11 Morphology and the Lexicon: Lexicalization and Productivity

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1 Morphology and the lexicon

According to one widely accepted view (Aronoff 1976, 1982), the morphology of a language, because it is part of grammar and trades in structural matters, deals primarily with the internal structure of the potential complex words of a language. These words may not all exist, but they all conform to the morphological structure of the language.[1] By contrast, the lexicon of a language is a list of existing items in the language, those that a speaker has to know because they are arbitrary signs: unpredictable in some way. Most of the items on this list are words, though the lexicon also contains larger units like idioms, and maybe also smaller units like affixes. On this view, in which the regular morphology and the irregular lexicon are separate entities, one might imagine the two having very little to do with one another, since the morphology deals only with potential words and the lexicon only with existing words. In fact, the two systems do have a great deal to do with one another, for two simple reasons. The first is that they serve the same role in a language: both provide words. This overlap has even led some linguists to say that morphology is "in the lexicon" (Jensen and Stong-Jensen 1984), although in doing so, these linguists are using the term *lexicon* in a much broader and different sense, to mean the source of all words, actual and potential, rather than in the narrow sense of a list of unpredictable items that we have inherited from traditional grammar and from Bloomfield (Bloomfield 1933, Zwicky 1989, Aronoff 1994). The second reason is that morphology and the lexicon are interdependent. Most centrally, the morphology, which forms words from words, finds the words that it operates on (its bases) in the lexicon. We will explore each of these interrelations in a separate section.

1.1 Morphology versus the lexicon

As with any two entities that share a task, morphology and the lexicon do not always do so happily; they are rivals. This rivalry is not empty, but plays a central role in the larger system of the language. In order to understand its nature, we must consider a single speaker/hearer. When we speak of the lexicon from this perspective, we speak of the individual's mental lexicon, the list of irregular items that the speaker/hearer carries around in his or her head. We may then define the difference between existing words and potential words in terms of this mental lexicon. We will say that any word that is stored in a single speaker/hearer's mental lexicon or list of irregular items is an existing word, and that nothing else is. In particular, a word that meets all the criteria for being a word of the language but that is not in an individual's mental lexicon does not exist for that person, though it may exist for another speaker/hearer. The unlisted word is a potential word, and we will say that morphologically well-formed complex potential words are provided by the morphology, not by the lexicon. Thus, the conventional idea that the existing words of a language – English, for example – comprise all the words in the *Oxford English Dictionary* or some other comprehensive dictionary does not apply in this model of the lexicon and the morphology. The difference between which words exist and which are potential is defined solely in terms of the individual's lexicon and morphology.

 Most importantly for our purposes, even if our ideal speaker/hearer has spoken or heard (or read) a particular word before, if that word has not been stored in that person's mental lexicon for some reason, then the word is still a potential word rather than an existing word as far as the mental lexicon is concerned. Which words are stored? In the simplest case, a word will be stored because it contain only one morpheme. Take the word *bamboozle*.[2] It has no morphological structure, so nothing to predict its meaning. Someone who hears this word, even in a context in which its sense is clear, must enter it into memory in order to use it again, so it will enter the hearer's mental lexicon. Similarly, a morphologically complex word must be placed in the lexicon if a piece of it is unknown to the hearer. An example of this type is *hornswoggle*, which is almost synonymous with *bamboozle*. One of its components, *horn*, is recognizable, but the other one, *swoggle*, is not, so that, again, we must memorize the word in its entirety if we wish to reuse it in the same sense, even if we can deduce its sense from the context in which we hear it. Yet again, all the components of a word may be familiar, but its sense may not be deducible from them. Here too we must put the word in our lexicon. An example of this phenomenon is yet a third synonym, *hoodwink*. Both *hood* and *wink* are familiar words, but the sense of the entire word *hoodwink* has little to do with the sense of its parts, so even here our ideal speaker/hearer must resort to lexical storage in order to have a hope of reusing the word. So if a word is unpredictable, it must be stored in the lexicon. By contrast, consider the word *rigidification*, encountered in a journal article recently. The parts of this word are readily

