19

Morpheme position

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19.1 Introduction

Affixes are commonly classified as prefixes or suffixes. Prefixes appear at the left edge of a stem, like American English [ɪn] 'in-' (e.g. [ɪnseɪn] 'insane'); suffixes appear at the right edge of a stem, like [ɪɾi] '-ity' (e.g. [sænɪɾi] 'sanity'). However, affixes can appear in other positions as well. For instance, they can appear 'infixed' inside a morpheme like the Tagalog morpheme [-um-] in [s-um-ulat] 'write'.

Morpheme position can vary by a range of parameters. The following three parameters are relevant here:

(i) whether an affix is default-prefixing or default-suffixing (i.e. whether it is oriented toward the left or the right edge of the word)
(ii) whether or not an affix is influenced by phonological pressures (i.e. whether an affix always occurs at an edge, or whether phonological well-formedness overrides edge placement)
(iii) whether or not an affix is contiguous (i.e. whether an affix is concatenative or not)

Despite the wide array of positions affixes can appear in, this chapter will argue, following McCarthy and Prince (1986 et seq.), that there are only two basic types of affix: prefixes and suffixes. When affixes occur anywhere other than the edge of a word, phonological pressures are always responsible.

Because of the interesting behavior of nonconcatenative morphology, special attention is paid in this chapter to the properties and analysis of interfixes, affixes that tend to be segmentally discontiguous and that typically replace material in the content morpheme they combine with. The core of the discussion concerns the extent to which phonology has an influence on morpheme position; as we will see, the influence can be quite important, to the extent that phonological well-formedness can determine morpheme position.[1]

19.2 The theory of edge orientation

19.2.1 Generalized Alignment

Current models of phonology tend to view concatenative affixation as an edge-oriented phenomenon. Within Optimality Theory, Generalized Alignment (GA; McCarthy and Prince 1993a) provides a framework for analyzing morpheme position. The overarching schema of GA holds that edges of both Phonological Categories (PCat) and Morphological or Grammatical Categories (GCat) should coincide. In particular, GA constraints are typically of the form given in (1):

(1) *Generalized Alignment* (McCarthy and Prince 1993a)

ALIGN (Cat1, Edge1, Cat2, Edge2) $=_{def}$
∀ Cat1 ∃ Cat2 such that Edge1 of Cat1 and Edge2 of Cat2 coincide.
Where Cat1, Cat2 ∈ PCat ∪ GCat
Edge1, Edge2 ∈ {Right, Left}

Deconstructing (1), the basic thrust of GA is that there are output-oriented constraints that state "align some edge of every element *x* with some edge of an element *y*."

19.2.2 Cases

The type of demand made by alignment constraints is most easily understood in a simple case. To begin, consider the case of English *in-* prefixation. Prefixes attach to the left edge of a word, as seen in the following examples (2) from American English, which prefixes *in-* to an adjective to convey the meaning 'not {adjective}'. The phonological exponence of the prefix's nasal consonant varies in place of articulation depending on the first segment of the stem to which it attaches.

(2) *Prefixes: American English in- 'not' prefixation*

Adjective		in-*adjective*	
Orthography	*IPA*	*Orthography*	*IPA*
audible	[ɔɾəbl̩]	inaudible	[ɪnɔɾəbl̩]
sane	[seɪn]	insane	[ɪnseɪn]
competent	[kɑmpəɾn̩ʔ]	incompetent	[ɪŋkɑmpəɾn̩ʔ]
congruent	[kəŋgɹun̩ʔ]	incongruent	[ɪŋkəŋgɹun̩ʔ]
possible	[pɑsəbl̩]	impossible	[ɪmpɑsəbl̩]
movable	[muvəbl̩]	immovable	[ɪmuvəbl̩]

Under GA, no prefixal status need be granted to *in*. Its location at the left edge of forms is the result of a high-ranking constraint aligning *in* to the left edge of a stem. The formal constraint is provided in (3):

(3) ALIGN-L (*in*, Stem)

Effectively, (3) states "the left edge of every instance of the morpheme *in* coincides with the left edge of some stem." This constraint will be referred

to as ALIGN-*in* below, for convenience. The constraint, as an undominated constraint in English, is always satisfied; that is, *in-* never appears anywhere but at the left edge – thus its uniform status as a prefix. Thus, in OT, the prefixhood of *in-* is achieved through a constraint on output well-formedness, rather than being specified lexically. Suffixes are treated in a similar fashion under this approach, with the simple parametric modification that alignment is to the right edge rather than the left. A simple example to illustrate suffixation comes from the verbal paradigm of Modern Hebrew (4), where the suffix [-ɛt] is used to mark feminine gender in the present tense (these examples all involve the same prefix as well):

