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FEATURE PERCOLATION AND THE PREFIX a-

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1. *a-* prefixes

There are at least five homophonous prefixes *a-* in English.[1] Since we shall be concerned mainly with two of these we will describe them and their homophonous fellows briefly.

The particular prefixes we are interested in are firstly one which converts noun, verb, and adjective roots (in the sense of Selkirk 1982) to predicate adjectives;[2] e.g.

1. noun roots: *astern, ashore, afield, aboard*
2. verb roots: *adrift, aglow, asleep, aflutter, awake, afloat*
3. adjective roots: *alone, alike, alive*

That these are possibly predicate adjectives can be seen by the fact that they function in the following frames:

NP *be/seem/appear* _____. e.g. *He seemed alone*
NP *like/see* NP _____. e.g. *He liked his captives alive*
e.g. *They saw the boy awake*

These frames are the locations of what are traditionally called 'complements', or, in systemic grammar terms, 'intensive complements'. But these adjectives do not appear in the frame:

Det _____ N e.g. **the alone man*

There is the possibility that some or all of these words may be adverbs, since there appears to be a second prefix *a-* which is an adverb creating prefix:

1. noun roots: *aside*

2. verb roots: *aglow*
3. adjective roots: *afresh, aloud, aright*

That these are adverbs can be seen from their functioning in general postverbal position, e.g. *He tried afresh, He sang aloud.* Since it is not of any consequence for the later argument whether these are in fact one or other or both syntactic category, assignment to a single category is not required. Furthermore, in X bar theory it is the case that the class of adjectives and adverbs share certain cross-category generalizations, although they differ in two respects: 'Many adjectives strictly subcategorize a PP or an S in their complements, but the related adverbs do not' (Jackendoff 1977:24) and 'adjectives are dominated by NP and Predicate (i.e. the complement of *be, become* etc. - cf. Chomsky 1965:107), and adverbs are dominated by VP, S and Degree' (Jackendoff 1977:25).

The third prefix creates prepositions as follows:

1. noun roots: *atop, astern, amidst, aside*
2. verb roots (possibly): *astride*
3. adjective roots: *around, along*

That these are prepositions can be seen by the fact that they take NP and PP complements in prepositional phrases: e.g. *around the tree, atop the mast, astern of the boat, astride the grave.* The adverb and adjective prefixes do not subcategorize for NPs. This allows them to be distinguished from prepositions. There appear to be a number of clear cases where the preposition and adjective/adverb are distinguishable; e.g. *around* will function in the preposition frames but it will not function in the predicate adjective frames and *alone* has the converse property.

The affix *a-* forming predicate adjectives is associated with at least two semantic interpretations:

1. [in a state of Ving] / [in a state of Aness] — *adrift, asleep, afloat* / *alone, alive*
2. [in/to location N] — *ashore, astern, ahorse*

The *a-* forming adverbs share these semantic interpretation possibilities:

1. [in a state of Ving] — *aglow*
2. [in/to location N] — *aside*

But it also has more typical adverbial semantic interpretation:

3. [in a/an Adj manner] *afresh, aloud*

The prepositions all appear to have a locative semantic interpretation.

The prefixes with which we are not concerned are:

1. The prefix which indicates the negative sense of the stem but which does not change syntactic features; e.g. *asexual, amoral, apolitical.*

2. The prefix which might be held to be a constituent of the following verbs: *avow, appoint, arrange, amend, award, affront.*

As has already been suggested, some lexical items with the prefix *a-* may be ambiguous as to category. For example it might be claimed that *aside* is an adverb in *to stand aside* but a preposition in *stand aside of the river.* It is clear that if these words are adverbs then they are not the normal transportable adverb which can appear within the auxiliary **They had asleep left their child.* It might appear these are adverbs after verbs like *be, seem* and *appear* in that they can be given in answer to Wh questions as *How did they leave their child?* But the predicate adjective *ill* can also appear in answer to such questions. Since the argument to follow does not depend crucially on category assignment, I suggest that the clear cases of adverbs are those with adjective stems and manner interpretations. The rest can be left ambiguous although it is crucial that the adjectives be predicate adjectives.

2. Two theories of feature percolation

The theories which will initially be compared in what follows both attempt to account for the observation that some of the properties of polymorphemic words are predictable on the basis of the syntactic and other properties of one of the word's constituents. This constituent is termed the head and its properties become the properties of the word of which it is part by the process of feature percolation.