apparent: *rigid*, *ify* (which forms verbs from adjectives and nouns), and *ation* (which forms abstract nouns from verbs), with *ific* being a contextual variant of *ify* that appears regularly before *ation*. Also transparent is its meaning, which can be paraphrased roughly as 'the act or fact or state of making or becoming rigid'. The paraphrase is ambiguous, but which of these senses is meant in a particular instance will generally be clear from the context. Since the actual sense of the word does not diverge from its predicted sense, based on its parts and its morphological structure, there is no need for this word to be listed in the speaker/hearer's lexicon, for the morphological component of the speaker/hearer's grammar is able to process it entirely. The word will therefore be spoken, heard, and most likely discarded by all parties, perhaps to be created and discarded again, but not stored, unless it is used in some special sense that is not predictable from the morphology.[3]

So far, the morphology and the lexicon do not interact. The first creates regular words, and the second stores irregular words. To see how they do interact, we must look at a case where both the lexicon and the morphology are in principle capable of being invoked. We will begin with a simple case, that of the plural of a noun in English. Some plurals come from the lexicon, and some from the morphology. The plural will come from the lexicon in case it is irregular and stored there on account of its irregularity, like *women* or *people*, and it will come from the morphology in case it is regular, like *dogs*. But now a question arises. If a word has an irregular plural stored in the lexicon, why does it not also have a regular plural, which comes from the morphology? In the case at hand, how does a speaker know not to say *womans* instead of or as well as *women*? Or why doesn't the speaker sometimes say one and sometimes the other? Something must be preventing the morphology from producing a regular plural just in case an irregular plural for the same word exists in the lexicon. The same is true of irregular past tenses of verbs. A person who knows that the past tense of *go* is *went* (a fact that must be stored in the lexicon) will not say *goed*, although a young child or someone in the early stages of learning English as a second language might say *goed*, because the child or learner hasn't yet learned the form *went*. The lexicon and the morphology seem to interact in assuring that only one form will be used, but how? Does the speaker/hearer somehow check the lexicon to see if a word is there, and only resort to the morphology if there is none?

A clue to the right answer to this question has been known for centuries: languages tend to avoid synonyms (though not always, as *bamboozle*, *hornswoggle*, and *hoodwink* reveal). In most cases, the speaker will use a word from his or her lexicon (*women*, *went*) rather than resort to the morphology to produce a new word with the same meaning. This phenomenon, "the nonoccurrence of one form due to the simple existence of another" (Aronoff 1976: 43), is called *blocking*, and its effects can be seen not only in inflection, but also in derivation, where a word like **furiosity* (formed from *furious*) will be blocked by *fury*, which already exists in a speaker's lexicon. We can tell that blocking is at work in rendering **furiosity* unacceptable, because other words of the same pattern are perfectly acceptable, when there is no already existing word to block them.

Thus, *curiosity*, which is structurally analogous to **furiosity*, is perfectly accept-
able, because there is no word **cury* to block it. The effects of blocking are also
felt in syntax, where an existing word will sometimes block an entire syn-
onymous phrase, as Hoffman (1982) first noted. We do not, for example, find
this night used in standard English in a sense parallel to *this morning* or *this
evening*, because of the existence of synonymous *tonight*. As the example shows,
exact synonymy is crucial, for the expression *this night* can in fact be used, so
long as it is not synonymous with *tonight* (e.g. in the question "Why is this
night different from all other nights?"). There will also be no blocking without
synonymy, so we may find a pair like *brethren* and *brothers*, precisely because
the former refers not to actual brothers but rather to fellow members of an
organized group of some sort. The most cogent account of why blocking occurs
is Horn's (1984, 1993), based on general principles of economy of expression,
to which we will return in section 2.3.

Because blocking is a psychological phenomenon, it is subject to the vagaries
of the mind: if a person has temporarily forgotten the word *fame*, then that
person may in fact use the word **famousness*, which *fame* would otherwise
block. This seeming failure of blocking is especially common in children, who
coin new words quite freely, because their vocabulary is not as entrenched as
that of adults. An articulate child might use words like *famousness* and *liquidize*
in conversation without hesitating.