(4) *Suffixes:* Modern Hebrew 'feminine' [-ɛt] suffixation

Verb (masculine)	*Verb-*et *(feminine)*	*Gloss*
medaber	medaberɛt	'speak'
megadel	megadelɛt	'raise'
mefakses	mefakseseɛt	'send a fax'
metaʔer	metaʔerɛt	'describe'
metajek	metajekɛt	'file'
medamem	medamemɛt	'bleed'

In the interesting case of circumfixes, alignment to *both* edges is crucial. That is, an affix appears to simultaneously exhibit properties of both prefixes and suffixes. Representative data come from German verbal past participles (5); regular verbs have the circumfix *ge- -t*:

(5) *Circumfixes:* German past participles

Verbal root		*Past participle*		*Gloss*
spiel	[ʃpiːl]	gespielt	[gəʃpiːlt]	'play'
such	[zuːx]	gesucht	[gəzuːxt]	'search'
koch	[kɔx]	gekocht	[gəkɔxt]	'cook'
hör	[høːʁ]	gehört	[gəhøːʁt]	'hear'
blick	[blɪk]	geblickt	[gəblɪkt]	'look'

Analysis of such forms within GA involves alignment constraints that reference both the left and right edges; in undominated position, such constraints result in circumfixion.

19.2.3 Alternative approaches

In the GA approach to morpheme position, distance from the left (or right) edge is assessed gradiently. That is, for morphemes whose position does not fall at an edge, they are nonetheless edge-oriented in that the same morpheme consistently occurs *close* to an edge (see the case of Tagalog, presented below). Recent work by McCarthy (2003b) presents an alternative view whereby all constraints are categorical, and develops this idea even for cases where gradient constraint evaluation seems crucial. Another

alternative is presented by Horwood (2002), where the analysis of morpheme position depends on faithfulness, rather than on markedness (more specifically, on the preservation of precedence relations).

19.3 Phonological demands on well-formedness may override alignment

The main idea behind the GA approach is that all affixes are essentially prefixes or suffixes, and that deviations from edgemost position are due to phonological requirements. In more theoretical terms, every affix is affected by the demand to appear at either the left or the right edge of a stem; this is expressed via an alignment constraint. Deviations from the edge are caused by higher-ranking markedness constraints on phonological well-formedness. Two types of phonologically induced edge-deviation exist: cases where the affix cannot occur within the stem (variable-direction affixes), and cases where the affix can appear inside the stem (infixes).

19.3.1 Variable-direction affixes

As discussed by Fulmer (1997), based on data from Bliese (1981), the Cushitic language Afar presents an interesting case of variable-direction affixes. These occur in the verbal system, where the affix-expressing person marking on verbs varies in its location due to phonological requirements. For instance, in the second-person form of verbs, the person marker [-t-] occurs stem-finally if the stem begins with a consonant (6a), and stem-initially if the stem begins with a vowel (6b):[2]

(6) *Afar variable-direction person marking (data from Fulmer 1997)*

	Verb	*Gloss*
(a)	nak-t-eː	'drink milk'
	haj-t-eː	'put'
	sug-t-eː	'had'
	kal-t-eː	'prevent'
(b)	t-eh-eː	'give'
	t-ibbiḍ-eː	'seize'
	t-okm-eː	'eat'
	t-usuul-eː	'laugh'

Variability in the position of the second-person marker [-t-] can be viewed as phonologically based: the affix occurs to the right of the stem (i.e. as a suffix), except when the stem is vowel-initial, in which case the affix surfaces as a prefix. Abstracting away from complexities involving the position of the person marker relevant to the affix marker, a GA-based account of this variability is easily available: a right edge-oriented alignment

constraint on the person marker (capturing its suffixal nature) is dominated by ONSET, a constraint requiring syllables to have onsets. Since consonant-initial stems have an onset, the alignment constraint exerts its effect on the position of the person marker. However, vowel-initial stems surface with the person marker at the left edge, resulting in a more harmonic output from the point of view of syllable structure, to which alignment is subordinated.

