Phonology at Santa Cruz, Vol.4, 1995, pp. 57-68

An Alignment Solution to Bracketing Paradoxes

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1 Introduction and background

This paper attempts to give an account of bracketing paradoxes by developing the theory of alignment (McCarthy and Prince 1993b). The rubric 'bracketing paradox' (BP) has been used to cover a number of disparate phenomena, though it is not obvious that these phenomena should be given a unitary analysis. I will confine my attention here to the kind of BP illustrated in (1).

(1) ungrammaticality
undecidability
unkinder
unhappier
untruth
underestimation
reburial
decongestant

Bracketing paradoxes of this type arise from the discrepancy between the bracketing required by the meaning and the syntactic subcategorization as in (2a) and that required by the morphological subcategorization as in (2b).[1] The prefix *un-* attaches (regularly) only to adjectives and the resulting complex is an adjective (in accordance with Williams' (1981) Right-hand Head Rule), and *-ity* attaches to adjectives creating a noun. The compound has the regularly compositional meaning contributed by its parts: the property (*-ity*) of being not (*un-*) grammatical.

(2) a. $[[\text{un } [\text{grammatical}]_A]_A \text{ ity}]_N$ b. $[\text{un } [[\text{grammatical}]_{Rt} \text{ ity}]_{St}]_{St}$

Thanks to Junko Itô for helpful comments on an earlier draft and to the editors for corrections on the current version. I retain sole responsibility for remaining shortcomings or oversights.

[1] Semantically motivated BPs such as *four-legged* or *transformational grammarian*, discussed in Williams 1981, Spencer 1988, 1991, and NLLT 1993, will not be under consideration here.

The bracketing in (2b) is motivated by the observation that there is a regularity in the distribution of two classes of affixes in English, nonneutral ('level 1') and neutral ('level 2'), corresponding to a range of phonological processes. This generalization was first studied by Siegel (1974), and is known as the Level Ordering Hypothesis (Allen 1978) or the Affix Ordering Generalization (Selkirk 1982, 1986) (henceforth AOG).

The two competing types of selectional requirements at play in these constructions are illustrated in the lexical entries in (3). The prefix *un-* belongs to 'level 2' (i.e., attaches to a Stem) but selects an adjective, whereas the suffix *-ity* is 'level 1' (attaches to a Root) and selects a Adjective. Being a suffix, *-ity* itself has a syntactic category (or bundle of syntactic category features), represented by the subscripted N. I will refer to the morphological category membership as encoding the AOG and fulfilling the requirements of the morphology, and the syntactic subcategorization frames as fulfilling syntactic selectional restrictions.

(3) Lexical entry schema:

	phonological specification	*morphological category*	*syntactic frame*
un-	/un/	Af_2	__Adj
-ity$_N$	/iti/	Af_1	Adj__

BPs have been the subject of much work in generative morphology, with various solutions proposed. Two approaches have predominated: those which attempt to assimilate the syntactic bracketing to the morphological, and those which take the morphological as primary and derive the syntactic/semantic.

The first approach is exemplified by Sproat (1985, 1988), who invokes a theory of non-concatenativity in his 'Mapping Principle' which allows him in effect to rebracket [[ungrammatical]ity] as [un[grammaticality]]. Strauss (1982) does not rebracket, but rather relaxes the requirements of level-ordering, claiming that they apply only to affixes which appear on the same side of stem. Aronoff and Sridhar (1983, 1987) go one step further, denying the existence of level ordering; they treat the 'semantic' bracketing as [[un grammatical] ity] but generate the phonologically relevant prosodic bracketing (un (grammaticality)), treating *un-* like a clitic, fully parallel to (an (apple)).