Blocking is also subject to another psychological factor: familiarity or its
more easily measurable counterpart, frequency. In general, the more frequently
used an irregular form is, both in absolute terms and compared to its base, the
more likely it is to block the corresponding regular form (Anshen and Aronoff
1988, Rainer 1988). This effect of frequency can be detected not only experi-
mentally (Pinker and Prince 1991), but also in children's "overregularizations,"
as Bybee and Slobin (1982) have shown for irregular verbs in English. The
effect of frequency can also be seen in morphological regularization over time:
in general, the more frequently an irregular form is used, the more resistant
it will be to being replaced by a regular form, which is to say, the more likely
it is to block the corresponding regular form (Anshen and Aronoff 1988). The
most widely accepted models of blocking take frequency into account by trans-
lating it into processing speed. According to these models (MacWhinney 1975,
Anshen and Aronoff 1988, Pinker and Prince 1991), the search for the proper
word can be viewed as a race between the mental lexicon and the morpho-
logy. Both operate simultaneously, and the faster one wins. If it is true that
the speed of lexical access for individual stored irregular words is propor-
tional to the logarithm of their frequency, then the more frequent an irregular
word is compared to its base, the more likely it will be to block the morpho-
logy. Note that this general model does not involve any direct interaction
between the mental lexicon and the morphology. The two components of the
language mechanism can thus be insulated from each other, as far as this one
phenomenon is concerned. They interact more closely in the actual operation
of the morphology, which we will now explore.

Table 11.1   All words of the form *Xidify* and *Xidification* in a very large word list

Xidify	Xidification
acidify	acidification
deacidify	deacidification
reacidify	reacidification
disacidify	*
rancidify	rancidification
*	lucidification
rigidify	*
*	validification
solidify	solidification
resolidify	resolidification
humidify	humidification
dehumidify	dehumidification
nidify	nidification
renidify	renidification
lapidify	lapidification
fluidify	fluidification

1.2 Morphology based on the lexicon

Morphological patterns are abstract. Returning to the word *rigidification*, we may view it simply as an instantiation of the abstract pattern $[[[X]_A \text{ ify}]_V \text{ ation}]_N$. But if we look more closely at attested words that fit this pattern, we see the effect of the lexicon. Let us narrow our gaze from the general pattern just mentioned to a slightly more particular one, in which the adjective is of the form *Xid* (e.g. *acid*, *livid*, *candid*). If the pattern were completely independent of the lexicon, then we might expect to find that any adjective of the form *Xid* could serve as the base of an attested word of the form *Xidification*. We have access to a very large English word list, compiled from eighteen general and technical dictionaries, containing about 400,000 entries. Among these are approximately 1,000 words of the form *Xid*. But there are only 14 words of the form *Xidify*, which indicates that this particular rule is not very productive. Thus, we do not find the following words in the list, though all of them have easily constructible senses: **rabidify*, **lividify*, **acridify*, **stolidify*. There are similarly only 14 words of the form *Xidification*. Remarkably, as table 11.1 shows, in all but two cases in each column, the words of the two forms share a base. We cannot, of course, extrapolate directly from a large dictionary to the mental lexicon, but dictionary data of this type, which can be repeated for many patterns in which one suffix is added to another, suggest that the actual

production of morphologically complex words is done largely by applying morphological rules (adding affixes) to actually occurring base words that are stored in a speaker's mental lexicon.

Another indication that morphological rules operate on words in the lexicon is the inheritance of irregularity. The most common type of inherited irregularity is semantic. Complex words often have conventional senses that differ slightly from their predicted sense (see section 2.2). Consider the word *immeasurable*. Judging by its parts, it should mean 'that cannot be measured'. In actual use, it almost always means 'very large'. The adverb formed from it, *immeasurably*, therefore means 'greatly', as in expressions like "I have benefited immeasurably from your assistance." Another example is *naturalize*, which should mean 'to make natural', but which has a number of specialized senses, including 'to confer the rights of citizenship upon (an alien)' and 'to adapt (a plant or animal) to a new environment'. The noun *naturalization* that is derived from this verb has the nominal derivatives of these two as senses, because it is formed on the actual verb in the lexicon with all of its specialized senses. Furthermore, because the most familiar sense of the verb for most people is 'to confer the rights of citizenship upon (an alien)', the most salient sense of the noun for most people is based on this sense of the verb. So, for example, a search of our university library's computerized catalogue under the key word *naturalization* reveals a large number of books having to do with immigration to various countries and no other books (though we might expect a different outcome at a school of horticulture).