The major proposals of such theories are reviewed in Zwicky (1984:58-63), which can be selectively summarized as follows. Morphological heads determine the following properties of words:

a. Their semantic arguments. This is asserted to be the case in compounds, particularly synthetic compounds. For example *box* is the head of *toybox* and thus a toybox is a kind of box. *Driver* is the head of *truckdriver* and thus the word *truck* is interpreted as the object of the verb *drive* because the verb requires an object by the convention of argument linking proposed by (among others) Kaplan and Bresnan (1982).

b. Their inflexional locus. It is often proposed that the rightmost constituent of English words is the head (Williams 1981a) and it is also the case that inflected words in English take inflexion as a final suffix. Therefore the head of a word could be seen to determine the inflexional locus.

c. Their governor. In some cases where inflexions appear internal to a compound they appear on the governed constituent. The other constituent becomes the governor and thus the head, e.g. *kinsman* has *man* as head.

d. Their distributional properties. While this property of heads does not always comfortably apply to derivational affixes, in the case of compounds the distributional properties of the compound are usually the same as those of one of its constituents, the rightmost in many cases.

e. Their morphosyntactic properties. For example, German suffixes determine the declension class of nouns, and the right hand constituent of English compounds determines whether the compound takes a weak or strong inflexion.

Selkirk's theory of headedness and percolation (Selkirk 1982), insofar as it has a bearing on our prefixes, runs as follows. The structure of words is generated by context free re-write rules which fit into an X bar schema. There are two levels in this schema: the lower level is that of roots and the higher level that of stems. Affixes are classified as to whether they attach to roots or stems. The rules which purport to generate the adjective prefix *a-* are as follows:

R1. $A^r \rightarrow Af \quad A^r$

R2. $A^r \rightarrow A^{af} \quad N^r$

R3. $A^r \rightarrow A^{af}\ V^r$

According to Selkirk the head of the word in each case is that constituent whose features match those of the word. In the case of the three rules above, Selkirk claims that in rule 1 the the right hand constituent is the head whereas in the case of the other two rules it is the prefix which is the head. Her reason for supposing this to be the case is that the syntactic category features of the right hand constituent match that of the immediately dominating node in the case of the rule 1 but not in the other cases. Thus for Selkirk there exist three homophonous adjective-forming prefixes. The preposition-forming prefix would operate in the same way, with the prefix this time being the head in each case because the left hand constituent never matches the dominating category. However, Selkirk does not mention the existence of this preposition-forming affix in either her general rules for derivation (Selkirk 1982:88) or in her list of English derivational affixes (Selkirk 1982:85-86).

Lieber's account of derivational morphology is rather different. For her, affixes are morphemes with sub-categorization frames, where the subcategorization frame specifies the nature of the lexical structures within which the affix may be inserted. Headedness is then determined by a set of feature-percolating conventions which label the tree into which morphemes have been inserted. The adjective prefix which is the focus of attention here will have a subcategorization frame as follows:

$[_A$ _____ $[_{\substack{A \\ N \\ V}}$

The prefix will also have an insertion frame since adjectives have insertion frames. This frame will be the one for predicate adjectives and not for attributive adjectives; perhaps something like the following:

$[_{VP}[_V(\substack{be \\ seem \\ appear})]\ [_{AP}$ _____]], e.g. *seem asleep*

A second insertion frame is needed for some of these adjectives when they function in post-object phrases, perhaps as follows:

$[_{VP}[_V\ ][_{NP}\ ][_{AP}$ _____]]], e.g. *catch* NP *alive, cast* NP *adrift*

The preposition-forming affix would have a similar sub-categorization frame:

$$[_{PREP} \_\_\_\_ [\begin{matrix} N \\ V \\ A \end{matrix}$$

Lieber, unlike Selkirk, does mention the possibility of preposition-creating affixes in her account of compounding (Lieber 1983:262): 'there are no affixes which attach to stems to yield new prepositions nor can we coin an entirely new preposition as we can a new verb'. There is no dispute about this fact but what is significant are the conclusions which can be drawn from it. Firstly, this is a fact about the set of existing words, not necessarily about the set of possible words.[3] (Note for example cases such as *into* and *onto*.) Secondly, Lieber wishes to block compounding of prepositions by reference to the fact that prepositions are a closed class (Lieber 1982: 255). Since Lieber's is an overgenerating morphology, it would appear that this fact has no place supporting an argument for the limitation of the generative capacity of lexical mechanisms without further principles to support such a limitation, principles which would provide a theoretical limit on the affixation and compounding of closed-class lexical items. Such a principle would, for example, also limit the generative capacity of rules and principles which might apply to quantifiers and degree words which, although they function as heads of phrase (Jackendoff 1977), nevertheless do not participate as output categories of either derivation or compounding. We shall return to these facts later in the discussion of productivity.