The second approach is taken in Kiparsky (1983). Kiparsky invokes a mechanism of reanalysis and allows exceptions to the application of bracket erasure within Lexical Phonology, turning [un [[grammatical]$_A$ ity]$_N$] into [[un [grammatical]$_A$]$_A$ ity]$_N$. A similar tack is found in Pesetsky (1985), where the paradoxes are resolved by claiming that affix ordering constraints apply at (or before) S-structure, but that a rule of 'morphological QR' occurs before LF, where the syntactic subcategorizational restrictions are met and the form is interpreted. A variation on this theme is to claim that the morphological restrictions are all that is relevant, and leave the interpretation to some other theory. This approach is taken by Lieber (1980) and Selkirk (1982), who argue that the paradoxes can be ignored in the morphological component, and that the discrepancy in meaning will be taken care of by the lexical semantic component. A similar approach is that of Williams's (1981) notion of 'lexical relatedness', which deals well with the semantics of forms like *macroeconomist*, but which still offers no solution to the purely syntactic subcategorization violations of *ungrammaticality*, a weakness it shares with Lieber and Selkirk's accounts.

What most of these approaches have in common is an element of rebracketing. These alternatives can be summarized as follows (adapting Anderson 1992:263-4):

I. Construct the form respecting the AOG (i.e., by first adding *-ity* at level I and then *-un* at level II), then either rebracket to fulfill syntactic selectional restrictions and serve as the basis of semantic interpretation (Kiparsky, Pesetsky) or leave the 'rebracketing' to some other component (Lieber, Selkirk, Williams).

II. Construct the form the way the syntax/semantics seems to indicate in violation of the AOG, then either rebracket before the application of phonological rules (Aronoff and Sridhar, Sproat) or reject the AOG in these cases (Strauss).

In this paper, I will propose a solution to the ungrammaticality kind of BP which relies on neither of the above tactics. Under a proper interpretation of alignment and a correspondingly developed theory of morphology, no rebracketing is necessary to satisfy both morphological and syntactic restrictions. My analysis proposes that the kind of morphological constituent structure assumed in most formalisms in accounting for the AOG is unnecessary and should be replaced with purely Alignment-theoretic notions of 'constituency', in which immediate dominance and linear precedence are determined independently and fully-developed 'tree' structures of the familiar kind are not employed.

2 General considerations of morphology

2.1 Morphological assumptions in OT

The seminal works in Optimality Theory (especially Prince and Smolensky 1993 and McCarthy and Prince 1993a) did not concentrate on developing a theory of morphology. The main principles of Gen mention morphology only once:

(4) a. Freedom of Analysis. Any amount of structure may be posited.
b. Containment. No element may be literally removed from the input form. The input is thus contained in every candidate form.
c. Consistency of Exponence. No changes in the exponence of a phonologically-specified morpheme are permitted.

In fact, Freedom of Analysis seems to refer only to phonological/prosodic structure in general, not to morphological structures, i.e., Gen is not free to underparse or fill morphological categories at will. Ideally, it seems, rebracketing would be ruled out in OT on theoretical grounds: OT in general need not countenance more than one level of phonological analysis. Even though McCarthy and Prince's weaken this slightly (with their rule of bracket erasure (1993a:147ff.)), they concur with the conclusions of Inkelas (1989:56-7) that only prosodic and not morphological analysis is subject to bracket erasure. The role of Containment for morphological analysis is thus voided, since Freedom of Analysis does not apply.

Prince and Smolensky (1993) do however explicitly claim that morphological structure "can be understood as something the input lacks and the output has, the product of parsing" (p.49). Under this view, an input would consist simply of an unordered set of morphemes, e.g., {root, affix}. Possible parses of this input include [Root Af]$_{Stem}$ and the null parse <root, affix>. They give as an example the English comparative suffix *-er*, which they claim attaches only to (one-foot) Minimal Words. Thus for an input {violet, er} the null parse <violet, er> is superior to the parsed [violet-er], since the appropriate morphological Align constraint (Align(-er, L, MinWd, R)?) is presumably higher-ranked than their posited M(orphological)-Parse. Let us put aside this conjecture about the powers of Gen and retain the conservative standard view for the time being, though we will have cause to return to this question below.

