that ensure proper realization of an affix-μ in the first place.

(46) a. *× Assign a violation mark for every pair of crossing association lines.

b. σ ↑ μ Assign a violation mark for every μ that is not dominated by a σ.

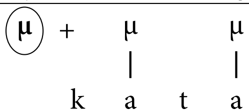
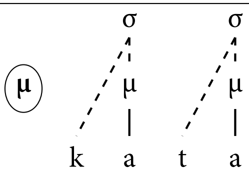
c. μ ↓ • Assign a violation mark for every μ that does not dominate any segment.

(47) *Binyan II: Gemination*

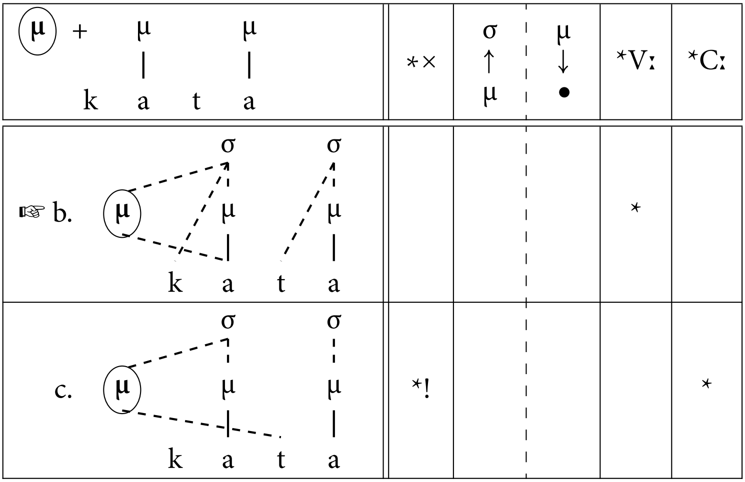
	*×	σ ↑ μ	μ ↓ •	*Vː	*Cː
a. 		*!	*		
b. 				*!	
☞ c. 					*

The second μ-affix, on the other hand, is taken to be a prefix to the first μ (46-b). Although vowel-lengthening is the dispreferred option to realize an additional μ in Classical Arabic, this μ-prefix will always result in vowel-lengthening simply because there is no consonant the μ could associate to without creating a crossing association line configuration (given that initial geminates are generally illicit).

(48) *Binyan III: Vowel Lengthening (to be continued)*

	*×	σ ↑ μ	μ ↓ •	*Vː	*Cː
a. 		*!	*		

(48) *Binyan III: Vowel Lengthening (continued)*



5. Conclusion

We have argued that μ-affixation is pivot-affixation and explicitly reject any phonological dislocation (or 'phonological readjustment') to account for infixation. Affixation of a morphological μ is therefore a morphological operation that is independent and derivationally prior to phonological optimization. An alternative account assuming phonological dislocation is empirically inadequate and too unrestrictive at the same time. It predicts unattested instances of non-local infixation and variable infixation but fails on the other hand to predict attested instances of fixed infixation or moraic distinctiveness.

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