19.3.2 Phonologically driven infixation

Phonological restrictions can force morphemes to appear away from stem edges. In these situations, the affected morpheme is called an 'infix'. Although typically edge-oriented, infixes appear *within* a form, rather than at the absolute edge of a form. A well-known example comes from English expletive infixation (7), where the expletive prefixes to a stressed syllable.

(7) *American English expletive infixation* (McCarthy 1982, Hammond 1999) (examples appear orthographically)

Base	*With expletive infix*
Arizóna	Àri-fùckin-zóna
Càlifórnia	Càli-fùckin-fórnia
Àlamagórdo	Àlama-fùckin-górdo
Àppalàchicóla	Àppa-fùckin-làchicóla, Àppalàchi-fùckin-cóla
Mìnnesóta	Mìnne-fùckin-sóta

Tagalog presents another well-known case of infixation. In Tagalog, the agentive focus marker [-um-] may occur either at the left edge of a form or within a form. As we will see, this distribution is not random. Relevant data appear in (8).

(8) *Tagalog [-um-] agentive focus* (French 1988, McCarthy 2003b)

Root	*root + -um-*	*Gloss*
aral	um-aral	'teach'
abot	um-abot	'reach for'
sulat	s-um-ulat	'write'
gradwet	gr-um-adwet	'graduate'
preno	pr-um-eno	'to brake'

The basic analysis of Tagalog presented in Prince and Smolensky (2004) and McCarthy and Prince (1993a) involves an alignment constraint that is morpheme-specific, requiring [-um-] to occur at the left edge of the stem:

(9) ALIGN-L(*um*, STEM) (abbreviated to ALIGN-*um* below)

This constraint on its own has the effect of placing the affix [-um-] at the left edge of a form, resulting in the prefixal nature of the affix. In other words, as

explained in Prince and Smolensky (2004) and McCarthy and Prince (1993a), [-um-] is basically a prefix and when possible surfaces as such: [um-aral]. However, the data from Tagalog show that the affix is not consistently realized at the left edge of every form: consonant-initial forms, when combined with [-um-], surface with the initial consonant (or consonant cluster) at the left edge. This is due to the overriding effect of high-ranking NoCoda, as tableau (10) from McCarthy and Prince (1993a) shows. For the sake of clarity, violations of Align-*um* are marked using the segments that cause the violation.

(10) *gradwet-um*

	/gradwet-um/	NoCoda	Align-*um*
	(a) um.grad.wet	***!	
	(b) gum.rad.wet	***!	g
	(c) gra.dum.wet	**	grad!
☞	(d) gru.mad.wet	**	gr

Violations of the alignment constraint are assessed by counting the number of segments separating the left edge of [-um-] from the left edge of each candidate form. Candidate (10a) achieves perfect alignment of [-um-] to the left edge, while candidates (10b-d) exemplify varying distances from the left edge of the word. Since the well-aligned candidate (10a) is not the actual output, some other constraint must be responsible for the surface position of [-um-] in (10d), the optimal form. It is clear that avoidance of syllable codas (formalized by the constraint NoCoda) is more important than edge-realization of [-um-] in Tagalog. The alignment-based analysis, then, has as a consequence that infixation is viewed as an edge-oriented phenomenon: an affix prefers to be realized at an edge, *modulo* demands made by phonological markedness like syllable structure constraints (such as NoCoda). Although the Tagalog case is not as cut and dried as presented here, the basic message of the analysis holds: that infixation, like prefixation or suffixation, is an edge-oriented phenomenon. For more on Tagalog, see Zuraw (1996), Orgun and Sprouse (1999), McCarthy (2003b), Yu (2003), and Klein (2005) on the variability of the locus of infixation. An alternative to the Generalized Alignment approach is presented in McCarthy (2003b), who argues for a categorical interpretation of all constraints in OT. Another alternative analysis is the Exogenesis Theory of Infixation of Yu (2003), who argues for true infixes – morphemes that always appear inside a stem.