Just as Gen cannot add or delete morphological structure, neither can it alter the morphological constituency of an input form, by Consistency of Exponence -- for example, by changing a Stem into a Root. This being the case, it is incumbent upon us to define precisely what kinds of morphological constituents we are to assume. Notice that this restriction upon Gen makes a powerful prediction: in contrast to the freedom of analysis posited for prosodic constituency, morphological specifications and, crucially, morphological structure, are prespecified by some independent theory of morphology and are present in the input to Gen. Although McCarthy and Prince (1993b) assume basically a set of phrase-structure rules which build morphological structures similar to X-bar syntactic structure following Selkirk (1982) and Mohanan (1986), their theory of Alignment in fact makes no direct reference to these posited structures at all. Alignment deals only with edges, not with tree structure. McCarthy and Prince assume the hierarchy in (5) (p.6):

(5) Morphological Hierarchy (ignoring compounding)
- a. MWd ∅ Stem*
- b. Stem ∅ Stem, Af
- c. Stem ∅ Root

As they point out, (5) "specifies constituency relations but not linear order of stem and affix ... [the hierarchy] represents a commitment only to the hierarchical organization of the constituent morphemes, not to linear ordering or continuity of the terminal string" (ibid.). This interpretation of the rules in (5) is a departure from the traditional interpretation, as employed in Selkirk 1982, for example. This dominance-but-not-precedence interpretation of such rules (note the comma in the second rule) is in the tradition of Generalized Phrase Structure Grammar (GPSG), following Pullum's (1982) and Pullum and Gazdar's (1982) distinction between immediate dominance (ID) rules and linear precedence (LP). The schema in (5) thus specifies only ID relations.

Of course, the schema in (5) is too simple to deal with the data under consideration here. Adapting the above in light of the AOG, I will employ the schema in (6) in the following discussion (Stem = Selkirk's 'Word').

(6) a. MWd ∅ Stem*

b. Stem ∅ Stem, Af_2
c. Stem ∅ Root
d. Root ∅ Root, Af_1

Given that (6) specifies the ID relations, it remains to develop a theory of how LP relations are determined. Instead of employing rules of the format in Pullum and Gazdar (1982), we have at hand already a theory of such relations: Alignment. Alignment does not specify linearity directly of course, but rather by the effects of transitivity, given that edges are immutable. Thus in the conception of morphology assumed here, LP statements as such do not exist, nor does the schema in (6) make any predictions about such order; rather, all effects of seeming concatenation, for example, are products of Align constraints over the affected morphemes. (I shall return to the question whether ID relations can similarly be incorporated into Eval as constraints.)

In practice, such constraints take the form of individual constraints with individual morphemes as arguments, as in McCarthy and Prince's (1993b) Align([um]Af, L, Stem, L) for Tagalog (adapting Prince and Smolensky's (1991) account). Clearly it would be preferable to be able to generalize this type of LP statement for all morphemes which it affects. The AOG can be captured in alignment terms, for example, by the constraints given in (7) and (8):

(7) a. Align(Af_1, R, Rt, L) 'level 1' prefix
b. Align(Af_1, L, Rt, R) 'level 1' suffix

(8) a. Align(Af_2, R, St, L) 'level 2' prefix
b. Align(Af_2, L, St, R) 'level 2' suffix

Lexical entries, such as those in (3) above, specify the first two arguments of this alignment schema, namely their morphological category (Af_1 or Af_2) and the edge to be aligned (indicated by a single dash (-) before or after the affix in (3)). Astute and formally minded readers will notice that the specification of edges is over-determined or redundant, since we are assuming that the addition of an affix to either a Root or Stem results in another Root or Stem; as McCarthy and Prince (1993b:38) put it, "each suffix is assumed to create a new stem category recursively". Since the schema in (6) ensures that, for example, a Root can only dominate another Root and an affix, but never a Stem, we could factor one argument out of the constraints in (7) and (8). For example, Align(Af_1, R, Rt, L) = Align(Af_1, L, Rt, L); we can abbreviate the latter as AlignL(Af_1, Rt). This condensed notation gives us the constraints in (9) and (10):