To account for the same facts that Selkirk accounts for by her distinction between roots and stems, Lieber provides diacritic marks. The prefix here is a level 1 prefix and thus has the diacritic 'Level 1'. The percolating conventions which provide for the labelling of the words which contain *a-* as a prefix then run as follows (Lieber 1981:49):

> Convention 1: all features of a stem morpheme including category features percolate to the first non-branching node dominating that morpheme.
>
> Convention 2: all features of an affix morpheme

including category features percolate to the first branching node dominating that morpheme.

Thus for Lieber there are not three homophonous predicate adjective creating prefixes *a-* but only one.

3. The predictions of feature percolation

3.1 Categories and insertion frames

We can now compare the predictions made by the two theories of feature percolation about the prefix *a-*. Since heads must agree with their dominating nodes in all their features, Selkirk's theory does not account for the insertion frame of *a-* adjectives. In principle there is no reason why it should not however. (In other words, it may be that Selkirk has merely analysed this prefix incorrectly.) If it did, the prediction would be that there is only one affix which forms predicate adjectives by *a-*. Lieber can account for the fact that *a-* adjectives are predicate adjectives. So it appears that without the modification of Selkirk's theory, Lieber's theory of feature percolation is superior to Selkirk's.

Further support for Lieber's theory is provided by the fact that Lieber's theory is able to account for the generalization that all these adjectives appear to have both insertion frames.[4]

seem alone	*leave* NP *alone*
be adrift	*cast* NP *adrift*
seem alight	*set* NP *alight*

3.2 Subcategorization frames

There are however syntactic features of these adjectives, adverbs, and prepositions which percolation will not predict. Each of these categories is head of its respective phrase type and therefore subcategorizes for complements within such phrases. Following Jackendoff (1977:76-79), we would predict that the prefix *a-* uniformly predicts subcategorization as follows: Adjectives

subcategorize for PP and S'. Particularly adjectives with transitive verb stems take PP complements with the preposition *of*, e.g. *fearful of the dragon.* Adverbs on the whole take no complement. Prepositions subcategorize for NP, PP and S' complements.

But it appears that the prediction is not borne out. First the adjectives do not uniformly subcategorize for PP complements:

[+A, - _____ PP]

asleep	**asleep of the night*
ahorse	**ahorse of the pony*
aground	**aground of the rocks*
afoot	**afoot of the track*
aflicker	*?aflicker with torches*

[+A, + _____ PP]

afire	*afire with enthusiasm*
aflutter	*aflutter with bats*
abreast	*abreast of developments*

It may be claimed that the optionally transitive cases taking PPs are prepositions since there are *a-* prefixed prepositions. One argument against this position is that the rest of the prepositions are all transitive, taking NP or PP complements. This objection would merely shift the ground to the prepositions, which would then have unpredictable subcategorizations.

These subcategorization facts are related to the argument structure of the adjectives concerned. Predicate adjectives, according to Williams (1981b:85), have argument structure. They have, to use Williams's terminology, one external argument and possibly further internal arguments. Arguments are logical arguments in a predicate argument structure where the predicate is either a V or a Prep. Arguments take theta roles (thematic roles rather like Fillmore's deep cases, Fillmore 1968, and first proposed for generative theory in Gruber 1965). An external argument of an argument-taking category is its subject while the internal arguments are those which are subcategorized as its complements. If percolation is uniformly to predict the argument structure of the class of predicate adjectives prefixed by *a-* and if Williams is correct in believing that adjectives can be argument

taking, then all these adjectives should share the same argument structure.

The same is the case with prepositions. Some prepositions prefixed with *a-* take obligatory complements. Others do not.

[+PREP, + _____ NP]

amidst	*amidst the crowd, *He stood amidst.*
atop	*atop the flagpole, *He climbed atop.*

[+PREP, ± _____ NP]

astride	*astride the log, He stood astride.*
aslant	*aslant the road, The rain fell aslant.*[5]

Again these subcategorization facts have parallel argument-linking facts. In the terminology of Williams (1981b) *amidst* has an obligatory internal argument.[6]

This range of facts shows that theories of feature percolation such as those of Selkirk and Lieber cannot predict in a principled way the strict subcategorization and argument structures of the adjectives and prepositions formed by the affix *a-*. This is an interesting fact because such theories do make correct predictions about the insertion frames of the adjectives, namely that they are predicate adjectives. It is therefore an interesting problem for theories of feature percolation to see if a principled distinction could be drawn between the percolation of insertion frames, and the percolation of argument structures and strict-subcategorization frames in lexical structure. From this range of facts, it appears that both the percolation of argument structures and thus subcategorization frames is not universally predictable. Similar facts, as we shall see later, lead Lieber to suggest that the suffixes *-eer* and *-ate* are not suffixes of English.