19.3.3 Infixation to a prosodic category

Earlier treatments of prosodically driven infixation were proposed in McCarthy and Prince (1986 et seq., McCarthy 2000a) using the notion of *prosodic circumscription*. Under this notion, a stem is divided into two parts, and an affix is attached to one of these. For instance, in Ulwa, a Nicaraguan

language, the possessive marker [-ka-] 'his' always occurs after the head foot of the word it attaches to. If the word only contains one foot, [-ka-] is a suffix (11a); otherwise, it is an infix (11b), as illustrated in the following data from McCarthy and Prince (1993a):

(11) *Infixes: Ulwa possessive* [-ka-]

	Unaffixed	*Possessive*	*Gloss*
(a)	'bas	('bas)–ka	'hair'
	'ki:	('ki:)–ka	'stone'
	a'mak	(a'mak)–ka	'bee'
	sa'pa:	(sa'pa:)–ka	'forehead'
(b)	'su:lu	('su:)–ka–lu	'dog'
	ku'luluk	(ku'lu)–ka–luk	'woodpecker'
	a'na:la:ka	(a'na:)–ka–la:ka	'chin'
	ka'rasmak	(ka'ras)–ka–mak	'knee'

Under the prosodic circumscription account, the head foot of the unaffixed form is circumscribed from the word, followed by suffixation of the possessive affix to this foot. Under an OT alignment-based account, the position of the possessive affix is determined by the constraint ALIGN-TO-FOOT (McCarthy and Prince 1993a), which requires that the left edge of the possessive affix coincide with the right edge of the head foot of the word. For words containing only one foot (11a) the result is that the possessive surfaces at the end of the word – that is, as a suffix. When the word contains more material than fits into a single foot (11b), the affix is essentially suffixed to the head foot, but surfaces as an infix.

19.4 Phonology beats both alignment and morpheme contiguity

In addition to forcing a morpheme to surface as an infix, phonological constraints can also force a morpheme to split apart. The result is a type of morphology known as *nonconcatenative* morphology, where the segmental content of an affix may be distributed within a stem (thus, they are sometimes referred to as interfixes). A classic case of nonconcatenative morphology is exemplified by Modern Hebrew (henceforth referred to as Hebrew) and other Semitic languages. The most influential study of nonconcatenative morphology can be found in McCarthy (1979a, 1981), where important notions of morpheme position and compositionality are formalized. More recent work within current models can be found in Bat-El (1989, 1994, 2003) and Ussishkin (2000, 2005), where nonconcatenative behavior emerges through the interaction of constraints in OT.

Along with the discontiguous character of Semitic affixes, another noteworthy property of nonconcatenative morphology is the templatic effects so widely observed in these languages. These effects demonstrate the existence of strong preferences in these languages for words to conform to a very limited set of prosodic structures. Hebrew affixation shows that templatic effects are the result of two subcategories of constraints: ones on syllable structure, and ones on prosodic word size. Together, these two types of structural constraints impose a set of restrictions on the optimal phonological shape of words that results in interfixational phenomena, without explicit recourse to interfixes as a special class of morpheme. In this way, interfixes behave similarly to the GA view of infixes: namely, that they are emergent elements and not a special category of affix.

Here, two types of affixation are considered: 'non-hybrid' affixation (affixation of a prefix alone to a form, or of an interfix alone to a form) and 'hybrid' affixation (affixation of a prefix and an interfix to the same form).[3] For the non-hybrid cases in Hebrew the affixes in question are composed of two vowels. For instance, consider the case of the puʕal binyan[4], which is in a clear relationship with the piʕel binyan: a puʕal verb is always a passive version of a corresponding active piʕel counterpart. A verb in the puʕal binyan is formed by affixing the vowels /u a/ to an existing piʕel form – the problem to be solved concerns how a form such as *dubar* 'it was spoken' results from affixing this vocalic pattern to the form *diber* 'he spoke' (12).

(12) *Non-hybrid affixation:* Interfix only – piʕel vs. puʕal

PiʕeI	*Gloss*	*PuʕaI*	*Gloss*
gidel	'he raised'	gudal	'he was raised'
ʔikel	'he consumed'	ʔukal	'it was consumed'
kibel	'he received'	kubal	'it was received'
diber	'he spoke'	dubar	'it was spoken'

In the following non-hybrid examples (13), a prefix *ni-* is added to a paʕal verb, resulting in a verb in the nifʕal binyan. In addition to prefixing *ni-*, the nifʕal forms all involve deletion of one of the vowels with the result that the forms are all bisyllabic, like the paʕal forms. An incidental process of spirantization causes [k] and [b] to become [x] and [v] respectively.