(9) a. AlignL(Af_1, Rt) 'level 1' prefix
b. AlignR(Af_1, Rt) 'level 1' suffix

(10) a. AlignL(Af_2, St) 'level 2' prefix
b. AlignR(Af_2, St) 'level 2' suffix

In fact, the constraints in (7, 8) make different predictions from those in (9, 10) in crucial cases, under the revision of the nature of higher morphological constituency to be argued for below. For this reason, I will retain the original formulations.

As with any posited alignment constraint, one should immediately ask what it would mean to exchange the arguments. In fact, the mirror-image constraints to those in (7, 8) seem to be little needed in the morphology of English. One group of potential candidates for Align(Rt, L, Af_1, R) might be the so-called bound roots such as *-mit, -ceive, -pose, -fer* of *permit, receive, propose, refer*.[2] Another possible group of candidates would be the roots and stems in languages with obligatory affixes or theme vowels (Algonkian, Athapaskan, Bantu in the first group, the Romance languages in the second). One might even explore the relation of inflectional morphology in this framework, especially given the various claims in the literature regarding its place in morphological composition. All of these considerations are beyond the scope of the present paper, however. For our purposes, it will suffice to limit ourselves to the constraints in (7) and (8).

2.2 Build or license?

The interpretation of alignment constraints is well known; I will assume here the general framework of McCarthy and Prince 1993b with the revision argued for in Itô and Mester 1994. But how are we to interpret the schema in (6)? Under one interpretation of context-free phrase-structure grammars (CF-PSGs), these rules build structure directly. In other words, any node labelled 'Stem' can be expanded either by two nodes, labelled 'Stem' and 'Affix$_2$', or by a single node labelled 'Root'. Under another interpretation, rule schemata as in (6) simply license structure, which is freely generated. This second interpretation is that usually given to subcategorization frames. In either interpretation, we could write *affix$_1$,* Root__ and *affix$_2$,* Stem__ instead of the rules in the 'rewrite' format of (6); i.e., replace the category information by subcategorization frames. The information encoded in the lexicon is the same under both interpretations, although they are not notational variants -- the first requiring that the rules in (6) build structure, the other merely that they license structure projected from the lexicon. That this is the case can be seen by examining the simple PSG given in (11):

(11) S ∅ A B
A ∅ α / __β
B ∅ β / α__

The tree in (12) is licit under the 'licensing' interpretation of the schemata in (11), but not under the 'build' interpretation.

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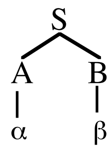
[2] Of course, one could turn the tables and claim that this was a fact about the alignment constraints holding of the prefixes *per-, re-, pro-*, etc., with the selectional restrictions of these prefixes and bases eliminating all other pairings. A third approach is to deny the independent morphological existence of such 'quasi-morphemes', since no meaning can be assigned to either the prefix or the base in these forms: only the entire form has a meaning, which is non-compositional and opaque.

(12)



Under the licensing interpretation, every node in the tree is licensed: S is allowed to dominate nodes labelled A and B, A is allowed to dominate α iff A precedes β, and B can dominate β iff α precedes B. But it is easy to see that no algorithm for construction employing the rules in (11) could generate the tree in (12), since in order for A to be able to 'build' an α below it, it would have to precede a β, which could only be the case if B had already 'built' a β below itself, which could not occur until A had 'built' an α, and so on.