3.3 Productivity

There are further characteristics of *a-* adjectives and prepositions which neither percolation theory seems able to handle. *A-* adjectives and prepositions appear, with one or two exceptions, to block further affixation even though *a-* is a level 1 affix, ('root' in Selkirk's terms):

1.	*-ness*	**aloneness, *aliveness, *adriftness*
2.	*-in*	**inasleep, *inastern, *inastride*
3.	*-ist*	**asleepish, *alonish, *awakish*
4.	*-un*	**unasleep, *unalive, *unadrift*
5.	*-ity*	**awakity, *alonity, *adriftity*

This is a case of negative potentiation (Williams 1981a: 249-250). Most treatments suppose this kind of property to be a function of diacritics such as the feature [+latinate]. The prefix *a-* appears to be [-latinate] at least. But this is insufficient since neither native affixes such as *-ish* nor non-native affixes such as *-ity* appear to attach to stems containing the *a-* prefix. This is a problem since both Selkirk and Lieber support an over-generating morphology in the manner of Halle (1973) and Allen (1978). In such morphologies it is supposed that speakers have intuitions which allow them to distinguish possible from impossible words. All the cases starred above containing *-un* and *-ish* would, in an overgenerating morphology, be possible words since they have permissable level 2 affixes attached to permissable roots (to use Selkirk's terminology). However, it becomes a problem when none of a class of permissable words actually occurs and this appears to be the case with the prefix *a-*.

One possible source of the negative potentiation is to be found in Aronoff's theory of blocking (Aronoff 1976). A rule of word formation is blocked if the lexicon already contains an existing item with the same syntactic and semantic characteristics. Thus the existence of the abstract noun *glory* blocks the word *gloriosity* from appearing in the lexicon. However there is no blocking case in the derived forms cited above. It might on the contrary be argued that since there are very few clear cases of compulsory predicate adjectives, i.e. adjectives which are only predicate adjectives, there can be no case for blocking at all. A clear case of such a predicate adjective not containing *a-* is the word *ill*.[7] Allen (1978:208) provides a filtering account of blocking such that a derivation is blocked if it contains the same node label twice in the derivation. This alternative also does not account for the blocking of further derivation of *a-* prefixed forms since such forms do not in most cases have the same node label appearing twice in the derivation. Where they do, such as in the derivation of *a-* prefixed predicate adjectives derived from adjectives, Allen's blocking filter appears to make further incorrect predictions since such forms exist and are acceptable. The fact

that further affixation appears to be impossible in most cases (with a few exceptions, e.g. *?unalive, ?aloneness*) is thus not predicted by feature percolation. In fact an overgenerating morphology predicts that there should at least be instances of further affixation and that native speakers would recognize non-occurring forms as possible words. Again it seems difficult to find clear cases of such an intuition. An overgenerating morphology thus appears to make incorrect predictions about possible further affixation in this case.

The *a-* prepositions appear to function similarly. It may be objected that since prepositions are a closed class, they cannot take further affixation. This is an interesting argument since that would make the productivity of an affix a function of the base, i.e. of a non-head constituent. This is accomplished by having no rules of derivation which have closed-class items stated as bases in the insertion frame of any affix. That is certainly possible, but does not explain why closed-class items do not take affixes. Since there are compounds with the structure $[_N[_P\ \ ][_V\ \ ]]$, e.g. *input, outflow,* it cannot be the case that word formation in general cannot have access to closed-class categories. It should also be noted that the notion 'closed class' has only pre-theoretical status in current generative syntax or morphology.[8]

Negative potentiation is closely related to a further problem, which is that the affix itself appears to be at present diachronically unproductive, i.e. it is not possible to coin new predicate adjectives with it.[9] This is clearly of no interest to a synchronic word-level grammar unless it influences native speaker intuitions about the synchronic productivity of the affix.

Overgenerating morphologists suggest that native speakers have intuitions about the productivity of affixes and that such intuitions are based on the class of possible words which the morphology predicts for a particular affix or combination of affixes. The problem that the prefix *a-* creates for overgenerating morphologies is that *a-* attaches to an extensive range of stem categories and is a level 1 prefix. Lieber (1981:114-115) proposes that the producitivity of an affix is simply a function of the size of the class to which it attaches. The class which is defined as the set of roots to which the prefix *a-* attaches is the set of all native, i.e. non-latinate

noun, verb and adjective roots. Clearly this is not as large a class as the class of roots in general or the class of all stems, in the terms of Selkirk (1972). However it is a large class notwithstanding. Lieber's theory of productivity thus makes predictions about the class of possible words and the size of that class. It predicts that the following are recognizable possible words of English and that speakers of English could distinguish these words from the class of impossible words below:

