A Correspondence Theory of Morpheme Order

Since McCarthy & Prince (1993), it has been commonly assumed in Optimality Theory that the direction of attachment of affixes is regulated by morpheme-specific ALIGN constraints: a morpheme M is a prefix if there is a constraint ALIGN(M, Left, Stem, Left), while M is a suffix if the constraint is ALIGN(M, Right, Stem, R). An alternative to this theory is offered here. In this approach, an affix's direction of attachment is marked in its lexical entry. Informally, this proposal employs an 'empty slot', represented as □. In prefixes, the empty slot appears at the right edge of the string – e.g. *un-* is /ʌn□/, while in suffixes it appears at the left edge – e.g. *-ness* is /□nəs/. This approach can be seen as giving theoretical status to the '-' in the standard informal way of writing prefixes and suffixes: *un-*, *-ness*. In formal terms, the present proposal is that phonological strings may be *partial* functions from indices to members of the phonological alphabet (see Partee, ter Meulen, & Wall 1987:432). An empty slot, then, is an index that does not map onto a phonological formative.

I assume that the input to phonology consists of an unordered set of morphemes. So, when the morphemes *un-* and *pin* are input, for example, their phonological sets /ʌ$_1$n$_2$□$_3$/ and /p$_4$ɪ$_5$n$_6$/ combine to form many different candidate outputs. At this point, standard correspondence constraints determine the outcome (McCarthy & Prince 1995). The ones of present importance are MAX-IO, which prevents deletion, LINEARITY, which preserves precedence relations, and UNIFORMITY, which prohibits output elements from corresponding to more than one input element. With MAX-IO ranked above the other faithfulness constraints, the most harmonic candidate is [ʌ$_1$n$_2$p$_{3,4}$ɪ$_5$n$_6$], with the underlying /3/ and /4/ slots corresponding to the single [3,4] slot. This candidate does not violate LINEARITY, but violates UNIFORMITY. Other possible candidates are less harmonic out as they are harmonically bound by this form – there is no ranking in which they incur fewer violations (with MAX ranked high, violation of UNIFORMITY is unavoidable). The only form which obeys all constraints is [ʌ$_1$n$_2$□$_3$p$_4$ɪ$_5$n$_6$], but this is eliminated because empty slots are uninterpretable. So, faithfulness constraints conspire to produce the correct concatenated form. Suffixal concatenation proceeds in an analogous fashion.

As shown in the example above, a UNIFORMITY violation is forced by the higher-ranked MAX. This UNIFORMITY violation is essential if two morphemes are to form one morphological constituent since (as I propose) two morphemes can only form one morphological constituent if they are 'linked' – i.e. if one output slot corresponds to input slots in the two morphemes. Before considering the typological implications of this, there is another relevant constraint: Beckman (1998) shows that faithfulness constraints have specific instantiations for prominent positions. Since one of those positions is the initial position in a stem, there is a constraint UNIFORMITY-1, banning a stem-initial segment from having two input correspondents. Significantly, there are no such constraints for final position.

These constraints produce a typology of concatenation systems:

- MAX » UNIFORMITY, UNIFORMITY-1: No concatenation – an isolating language (e.g. Mandarin).
- UNIFORMITY » MAX: concatenation is allowed – both prefixes and suffixes (e.g. English)
- UNIFORMITY-1 » MAX » UNIFORMITY: concatenation is allowed – but *only suffixal* (e.g. ?)

In the last case, initial attachment (prefixation) is not allowed as this necessarily involves a UNIFORMITY-1 violation (e.g. [ʌ$_1$n$_2$$\underline{\text{p}_{3,4}}$ɪ$_5n_6$]). Significantly, there is no ranking in which only prefixes are allowed, but not suffixes. This explains the typological universal to this effect: if a language has prefixes, it also has suffixes, but not vice-versa (Greenberg 1957, 1966; Hawkins & Gilligan 1988; Bybee, Pagliuca, and Perkins 1990; Hall 1992).

A number of other empirical consequences are shown to following from the various rankings of faithfulness constraints. These account for the ordering relations between class I and II affixes (Siegel 1974), the typological differences between segmentally specified and reduplicative morphemes (Harvey 1998), and explain the behavious of various types of affixes (e.g. infixes and variable-direction affixes – Fulmer 1997).

From the theoretical side, the results are also desirous. No constraints have been added to the theory: all constraints used are of the correspondence variety (McCarthy & Prince 1995, Beckman 1998). In fact, a large number of constraints have been eliminated since morpheme-specific constraints are no longer needed. The only theoretical change is that the phonological strings have been redefined as partial functions.