Although I cannot see anything at present that hinges upon one assumption or the other, let us assume, in the general spirit of OT, that the schemata in (6) license structure, rather than build it directly. At this point, the mechanism in (6) lies outside the domain of OT *sensu stricto*, comprising a separate morphological component, whose output is the input to Gen. Without independent motivation for such a component, however, the null hypothesis is that it does not exist. The effects of such a component can be replaced by placing the morphological hierarchy in (6) in Gen, parallel to the prosodic hierarchy, and allowing morphological structure to be generated there.[3] Returning to the discussion in Prince and Smolensky 1993:49 regarding morphological structure as a product of parsing, we can envision morphological structure indeed as "something that the input lacks and the output has", though of a somewhat less constrained nature than prosodic structure. Whereas no recursion of σ or Foot is possible, recursion of a limited nature is allowed by the schema in (6). (Notice that in this respect, morphological structure is still more constrained than syntactic structure, which allows mother categories such as VP to recur dominated by daughter categories such as DP.) Let us assume then that higher morphological constituency is generated freely within the limits set by (6) (with one revision to be introduced in §3). Specifically, I see no reason to assume that constraints of the family M-Parse exist -- I assume here that every morpheme must be parsed by a higher morphological category if possible, terminating every word (in Bloomfield's (1933:178ff) sense of 'minimum free form') in an MWd. Actually, this distinction (termination at MWd) is somewhat arbitrary, since the input string of unordered morphemes has in fact always been assumed to comprise the constituents of an MWd to begin with (as in Prince and Smolensky's example {violet, -er}). One could easily imagine an extension of the structure building capabilities of Gen for a string of unordered morphemes to the level of an entire Clitic Group, and X-bar syntax beyond (see Grimshaw (1993) for such work), though this will not be considered here.

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[3] Alternatively, one might consider that (6) represents a series of universally highly-ranked constraints, though perhaps violable; pursuing this line of thought could allow one to develop an account of bracketing paradoxes distinct from the one proposed here. But without further motivation for such a move, it is preferable to leave the morphological hierarchy in Gen.

2.3 Dominance without trees

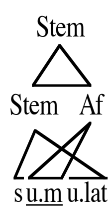
Dominance is a well-defined relation independent of the precedence relations of the daughters of a particular node. The innovation of the present view of morphology is that there are no 'precedence' relations as such. Rather, the role of precedence relations has been subsumed under alignment. Although the difference in conception between these two approaches may not be immediately apparent when dealing with a basically concatenative morphological system as in English, the advantages of the latter view become apparent when accounting for seemingly non-concatenative processes such as infixation. Let us take the now familiar case of *-um-* infixation in Tagalog, which marks actor focus in a certain class of verbs, as an example (from Anderson 1972, French 1988, McCarthy and Prince 1993b).

The affix *-um-* is subject to the constraint AlignL([um], Stem), which is dominated by NoCoda. This ranking gives us the pattern of data seen in (13):

(13) a. u.ma.ral 'teach'
b. su.mu.lat 'write'
c. gru.mad.wet 'graduate'

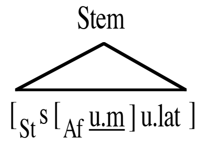
The prosodic bracketing and constituency of these forms is obvious, and demonstrate McCarthy and Prince's posited universal ranking **P** » **M**. But what is their morphological constituency? The standard prohibition against crossing lines (the Nontangling Condition) rules out the structure given in (14):

(14)



Several possible approaches to this problem could be pursued (perhaps one could motivate separate morpheme tiers, etc.). I propose instead that morphological categories of terminal elements themselves determine constituency and that relevant morphemic boundaries are calculated directly from the phonological exponence of the morpheme. This is a very old notion in some ways, similar to the SPE (Chomsky & Halle 1968) convention of bracketing. Under this conception there is no principled way to draw "connecting lines", i.e., tree structures, from morphological constituents provided by Gen in accordance with (6) to the 'inherent' morphological constituency of the terminal string phonological projections of morphemes in the lexicon. It is this 'inherent' morphology which the lexicon provides and which Gen cannot delete, add to, or alter. Higher morphological levels, on the other hand, like prosodic levels above the mora, are freely generated by Gen. The form in (13b) will have the diagrammed 'tree' structure given in (15a), which can be seen less perspicuously in the bracketed representation of (15b). In both cases the interior brackets of Stem and Affix are simply jogs for the eye to remind one of the respective inherent morphological constituency.