Possible words: *ashoe, aknee, afinger, ahouse, aship, ahit, acut, acall, aname, aleft, abright, aflat*

Impossible words: *acoloir, achain, abike, arip, arush*

This does not appear to be the case. In fact it appears that all these would be judged impossible and that native speakers know that the prefix *a-*, in spite of the comparatively large class of roots to which it attaches, is totally unproductive.[10] It may be that speakers know this because, as well as a list of morphemes with subcategorizations, speakers also know actual lexical items and that in this case there are no possibilities for productive use of the affix *a-* for word formation. Lieber appears to recognize the influence of native speaker knowledge about open and closed classes, as has already been mentioned. It thus appears that in this case an overgenerating morphology makes incorrect predictions about both the subcategorization features of an English prefix and also its productivity.

As pointed out earlier, overgenerating morphologies which employ a theory of percolation make a strong claim. The claim is that certain features of words are predictable on the basis of their structural composition. We have seen that there is no principled way to separate the correct prediction that adjectives in *a-* are predicate adjectives, that is, will have a predicate adjective insertion frame, from the incorrect prediction that they all will take identical subcategorization frames. We are left with the conclusion that the predictability of percolation must be arbitrarily restricted to just those features or those lexical items which are predictable. Lieber's way out is to say that an affix with such properties is not an affix at all (Lieber 1981:138-139):

> 'By claiming that *-ate* and *-eer* are not really suffixes in English we maintain the claim that suffixes impose uniform insertion frames on their outputs, and that the outputs of suffixes which belong to conversion pairs will uniformly have conversion mates.'

This, of course, saves the prediction but at the cost of what appears to be an ad hoc immunising strategem (Botha 1981).

3.4 Methodological remarks

However it is in order to add, in Lieber's defence, a number of methodological comments on the place of counter-examples in the lexicon. The lexicon is the traditional repository of idiosyncratic information, i.e. of non-rule governed cases. It is interesting to ask what this means for those rules which are lexical rules. Lieber takes it that some potential counter-examples can be taken to be idiosyncratic and thus listed separately in the lexicon. To do this clearly runs counter to native speaker intuitions that these are affixes and also loses the partial generalizations that there are to be made. The relegation of items to the list of idiosyncratic information in the lexicon should clearly be on a principled basis, otherwise there is potentially no crucial evidence for theories of the lexicon which propose that the lexicon is anything other than a list of exceptions. Lexicalist theories all propose that there are rules of word formation and that such rules account for the internal structure of the set of possible words, presumably at least in part on the basis of the structure of existing words. Exceptions to such rules therefore have two possible kinds of status: they may be genuine counter-examples and thus allow for the choice of a better theory which does not fall foul of these cases, or they may merely be exceptions and thus belong in the list of existing words as exceptions since the lexicon is both a location for partial regularities (Chomsky 1970) and a repository for exceptions. There appears to be no a priori way to tell whether a particular case happens to be a genuine counter-example or an exception. However it is clear that one way to treat such cases in a methodologically defensible way is to say that a genuine counter-example is one which motivates the choice of a superior theory, i.e. one which does not fall foul of these

cases. Where this is not possible the cases may be genuine exceptions. Counter-examples of such a kind should also not be relegated to the list of exceptions if, by incorporating some generalizations about them into rules, native speaker intuitions about such words would be captured which would otherwise be lost. By using Lieber's device of banishing such cases as *a-* prefixed adjectives, adverbs, and prepositions to the lexicon's list of exceptions, partial regularities are certainly lost. The chance to select a superior theory may also be being lost.

4. A full-entry alternative

The facts of *a-* prefixation appear to make this methodological point well. On the one hand we should wish to capture the generalizations about the prefix that there are, such as the simple fact that there is such a prefix. On the other hand it is clear that not all the characteristics of the words which have this prefix are predictable. One would not wish these cases therefore to refute any more claims than necessary. We might therefore wish to find a theory which did not lead to the abandonment of all the generalizations about the *a-* prefix which are captured by theories of feature percolation. Such a theory should allow for non-arbitrary assignment of exceptional cases to the set of lexical entries or give them the status of genuine counter-examples. As a consequence a weaker but not arbitrarily restricted theory might be preferred to a strong but arbitrarily restricted theory.

It has already been suggested that such an alternative theory might be based on actually existing words, i.e. on a theory which not only notes the distinction between possible and impossible, words, but also notes the distinction between existing and non-existing words. Such theories consequently allow for the distinction between accidental and systematic gaps in the lexicon. One such theory is that of Jackendoff (1975).