The inheritance of the phonological irregularities of words in the lexicon is a little harder to detect, largely because we tend to be less aware of them, but one example that springs to mind is the word *comfortable*, which for many people is pronounced [kəmftə(r)bl]. The adverb is similarly pronounced [kəmftə(r)bli], inheriting the phonological irregularity of the adjective base. By contrast, although *probably* is often pronounced [prabli], *probable* is not pronounced *[prabl], showing that a derived word (*probably*) may deviate phonologically from its base (*probable*) and acquire its own lexical entry.

In conclusion, we have seen that morphology is distinct from the lexicon (at least if by the word *lexicon* we mean a speaker/hearer's mental lexicon of unpredictable forms), and that the morphology and the lexicon are rival sources of words. The morphology depends on the lexicon, however, inasmuch as the bases of morphologically complex words are normally lexical entries.

2 Morphological productivity

2.1 Quantitative and qualitative productivity

Morphological productivity may be defined informally as the extent to which a particular affix is likely to be used in the production of new words in the language. On this view, productivity is a probabilistic continuum that predicts

Table 11.2 Morphologically restricted de-adjectival nominal suffixes

conditioned suffix	example	conditioning suffix	base word
-(c)e	tolerance	-ant	tolerant
"	putrescence	-ent	putrescent
-(c)y	buoyancy	-ant	buoyant
"	latency	-ent	latent
-ity	separability	-able/-ible	separable
"	legibility	"	legible
"	legality	-al/-ar	legal
"	popularity	"	popular
"	toxicity	-ic	toxic
"	stupidity	-id	stupid
"	agility	-ile	agile
"	ferocity	-ous	ferocious

the use of potential words. At one end of the continuum are the dead or completely unproductive affixes, which are not likely to be used at all in coining new words. One example of this from English is the nominal suffix *-th* (as in *truth* or *growth*), which has not been used successfully to form a new word for 400 years, despite valiant attempts at terms like *coolth* (which is attested sporadically, but which just never seems to be able to survive long). At the other end in English are the productive inflectional suffixes *-ed*, *-ing*, and *-s*, which are added whenever syntactic conditions are appropriate and there is no irregular form already in existence to block them, and highly productive derivational suffixes like *-ness* and *-ation*. In the middle, we find the less productive derivational suffixes like *-ity*. Some linguists treat morphological productivity as an absolute notion – a pattern is either productive or unproductive – but there is a good deal of evidence for the existence and utility of intermediate cases, which we will review below, so we will assume in this chapter that affixes may differ continuously in productivity, rather than falling only into the polar categories of completely productive and completely unproductive, to which some linguists have restricted the discussion.

Aside from quantitative considerations, there are qualitative morphological factors that are relevant to productivity. This can best be seen by examining rival affixes, affixes that are very similar in their semantic and syntactic conditions. Consider the several suffixes that form nouns from adjectives in English. Most of them are productive only within a morphologically restricted domain, as shown in table 11.2, which classifies the suffixes according to the preceding suffixes that they generally occur with. The suffix *-ness* is different from those exemplified in table 11.2. It occurs with a wide variety of base adjectives patterns, including monomorphemic words and those of the morphological types included in table 11.2: *dryness*, *redness*, *wetness*, *fetidness*,

prolificness, *venerableness*, *trivialness*, *obliviousness*, *recentness*, *pleasantness*. Being unrestricted, *-ness* operates as the default affix for forming de-adjectival nouns, the affix that is normally used when no additional morphological conditions on the base adjective hold. Linguists have found that one of the members of any similar set of rival affixes or operations will usually be the default, qualitatively unrestricted. This qualitative difference is usually mirrored quantitatively as well: the qualitatively least restricted operation among a set of rivals will most often also be the quantitatively most productive, though cases of the default not being the most productive have been found. Clahsen et al. (1992), for example, have shown that the default plural suffix in German is not the most productive or most common. It is also not always true that the least restricted member of a set of rivals will be totally unrestricted in its distribution. For example, we have shown in earlier work (Anshen and Aronoff 1981, 1988) that *-ness* does not attach at all to words of the form *Xible*, despite being the default for de-adjectival nouns in English.