(13) *Non-hybrid affixation:* Prefix only – paʕal vs. nifʕal

PaʕaI	*Gloss*	*NifʕaI*	*Gloss*
katav	'he wrote'	nixtav	'it was written'
badak	'he checked'	nivdak	'it was checked'
ganav	'he stole'	nignav	'it was stolen'
raʔa	'he saw'	nirʔa	'it seemed'

The next examples illustrate hybrid affixation, where both a prefix and an interfix occur. In (14), a causative hifʕil form results from prefixing *hi-* and interfixing *–i–* to a paʕal verb.

(14) *Hybrid affixation:* Prefix and interfix – paʕal vs. hifʕil

Paʕal	*Gloss*	*Hifʕil*	*Gloss*
katav	'he wrote'	hixtiv	'he dictated'
paxad	'he was scared'	hifxid	'he frightened'
gadal	'he grew up'	higdil	'he enlarged'

And in (15), a reflexive or reciprocal verb results from prefixing *hit-* and interfixing *a e* to a paʕal verb:

(15) *Hybrid affixation:* Prefix and interfix – paʕal vs. hitpaʕel

Paʕal	*Gloss*	*Hitpaʕel*	*Gloss*
katav	'he wrote'	hitkatev	'he corresponded'
raxat͡s	'he washed'	hitraxet͡s	'he washed himself'
lavaʃ	'he wore'	hitlabeʃ	'he dressed himself'

Other examples of interfixation are widely found in Semitic. For instance, Modern Standard Arabic differentiates its active vs. passive voice marking via this strategy, as seen in (16):

(16) *Arabic active and passive voice*

Active	*Gloss*	*Passive*	*Gloss*
kataba	'he wrote'	kutiba	'it was written'
kattaba	'he caused to write'	kuttiba	'it was dictated'
faʕala	'he did'	fuʕila	'it was done'
dafana	'he buried'	dufina	'he was buried'

Also found in Semitic languages is an interfixational pattern marked by a prosodic change. Maltese verbs exemplify this type of pattern, as seen when comparing binyan 1 verbs (with a $C_1VC_2VC_3$ structure) to binyan 2 verbs (with a $C_1VC_2C_2VC_3$ structure) (17). Binyan 2 in Maltese typically denotes valency change, resulting in causative and intensive verbs.

(17) *Maltese Binyan 1 vs. Binyan 2* (Borg and Azzopardi-Alexander 1997, Aquilina 1999)

Binyan 1	*Gloss*	*Binyan 2*	*Gloss*
bidel	'to change (opinion)'	biddel	'to change'
dahal	'to enter'	dahhal	'to admit'
ferah	'to rejoice'	ferrah	'to make happy'
gideb	'to lie'	giddeb	'to say that someone lied'
libes	'to dress'	libbes	'to dress someone'
ʔasam	'to split'	ʔassam	'to distribute'
ʔatar	'to fall by drops'	ʔattar	'to drip'

The unifying phonological pattern among the pairs of binyan 1 and binyan 2 verbs is the doubling (or gemination) of the second consonant in binyan 2. Other than this geminate, the two verbal binyanim are identical. The analysis of such forms involves affixation of a mora, or unit of phonological weight, to

binyan 1 forms in order to arrive at the binyan 2 forms (see McCarthy 1993 and Ussishkin 2000 for an analysis of how this works in Arabic).

Returning to the Hebrew data provided above, it is clear that the majority of verbal classes contain only bisyllabic forms. This restriction follows from constraints on word size that limit an output Prosodic Word to two syllables in length. Constraints on maximal word size are found in a number of other languages as well. Occasionally they are restricted to a particular morphological environment as in Japanese (Itô et al. 1996) and Southern Tepehuan (Black 1996). Such constraints may also apply to most or all words in the language, as in Hebrew (Ussishkin 2000, 2005) and Māori (de Lacy 2003c).

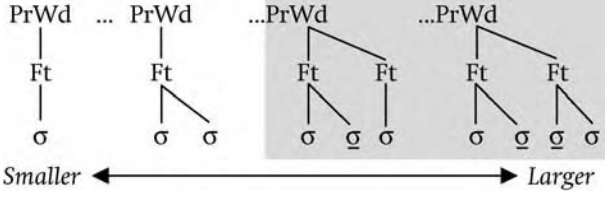
To begin the analysis of Hebrew, (18) introduces a bisyllabic upper limit on prosodic words, effectively limiting words to two syllables as a maximal size:

(18) *Syllable-PrWdAlignment (abbreviated as σ-Align)*

$\forall\sigma\exists$PrWd [PrWd $\supset$ σ and ALIGN (σ, PrWd)]
(≡Every syllable must be aligned to the edge of some prosodic word containing it.)