Jackendoff's full-entry theory of the lexicon takes as its point of departure the intuition of the native speaker that to know language L a native speaker must know some of the words of L. The idealized speaker-hearer who

knows the native language perfectly knows all the words. The relevant parts of Jackendoff's theory run as follows. The lexicon of a language is an ordered list of all the words of the language. These words are represented by lexical entries which consist of an entry number, a phonological representation, syntactic representation and semantic representation in the manner of Chomsky 1965. Unlike the lexicon of Chomsky 1970, however, the redundancy rules which specify regularities in the lexicon do not fill in redundant features in partially specified entries but instead are employed in an evaluation metric for the lexicon which measures the independent information content for every lexical entry given the presence of other entries and the redundancy rules in the lexicon. This is accomplished by the following information measure:

> 'Given a fully specified entry W to be introduced into the lexicon, the independent information it adds to the lexicon is
> (a) the information that W exists in the lexicon, i.e. that W is a word in the language; plus
> (b) all the information in W which cannot be predicted by the existence of some redundancy rule R which permits W to be partially described by information already in the lexicon; plus
> (c) the cost of referring to redundancy rule R.' (Jackendoff 1975:644)

There is also a metric for evaluating the cost of referring to the rule as in (c).

> 'The cost of referring to the redundancy rule R in evaluating a lexical entry W is $I_{R,W} \times P_{R,W}$, where $I_{R,W}$ is the amount of information in W predicted by R, and $P_{R,W}$ is a number between 0 and 1 measuring the regularity of R in applying to the derivation of W.' (Jackendoff 1975:666)

What might this amount to?

> 'Count a lexical pair related by R as an actual use of R. Count a lexical entry which meets one term of the structural description of R, but in whose evaluation R plays no role, as a non use of R. The sum of the actual uses and the non uses is the potential uses of R. $P_{R,W}$ should be near zero when the number of actual uses is near to the number of potential

uses; $P_{R,W}$ should be near 1 when the number of actual uses is much smaller than the number of potential uses; and it should rise monotonically from the former extreme to the latter.' (Jackendoff 1975:667)

How would such a theory of the lexicon account for the set of counter-examples which we have found to the theory of feature percolation? Let us suppose that all the words which presently exist in English which have the prefix *a-* are entered in the lexicon in the full entry mode which Jackendoff proposes. Lieber's feature percolation conventions will apply to such entries in reverse, relating the entries of such words to those of their stems and affixes. This will factor out as redundant the information that such words are predicate adjectives, adverbs, or prepositions. But it will not factor out as redundant the strict subcategorizations of such words, since these are not predictable. This amounts to a weakening of Lieber's theory as follows: where Lieber's theory makes the correct predictions, the rule of feature percolation factors out of pairs of words redundant information which is contained in the requisite feature percolation rule, but it does not do so where the rule is not instantiated. Feature percolation is thus an instruction to declare redundant those features of particular *a-* prefixed forms which are predicted on the basis of the entry for the prefix. This requires a lexicon which is different in one crucial respect from that which Jackendoff proposes, since in his lexicon there are no entries for affixes. It also requires the consequential change that the reference to word formation rules in the evaluation measure be changed to allow reference to the features of a head affix (or stem in the case of compounding) and reference to feature percolation conventions. The introduction of affixes into the lexicon with their requisite features can be justified in two ways. First a lexicon with affixes makes the claim that native speakers know the affixes of the language and the idiosyncratic information related to each affix in exactly the same way as they know the individual words of the language. Second it allows for the scrapping of all the rules of word formation in favour of the more general feature percolating conventions. Feature percolation is thus still operative and works to maximize the amount of redundant information in the lexicon. To do that it must be rephrased as follows:

Feature percolation conventions:

a. Convention I

Declare as redundant all the features of a morphologically complex word's stem which are predicted on the basis of the lexical entry for the stem. For example the features of the stem *standard* in the morphologically complex word *standardize* will be declared redundant on the basis of the existence of the entry for *standard* elsewhere in the lexicon.

b. Convention II

Declare as redundant all the features of the dominating node of a morphologically complex word which are also features of the outermost affix. For example the features of the word *standardize* will be declared redundant on the basis of the existence of the features of the suffix *-ize* elsewhere in the lexicon. Then repeat the procedure on the next affix in and so on down to the last root.