(15) a.



b. $[_{St}[_{St}$ s$[_{Af}$ <u>u.m</u>]u.lat]]

The ramifications of this proposed structure for alignment constraints are subtle. Since Alignment makes use of the downward-tracing relation *is-the-content-of*, we must define this relation for bracketed morphemes such as those in (15). Itô and Mester (1994:12) define *is-the-content-of* as follows: "a terminal substring A *is-the-content-of* a category Cat_1 iff A is the maximal terminal substring dominated by Cat_1". Under this formulation, neither *sulat* nor *-um-* will be-the-content-of the highest Stem, since neither is the maximal dominated substring. Nor, strictly speaking, will either be-the-content-of its own projected Stem or Affix, respectively, since in the present conception, these categories do not dominate the phonological string which is their exponence. Let us take the relation is-the-content-of (or is-a, for that matter) to be well-defined for these cases as well, namely by modifying the definition of is-the-content-of to include 'inherent contentfulness' along the following lines:

(16) A terminal substring A *is-the-content-of* a category Cat_1 iff A is the maximal terminal substring dominated by Cat_1 or A is the lexically specified phonological exponence of a morphological category Cat_1.

This captures the intuition embodied in Consistency of Exponence that epenthetic segments which appear within a morpheme are not part of the morpheme, since any such segments would not be lexically specified. Whether there is an interesting difference between this definition, which relates the phonological material in a lexical entry like (3) to the morphological category, and one based on the opposite orientation (e.g., an Affix has-as-its-content *-um-*, going from the morphological specification to the phonological), seems unlikely, since I know of no a priori evidence for giving one or the other informational primacy. Perhaps learnability issues would prefer the former conception.

Since there is no dominance relation involved in inherent content, there can be no difference the material selected by an upward-tracing relation like is-a and a downward-tracing relation like (the unrevised) is-the-content-of. One could imagine parameterizing Itô and Mester's (1994) definition of crispness to include MCat as well as PCat in the following manner: for any substring A, C a Cat, A the-content-of C, C is crisp iff A is-a Cat. But recall that there is no difference for MCats between the relations be-a and be-the-content-of. Therefore, all MCats are crisp.

This is admittedly a weakening of the original definition, since I have introduced a disjunction, but this seems necessary, in light of the impossibility of assigning coherent non-tangling tree structures to forms involving infixation, among others.

Alternatively, one might pursue a different notion of morphological constituency entirely, one where the nature of inherent contentfulness could predict the observation that alignment involving MCat is not gradient. One tack along these lines might be to link the categoricality of violation to the impossibility of the decomposition function returning a value for inherent MCats. This would necessitate a revision of the definition of alignment for MCats. For our present purposes, however, the conception of alignment described above is sufficient, and I will have nothing more to say about the categorical nature of MCat alignment violations.

2.4 Summary

The picture of morphology that emerges from the above deliberations can be summarized as follows:

i. The morphological hierarchy is a schema that licenses higher-level morphological structure which is freely generated by Gen.
ii. Since an affix A aligns with a base category B which is identical to that which dominates A (an affix is licensed under recursion of the base category), the Edge argument is redundant.
iii. Lexical entries determine inherent morphological constituency. This constituency can be referred to in alignment, though the labels Af_1, Af_2, and Root at this level are not associated with nodes in any graph-theoretic sense.