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There is only one candidate, though, in which all underlying slots can be preserved (due to MAX-IO) while the ordering relations between slots are preserved (due to LINEARITY): [$\text{ʌ}_1\text{n}_2\text{p}_{3,4}\text{ɪ}_5\text{n}_6$]. In this candidate, the underlying empty slot of *un-* and the slot containing the /p/ of *pin* have coalesced into one slot, indicated as $_{3,4}$ here. Other candidates are ruled out for a variety of reasons: (1) [$\text{ʌ}_1\text{n}_2\text{p}_4\text{ɪ}_5\text{n}_6$] with deletion of □ violates MAX-IO, (2) [$\text{ʌ}_1\text{n}_2\square_3\text{p}_4\text{ɪ}_5\text{n}_6$] is uninterpretable since it has an empty slot in the output, (3) [$\text{p}_4\text{ɪ}_5\text{n}_6\text{ʌ}_1\text{n}_{2,3}$] violates LINEARITY since 2 no longer precedes 3, and (4) [$\text{p}_4\text{ɪ}_5\text{n}_{6,1}\text{ʌ}_2\text{n}_3$] violates IDENT since slot 2 no longer contains /n/. The last two candidates show that a form with an underlying empty slot at its right edge must be concatenated with the left edge of another string, otherwise a constraint is violated. The only constraint that the acceptable output [$\text{ʌ}_1\text{n}_2\text{p}_{3,4}\text{ɪ}_5\text{n}_6$] violates is UNIFORMITY, since two underlying slots (3 and 4) correspond to one output one (3,4). This same reasoning can be used for the concatenation of a stem and a suffix.

The UNIFORMITY violation is crucial. Two morphemes can only form part of the same morphological constituent if they are 'linked' – i.e. if an output slot correponds to input slots in the two morphemes. Hence, a UNIFORMITY violation is essential if two morphemes are to be joined into one morphological constituent. As Beckman (1998) demonstrates, faithfulness constraints can refer to initial position, so there is a constraint UNIFORMITY-σ_1. The constraints MAX-IO, UNIFORMITY, and UNIFORMITY-σ_1 produce a typology of ranking:

- MAX » UNIFORMITY, UNIFORMITY-σ_1: an isolating language – no morphological concatenation
- UNIFORMITY » MAX: concatenating language with both prefixes and suffixes
- UNIFORMITY-σ_1 » MAX » UNIFORMITY: concatenating language, with prefixes <u>only</u>.

Importantly, there is no ranking which would produce a language which has only prefixes, and no suffixes. This explains the implicational relationship between affixes: if a language has prefixes, it also has suffixes, but not vice-versa The typological distinction between isolating and concatenating languages is also achieved in this study.

(discussed further below). This approach is argued to enjoy both empirical and conceptual advantages over the constraint-based model. On the empirical side, it accounts for the implicational relationship between prefixes and suffixes (Gilligan & Hawkins 1988; Bybee, Pagliuca, & Perkins 1990), ordering restrictions between class I and class II affixes (Siegel 1974), and the difference between isolating and non-isolating languages.

A number of other empirical consequences arise from this. A variety of affixal types are shown to be predicted by ranking faithfulness constraints in various ways, including variable-direction affixes (refs?). Desirable results for reduplication and infixation are also shown to follow from this.

In short, the empirical benefits of this approach are many: the 'if prefixes then suffixes' generalisation is explained, as is the ordering relation between class I and class II affixes. The difference between segmentally specified morphemes and reduplicative morphemes is also shown to follow.

From the theoretical side, the results are also desirous. No constraints have been added to the theory: all constraints used are of the correspondence variety (McCarthy & Prince 1995, Beckman 1998).
In fact, a large number of constraints have been eliminated since morpheme-specific constraints are no longer needed. The only theoretical change is that the phonological strings have been redefined as partial functions.

This idea returns to ideas that lexical entries are marked for direction of attachment (Sproat 1985, Lieber 1990).

Issues: infixes

1. The proposal
2. The implementation
3. The Empirical facts.
4. Objections
5. Conceptual advantages – added *no new constraints*. Only change: partial functions.

it is a well-established fact that a string consists of a finite set of ordered indices and a function from those indices to members of the phonological alphabet (i.e. features – segments are used here for simplicity's sake) (Partee, ter Meulen, & Wall 1987:432). For example, the string /kæt/ is properly described as {<1,k>, <2,æ>, <3,t>}, where 1 precededs 2 and 2 precedes 3. In all previous linguistic works, it has been assumed that strings are *total* functions: every index maps onto a phonological formative. The proposal in this paper is that they are in fact *restricted partial* functions: indices do not need to map onto a formative if they are peripheral in the string. This allows prefixes and suffixes to be differentiated: a prefix is a partial function with an unmapped index at its left edge, while a suffix has an unmapped index on its right edge. For example, the English prefix *un-* is {<1, ʌ>, <2,n>, 3}, or /ʌ$_{1}$n$_{2}$ $_{3}$/ for short. The suffix –*ness*, in comparison, is / $_{1}$n$_{2}$ə$_{3}$s$_{4}$/.