Lieber's further percolation conventions can be similarly redrawn as redundancy rules. Note that Convention II has an interesting consequence when rephrased in this way. Since the next affix in after the outermost affix may be a constituent of a non-existing lexical item, the features of this item are nevertheless able to be declared as redundant when feature-percolating Convention II applies. This is the original justification for overgenerating morphologies offered by Allen. But it is not a motivation for preferring such morphologies, since a full entry theory of the lexicon can also account for the phenomenon of a non-existing but possible word being a constituent of an existing word. So what is the difference in evaluating an entry where the constituent of a word is an existing word and one where it is not? It is in the cost of referring to the rules of feature percolation and the entry of the head. Where a constituent word acting as stem for the outermost affix actually exists, its features can be declared redundant just by referring to the entry for the word which exists elsewhere in the lexicon, whereas when the word does not exist reference has to be made both to the feature-percolating conventions and to the entries of the two constituents of the non-existing but possible word. Such a process is more costly in Jackendoff's terms, i.e. the prediction is that such words will be more difficult to learn than a word whose stem already exists in the lexicon. I therefore propose the following additional convention to feature-percolating Convention II: that the evaluation measure

in acting on a morphologically complex word will check to see if the outermost stem exists independently in the lexicon before referring to the feature percolation conventions. If that priority convention takes place cyclically from the outermost brackets inward, the evaluation measure will always minimize the cost of cross-reference to rules and lexical entries.

In this way the rules of percolation make important generalizations about the organization of the lexicon: namely, the rules of percolation account for some of the lexical relations in the existing lexicon. They also predict the form of possible morphologically-complex words which are in some measure redundant. Note that the conventions are both maximally general in that they allow for all features to be redundant. But in particular cases they also allow for less than maximal redundancy. It appears that both are possible. Thus the *a-* prefixes and the suffixes *-ate* and *-eer* are not exceptional. They are instead constituents of words which are not as redundant in their feature specification as some other words.

Unlike Lieber's theory, Jackendoff's makes an attempt at explanatory adequacy by suggesting how his account explains the acquisition of lexical items. The more redundant the item is, the easier it is to learn. One could add that since Jackendoff's proposal values maximum redundancy, retrieval of redundant items in a psychologically real lexicon is also likely to be facilitated by the fact that they have associations with other lexical items which share the same redundancies as well as with the other lexical entries which specify the redundancies.[11] Lieber's percolating conventions are valuable in maximizing redundancy along with other lexical conventions such as the binarity hypothesis investigated in, for example, Kuiper 1984.

What now of productivity, both intuitions about it and actual productivity? *A-* prefixed forms are unproductive. Jackendoff's theory has, in its cost of reference to rules, an index of this which makes quite different predictions from those of Lieber. Since the potential number of uses of feature percolation rule 2 to the entry for the *a-* prefix are quite large and the number of actual uses is quite small, the cost index can be used as a predictor of both intuitions about productivity and a predictor of actual productivity. Both the predictions and the facts are that productivity is low whereas Lieber's predictions

are that productivity should be high.

What of blocking of further affixation? Since there are no cases in the full-entry lexicon of further affixed forms, the prediction will be that these are not possible. The redundancy rules of, say, level 2 suffixes predict that further affixation should be possible. Perhaps one of the redundant features of all the *a-* prefixed cases is that they never form stems for other prefixes. I am not sure whether this is a feature of the affix itself or just a feature of all the words taking it. Perhaps since it is a feature of all these words, it should be a feature of the affix (since it is the head), which the feature-percolating conventions will declare redundant. If so, this seems to be a novelty.

The full-entry theory appears therefore to make the following predictions about the learning of *a-* prefixed adjectives, adverbs, and prepositions: they are partially predictable in form and therefore easier to learn than if they were even less predictable. There are relatively few of them and therefore the cost of learning them is higher than it would be if there were more. As far as general predictions about learning of lexical rules is concerned, the prediction is that the most highly valued grammar is that which allows for the maximum redundancy to be extracted from fully specified lexical entries. There may be specific properties in universal grammar which allow for this, such as the binarity constraint and percolation conventions parameterized to account, for example, for the fact that compounding is not right-headed in all languages. This would predict why, in the parsing and coining of novel compounds, particular strategies such as these are employed although existing compounds and affixed forms do not always follow these general conventions. We would also expect such features of universal grammar to manifest themselves in some form or other in the coining of nonce forms by children.

We can also now support the methodological point made earlier about the status of counter-examples. Since the most highly valued grammar is one in which lexical rules function to factor out redundancy, counter-examples have the same role as elsewhere, namely to provide choice between competing theories. Where this appears impossible, counter-examples may be assigned to lexical entries which will prove more expensive in the evaluation of the cost of learning such items. This is clearly a matter of

degree. The prefix *a-* appears to have motivated a choice between two competing theories and, implementing one, it has been possible to gain an account of the intuitions of native speakers about the structural properties of the words which have *a-* as a constituent. This account has also allowed for the idiosyncrasies to receive a principled treatment. It appears that feature percolation can be incorporated into such a theory to give more accurate though less powerful predictions than in the original formulation by Lieber and others.