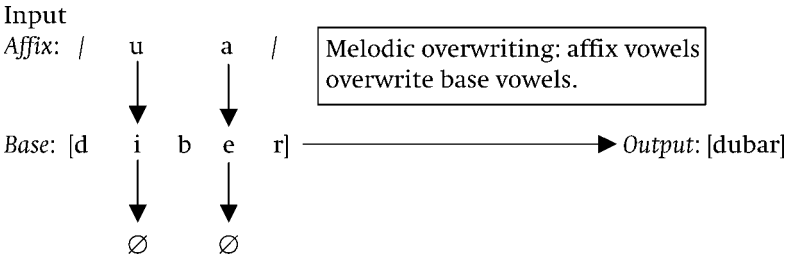
The constraint in (18), called σ-Align, is based on the concept of Hierarchical Alignment as developed by Itô et al. (1996), with further refinements developed by Ussishkin (2000, 2005). Essentially, the constraint demands that every syllable within a prosodic word share some edge with the same edge of the prosodic word. Alternative constraints achieve similar results, but the σ-Align approach will be taken here, as this is the most successful approach for maximal word size effects in Hebrew (Ussishkin 2005). The result is a situation where any non-edge syllable within a prosodic word violates this demand, as illustrated schematically in (19):

(19) *σ-Align: scalar illustration*[5]



The shaded structures in (19) are larger than two syllables and as a result violate σ-Align; the violation-incurring syllables are underlined. The main effect of the constraint then is that when a Hebrew verb is derived by affixing a bivocalic pattern to an existing form, melodic overwriting is forced as the only way to both realize the affix and maintain the bisyllabic maximal size restriction. Effectively, the vowels of the base are deleted in order to express the affix, as figure (20) illustrates:

(20) *Schematic illustration of melodic overwriting*



Note that the contiguous character of the affix is lost in the output: essentially the segments of the affix are split among the segments of the stem. Also, it is clear that the affix takes precedence over the stem, to the point where the affix in fact overwrites material in the stem. This points to the need for a high-ranking constraint forcing the realization of affix material, known as FAITH-AFFIX. This constraint must crucially outrank FAITH-STEM, which demands that all stem material surface in the output. Tableau (21) shows the effect of this high-ranking constraint in deriving the form *dubar* 'it was spoken' from *diber* 'he spoke'.

(21) *Deriving* dubar *from* diber

[diber]-u a	σ-ALIGN	FAITH-AFFIX	FAITH-STEM
(a) di.ber		u! a	
(b) di.bar		u!	e
(c) du.ber		a!	i
(d) di.be.rua	*!		
☞ (e) du.bar			i e

A candidate such as (21d), which faithfully realizes all input material, loses due to its violation of the two-syllable size limit imposed by σ-ALIGN. Violations of faithfulness constraints are shown by including unparsed segmental material in the relevant cells. As seen in the tableau, high-ranking AFFIX-FAITH is indeed necessary; without it, it is impossible to predict the optimal form, as seen in tableau (22), where the relative position of the two faithfulness constraints in the hierarchy are switched:

(22) *Deriving* dubar *from* diber

[diber]-u a	σ-ALIGN	FAITH-STEM	FAITH-AFFIX
💣 (a) diber			u a
(b) dibar		e!	u
(c) duber		i!	a
(d) diberua	*!		
☞ (e) dubar		i! e	

Once again, a candidate such as (22d), which faithfully realizes all input material, loses due to its violation of the two-syllable size limit. Meanwhile, the pointing hand signals the actual output, while the imminently exploding bomb signals the output that this ranking predicts as optimal. This demonstrates the need for FAITH-AFFIX and its high-ranking status. For further arguments in favor of FAITH-AFFIX (as opposed to a constraint such as REALIZE-MORPHEME), see Ussishkin (2005).