3 Bracketing paradoxes

We now turn to the application of the apparatus outlined above. Recall the basic nature of the problem arising in BPs is the discrepancy between the structure needed to satisfy semantic compositionality and syntactic subcategorization, and that seemingly required by the AOG:

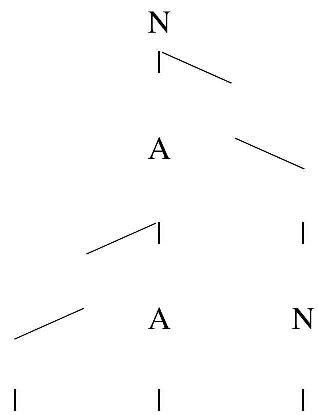
(17) a. [[un [grammatical]$_A$]$_A$ ity]$_N$ b. [un [[grammatical]$_{Rt}$ ity]$_{St}$]$_{St}$

But we have replaced a level-ordered derivational account of the AOG by the Alignment constraint family of (7) and (8) above. The relevant two members of this family are repeated in (18):

(18) a. Align(Af_1, L, Rt, R) 'level 1' suffix
b. Align(Af_2, R, St, L) 'level 2' prefix

Employing these constraints, we see that a structure respecting the syntactic selectional restrictions can also fulfill the alignment constraints of (18). One possibility is that the syntactic restrictions are what is involved in the word-formation component, based on idiosyncratic lexical information, and that structures such as (19), with the syntactic categories determined (whether represented by tree structure as here or by feature-percolation/changing Word Formation Rules) and with no morphological structure beyond the inherent content, are the input to Gen.

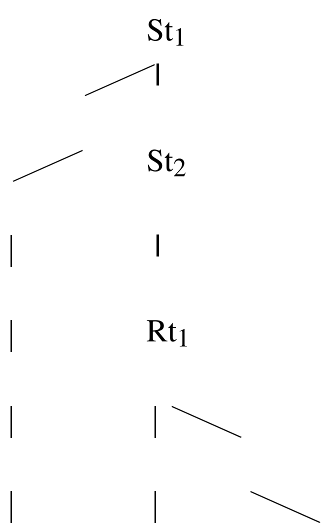
(19)



$[_{Af2}$ un] $[_{Rt}$ grammatical] $[_{Af1}$ ity]

Gen is then free to posit higher morphological constituency in accordance with the schema in (6). Only one such candidate is available, if we construe (6) as part of Gen, namely that given in (20):

(20)



$[_{Af2}$ un] $[_{Rt2}$ grammatical] $[_{Af1}$ ity]

The standard definition of *be-the-content-of* will apply regularly to decompositions of the higher constituent structure, yielding well-alignment of *-ity* with Rt_2 (I use subscripts on the base categories to distinguish them) in fulfillment of (17a). Likewise, Gen is free to posit a Stem (St_2) dominating Rt_1, to which *un-* is well-aligned. This conception of the interaction of the lexicon and Gen in effect claims that syntactic requirements are not relevant for the morphology beyond inherent content. The morphological structure which is claimed to be relevant to the evaluation of constraints is just the inherent content and whatever structure is posited by Gen. Given the restrictive nature of the schema in (6), however, it is reasonable to ask whether such schemata are necessary, and if so, whether they should be in Gen or violable constraints. Let us assume for now that some such schemata are necessary. What would the effect be of allowing them to be ranked among other constraints?

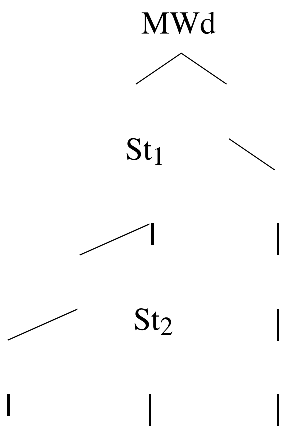
If we view the morphological hierarchy, like the prosodic hierarchy, as defining a family of Parse constraints, we will have the constraints given in (21).

(21) a. Parse(Af_1): An Af_1 should be parsed by a Root
b. Parse(Af_2): An Af_2 should be parsed by a Stem
c. Parse(Rt): A Root should be parsed by a Stem
d. Parse(St): A Stem should be parsed by an MWd

Gen has more leeway to violate these constraints, however. In addition to possible parsing of, for example, an Af1 into a Stem, in violation of P(Af_1), recursion is also possible: Rt may be parsed by Rt, violating P(Rt). Such a situation arises exactly when forced by perhaps universally higher-ranked Align(MCat) constraints.