NOTES

[1]To my knowledge no account of prefixation in English distinguishes all these cases from one another. See Adams 1973, Haldeman 1865, Marchand 1969, Selkirk 1982.

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[2]It is interesting to ask, if the prefix *a-* attaches to all these roots, why it does not attach to the other major categories, i.e. lexical heads of phrase in the terms of Jackendoff 1977, e.g. adverbs, prepositions, quantifiers, and degree words. The last three classes are ruled out because of the constraint proposed by Lieber (1983:262), namely that there is no word formation in closed classes. However that still leaves adverb roots. It seems that adverbs in English do not routinely take affixes although they are an open class. An anonymous *Te Reo* reviewer has suggested that the reason may be that the roots for *a-* prefixation are all morphologically simple. Since the number of morphologically-simple adverbs in English is probably a closed class, then Lieber's hypothesis takes care of these cases as well. But as stated elsewhere in this paper, I do not find this hypothesis compelling. There may be good reasons why closed classes should not be the output of word formation rules but that does not explain why they should not be input

to such rules.

[3]Lieber does have an explanation for the absence of compound prepositions and that is that prepositions are argument-taking and therefore the left hand preposition in a compound cannot link its argument within the compound (Lieber 1983: 264). But if it is the case that some prepositions may be optionally transitive, then this explanation does not have as much force as Lieber claims. It has also been suggested in Jin, Kuiper & Wu (in preparation) that compound prepositions are common in Chinese and that the rules for preposition compounding are productive in Chinese. English also has a rule of noun compound which yields the following structure:

$[_N[_{PREP}\ ][_V\ ]]$, e.g. *input, throughflow, bypass*

I take it therefore that prepositions may not be the output of word formation rules but that they may be input.

[4]Many of these cases appear to be idiomatic. For example the idiom *leave NP alone* is common but *meet NP alone* appears to be less so and may even be unacceptable. It may be that all such cases having the second insertion frame are idiomatic. However in an overgenerating morphology there appears to be no room for an account of idioms since idioms are in the permanent lexicon. See Haggo & Kuiper 1983 for a general account dealing with the listing of idioms in the lexicon.

[5]There are problems in deciding the category of the post-object position since it is quite possible for these to be adverbs as well. Note that they will take specifiers in what might be either an adverb, adjective, or prepositional phrase:

completely alone
fast asleep
just astern
just astride the stream

[6]It may be that these last cases are ambiguous between adverb and preposition. The same argument would then be shifted to the *a-* prefixed adverbs which would have unpredictable subcategorizations. An anonymous *Te Reo* reviewer suggests that many of the denominal *a-* prefixed forms which take PP and NP complements appear to be relator nouns (Starosta 1985). If this is the case, then it

is counter-evidence to feature-percolating theories since the noun is a non-head constituent and thus its features cannot predict the syntactic properties of the words of which it is the stem.

[7]I am grateful to Andrew Carstairs for providing this example. I take it that the idiom *an ill wind* is an idiom and that therefore this expression may be acceptable but ungrammatical. In my dialect and that of Andrew Carstairs, other expressions such as *an ill person* or *an ill patient* are ungrammatical. The notion that adjectives have arguments is an interesting one. The case filter predicts that adjectives cannot take NP complements, only PP complements since ADJ is not a case assigner. PREP, however, is a case assigner and therefore ADJs, according to the case filter, can only subcategorize for PPs. Thus all cases where an *a-* prefixed form is followed by an NP complement must be analysed as prepositions.

It is an interesting question to ask how Williams would cope with a case like *atop*. According to Williams (1981b:90), 'a morphological rule can affect only the external argument of its input, and ... it can affect this external argument in only one of two ways: it can make one of the internal arguments into the external argument, or it can add a new external argument.' Nouns can only have external arguments (Williams 1981b:85). Thus *top* can only have an external argument. Presumably *atop* has an obligatory internal argument. But Williams's constraint does not allow for the conversion of an external argument into an internal one. Presumably this case is thus counterevidence to Williams's general claims about the changes in argument structures which morphological rules induce.

[8]A second possibility is that no adjective subcategorized to be solely a predicate adjective will take further affixation. However the word *illness* shows this not to be the case.

[9]Laurie Bauer has pointed out to me that this does not prevent a resurgence of diachronic activity for a previously inactive word formation process. This was the case with the *a-* prefix in the 19th century when it was used productively in poetic vocabulary.

[10]The author's intuitions here are clear.

[11]See Botha 1979 for an account of such a grammar.

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