This account correctly predicts all cases of affixation in the Hebrew verbal system that involve an interfix. Two further cases remain to be accounted for: non-hybrid cases involving a prefix, and hybrid cases involving the combination of a prefix and an interfix. For non-hybrid cases that involve just a prefix, recall the nifʕal binyan, which involves prefixation of *ni-* to a paʕal form. Such cases require the prefix to align to the left edge of the prosodic word, as formalized by constraint (23):

(23) ALIGN-L (*ni*, PrWd)
The left edge of *ni-* is aligned to the left edge of a prosodic word.

Given that no nifʕal forms ever violate this constraint in Hebrew, it is taken to be undominated. Such cases are now almost trivial, given the maximal bisyllabic restriction imposed on Hebrew verbs. σ-ALIGN rules out any candidates longer than two syllables (24):

(24) *nixtav* 'it was written' from *katav* 'he wrote': derivation of nifʕal forms

	[ka$_1$ta$_2$v]-ni	σ-ALIGN	FAITH-AFFIX	FAITH-STEM
	(a) nixa$_1$ta$_2$v	*!		
☞	(b) nixta$_2$v			a$_1$

Although forms longer than two syllables are clearly excluded from consideration under the analysis, there remains a potential bisyllabic output still in need of rejection. Such an output chooses to parse the first stem vowel while deleting the second, resulting in a complex coda. Here is our first evidence, therefore, of syllable structure constraints at work in the affixational system; in this case a constraint barring complex syllable codas prevents the wrong vowel from being deleted (25).

(25) *nixtav* 'it was written' from *katav* 'he wrote': derivation of nifʕal forms

	[ka$_1$ta$_2$v]-ni	*COMPLEXCODA
	(a) nixa$_1$tv	*!
☞	(b) nixta$_2$v	

The ban on complex codas is observed throughout the native vocabulary in the language, with the exception of an inflectional suffix marking second person, past tense, feminine forms. Elsewhere, the constraint is satisfied, including within the verbal paradigm of binyan relations.

Consider our hybrid cases: Hebrew verbs involving a base form combined with a prefix and an interfix. As an example, take the hifʕil form *hixtiv* 'he dictated', based on the paʕal form *katav* 'he wrote'. Here, we have a prefix *hi-*, in addition to a second component, the vowel *i*. *Hi-* receives its prefixational status via an alignment constraint, similar to the constraint for *ni-*:

(26) ALIGN-L (*hi-*, PrWd)
The left edge of *hi-* is aligned to the left edge of a prosodic word.

Given the prefix/interfix combination in such cases, the only way to realize all of the affixal material (at the behest of high-ranking FAITH-AFFIX) is to both delete a vowel from the stem and overwrite a vowel from the stem, as illustrated in (27):

(27) *hixtiv* 'he dictated' from *katav* 'he wrote'

[ka_1ta_2v]-hi i	σ-ALIGN	FAITH-AFFIX	FAITH-STEM
(a) hixa_1ta_2v	*	i!	
(b) hix$a_1$tiv	*!		a_2
(c) hixita_2v	*	i!	a_1
☞ (d) hixtiv			a_1 a_2

In the hifʕil binyan a CV- prefix plus an additional vowel are affixed to the base form. Interestingly, such cases force a .CVC.CVC. output in order to satisfy σ-ALIGN. In other words, the *x* and *t* are adjacent to each other in the hifʕil, as opposed to in the paʕal (e.g. *katav*). The same result obtained in the nifʕal.

Finally, consider the case of the hitpaʕel binyan, which appears to be the only verbal class in Hebrew that violates the bisyllabic size restriction. The analysis of these forms is fairly straightforward; once again, an alignment constraint forces realization of *hit-* as a prefix:

(28) ALIGN-L (*hit-*, PrWd)
The left edge of *hit-* is aligned to the left edge of a prosodic word.

Such forms, like the hifʕil, involve a prefix/interfix combination, though the additional vowel in the hitpaʕel forces a trisyllabic output as seen in tableau (29):

(29) *hitraxets* 'he washed himself' from *raxats* 'he washed': derivation of hitpaʕel forms

[raxat͡s]-hit a e	FAITH-AFFIX	σ-ALIGN	FAITH-STEM
(a) hitraxat͡s	e!	*	
(b) raxet͡s	h! i t		
☞ (c) hitraxet͡s		*	a a

The optimal form violates σ-ALIGN, justifying the ranking FAITH-AFFIX » σ-ALIGN. Interestingly, since σ-ALIGN must outrank FAITH-STEM, then by transitivity the ranking FAITH-AFFIX » FAITH-STEM also results. This consequence has implications for phonological theory in the context of contrast preservation, especially under the well-known observation that cross-linguistically, affixes tend to be weaker than stems when the two compete for phonological exponence.