Consider first a possible structure such as (22), which parallels that of (19):

(22)



[$_{Af2}$ un] [$_{Rt}$ grammatical] [$_{Af1}$ ity]

Here there are two violators: parsing *-ity* into MWd directly violates P(Af_1), and the recursion of Stem violates P(St) (St_2 incurring the violation). All Alignment constraints are satisfied, since *un-* is aligned with the edge of St_2, and *-ity* aligns with Rt. Compare the structure in (19), which incurs violations of P(Rt) and P(St) (assuming there to be a higher MWd that parses St_1). If there were some reason to prefer the parallel structure of (22), we could rank P(Rt) » P(St), P(Af_1), since only (19) violates P(Rt). However, given standard ideas about morphology, it seems obtuse at best to penalize recursion (beyond whatever Fill constraints penalize structure per se). To eliminate these violations, we must introduce a disjunction into the relevant Parse constraints:

(23) a. Parse(Rt): A Root should be parsed by a Root or a Stem
b. Parse(St): A Stem should be parsed by a Stem or an MWd

With this revision, the structure in (19) incurs no violations at all, while (22) incurs only a violation of P(Af_1). Since the Alignment constraints are equally satisfied in both cases, no recourse can be made to them as formulated to help select (22) over (19). Notice that it is in these kinds of cases (Parse violations) where the formulations in (7, 8) make different predictions from those in (9, 10). The collapsed versions of (9, 10) require same-side alignment of the affix and base category, which is only fulfilled if the base category recurs.

Thus purely morphological considerations will always prefer structures which are well-behaved with respect to the AOG and Parse family. Competing with these considerations are the syntactic selectional restrictions, however. In the view sketched so far, these can have nothing to say, since the syntactic 'structure' they require is part of the input to Gen, and is in effect not relevant or even visible to morphological constituency. This may be the correct approach, generalizable to other types of bracketing paradoxes, but one other obvious possibility is that they too are but violable constraints (cf. GENDER of Tranel 1994). If the mechanism for fulfilling these syntactic subcategorization frames and the resulting feature sharing can be formalized in OT (along the lines of GPSG and Head-driven Phrase Structure Grammar treatments, presumably), we could truly leave all structure building to Gen. The input for *ungrammaticality* would then be simply an unordered set of morphemes {un, ity, grammatical}. These would be ordered by the Align constraints relevant to their morphological categories and by possibly contradictory syntactic requirements. Such an incorporation of feature-sharing mechanisms into the OT constraint hierarchy looks promising and defines an entire research program in itself.

4 Conclusion

This paper has attempted to work out some of the issues of the interaction of a theory of morphology with the Alignment apparatus posited in OT. My attention has focused on the implications of bracketing paradoxes for the OT treatment of morphological structure and syntactic selectional restrictions. It was proposed that the only morphological structure in the input to Gen was the 'inherent content' of the morpheme, which does not define a graph-theoretic tree structure with dominance relations. This necessitated a revision of the definition of *be-the-content-of*, in order that Alignment decomposition could refer to such 'inherent' edges, as well as those available by a downward-tracing relation. Since the input is morphologically underdetermined, Gen was posited to be able to build higher structure freely, parallel to prosodic structure, and subject to a similar family of Parse constraints, which however were seen to be weaker than their prosodic brethren in that they allow recursion. It was debated whether linear precedence relations in the input could be entirely replaced by Alignment constraints. The answer to this depends on a more developed theory of how and in what component syntactic restrictions should be satisfied.

Two reasonable approaches to the bracketing paradoxes emerged: either syntactic structure is predetermined in the input to Gen and is in effect irrelevant for the morphology and phonology, or syntactic restrictions are active constraints and the input has only inherent properties (idiosyncratic lexical information) and all structure is built by Gen.

Many alternatives to all of the above assumptions were mooted; only further research will determine which of them prove of maximal explanatory use in other areas as well.

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