This analysis of Hebrew morpheme position is heavily word-based, meaning that the affixes in question always combine with existing words, in the spirit of Benua's (1995) model of output-output correspondence. An alternative analysis based on affixation to the consonantal root is also possible, and will be briefly discussed here. Such an approach relies on earlier treatments of Semitic morphology whereby affixes combine not with an existing word, but rather with a consonantal root (McCarthy 1979a, 1981). For instance, in a root-based account, the form *dubar* 'it was spoken' is derived not from *diber* 'he spoke', but from the root /*d b r*/. Under this view, how do the vowels of the affix /*u a*/ surface in the correct position?

Once again, phonological considerations motivate morpheme position. The relevant considerations here are syllable structure constraints (also see Zec sec. 8.3.2):

(30) *Hebrew syllable structure constraints*[6]

ONSET	"Syllables must have onsets."
NOCODA	"Syllables must not have codas."
*COMPLEXCODA	"Syllables must not have more than one coda consonant."
*COMPLEXONSET	"Syllables must not have more than one onset consonant."

The analysis also assumes undominated faithfulness constraints, forcing all input-specified material to be present in the output. Given an input of /*d b r*/ + /*u a*/, the most harmonic output is *dubar*, according to the ranking in tableau (31):

(31) *Deriving* dubar *from* diber ('.' indicates a syllable boundary)

/d b r/+/u a/	ONSET	*COMPLEXCODA	*COMPLEXONSET	NOCODA
(a) .dbrua.			*!	
(b) .du.abr.	*!	*		*
(c) .dbu.ra.			*!	
(d) .ud.bar.	*!			*
☞ (e) .du.bar.				*

The best syllabification happens to also be the optimal form, *dubar*. Under this view, Hebrew morpheme position can be viewed as a result of phonological well-formedness exerting a strong influence on the morphology,

consistent with the overall theme of this chapter. Interestingly the issue of templatic effects – the rampant bisyllabicity of the verbal system – becomes secondary in the root-based approach because the lexical specification of the input in the root-based approach happens to contain exactly two syllables' worth of material.

19.5 Conclusion

In conclusion, this chapter has presented data that illustrate the different ways in which morpheme positions are manifested, and how morpheme position may be phonologically influenced. The essential claim of the chapter, after McCarthy & Prince (1986 et seq.), is that affixes come in two main flavors: prefixes and suffixes, and any deviation from position at the left or right edge is phonologically based. Aside from the interesting case of infixes, the chapter examined interfixes, as exemplified by the nonconcatenative systems typified by Semitic languages.

Questions regarding morpheme position remain. For instance, a strict interpretation of the prosodic morphology hypothesis holds that alignment to only prosodic categories can influence the position of an affix, but recent work (e.g. Yu 2003) provides compelling evidence for a broader view whereby sub-prosodic constituents (such as single consonants) must be referred to. Yu also discusses the historical basis for many cases of infixation, though this approach remains difficult to implement in a purely synchronic theory of morpheme position.

Notes

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1 Subsegmental/featural morphemes are not addressed here; readers are referred to the work of Lieber (1987), Akinlabi (1996), Rose (1997), Kurisu (2001), and Zoll (2001).
2 The [e:] suffix in the Afar verbal forms is an aspect marker. The transcription of tone in these examples has been suppressed, as it is not relevant to the discussion here.
3 See recent work by Graf (2005) for more on the distinction between hybrid and non-hybrid affixation in Semitic.
4 'Binyan' (plural='binyanim') here refers to the verbal class, and is the traditional term used in Semitic linguistics to describe classes of verbs that share phonological, morphosyntactic, and semantic features.

Binyan is equivalent to Classical Arabic 'measure', and to Maltese 'theme', and refers to the phonological structure, the morphosyntactic structure, and the semantic content of verbs.

5 The prosodic categories PrWd (prosodic word), Ft (metrical foot), and σ (syllable) are represented in these hierarchical structures, following work in prosodic phonology and morphology (Selkirk 1980a, b, among many others).

6 See the recent work of Bat-El (2003) and Graf (2005) motivating these and other constraints on syllable structure in Hebrew.