How can quantitative productivity be measured? Baayen (1992) has developed a number of measures that take advantage of modern computational analysis of large corpora in English and other languages. First of all, productivity is related to growth (the rate at which new words in general are being added to a language). The growth rate of the vocabulary of any language is estimated from a large corpus as the ratio of those words occurring only once in the corpus (*hapax legomena*, henceforth *hapaxes*) to the total number of word tokens in the corpus. For rival operations, a similar measure (the ratio of hapaxes formed by that operation to the total number of tokens of the same morphological type in the corpus) can be used to compute relative growth rates. The English suffixes *-ity* and *-ness*, for example, show growth rates of 0.0007 and 0.0044 in Baayen's calculation (based on a corpus of 18,000,000 words), meaning that *-ness* is six times as productive as *-ity*, regardless of any difference in the qualitative morphological restrictions on the two. Another statistical measure is what Baayen calls global productivity, which depends not only on the likelihood of encountering new words of a given morphological type, but also on the number of words of that type that a speaker already knows. By this measure, *-ness* is not quite three times more productive than *-ity*.

The ratio of hapaxes to tokens in a corpus is clearly associated with a lesser average frequency of types; the lower average frequency of *-ness* formations compared to *-ity* formations has long been noted (Aronoff 1982). Baayen's measures assume that the larger ratio of hapaxes is the cause of the lower average frequency, rather than vice versa. We can thread our way out of this trap if we go back to the original concept of productivity mentioned above, the extent to which a given affix is used in the production of new words in the language. The data presented in table 11.3 show that there are close to twice as many *-ness* words as *-ity* words in the language, but it also shows that the productivity of *-ity* as opposed to *-ness* has shown a steady increase over time (with one exception in the fifteenth century) until the *OED* shows more *-ity* words than *-ness* words coined in the twentieth century. Given the more

Table 11.3   The growth in productivity of *-ity* over
the centuries, based on entries in the *OED*

century	-ness	-ity	percent -ness
8th	4	0	100.00
9th	38	0	100.00
10th	67	0	100.00
11th	6	0	100.00
12th	21	0	100.00
13th	63	14	81.82
14th	225	72	75.76
15th	145	91	61.44
16th	610	193	75.97
17th	913	447	67.13
18th	308	196	61.11
19th	506	480	51.32
20th	152	166	47.80
total	3058	1659	64.83

restrictive environments for *-ity* versus *-ness*, the table shows that *-ity* is in fact
synchronically more productive in English than *-ness*, at least judging from the
dictionary data. The dictionary method and the corpus-based method do not
agree. A word of caution is in order, though: dictionaries are not always depend-
able indicators of actual usage, since the entries in a dictionary are selective
rather than inclusive, and since hapaxes are less likely to be seen as meriting
dictionary entries. Counts based on actual large corpora of the sort that Baayen
employs are generally more reliable, since they measure actual use, rather
than being filtered editorially. Thus, it may be that the *-ity* words, though in
fact less productively formed, are more likely to be listed in the dictionary,
because they are more memorable than the *-ness* words, a point that we will
return to in section 2.3.

2.2 *Frequency and productivity*

Word frequency, which we discussed above in relation to blocking, is also
related to productivity: the less productive a morphological pattern is, the
more frequent on average its individual members will be. But frequency is
also important in the selection of bases: a less productive affix is generally
found attached to higher-frequency base words than is a more productive affix
(Aronoff 1982). This makes sense in terms of what we know about the con-
nection between frequency and lexical recognition: words with high-frequency
bases are more readily recognized than words with similar frequency but

low-frequency bases (Laudanna and Burani 1985). If less productive affixes are at a disadvantage to begin with, then they seem to benefit from the boost provided by a more frequent base, although the exact psycholinguistic mechanism behind this pattern is not yet clear.

2.3 *Pragmatics and productivity*

Some scholars have insisted that the study of morphological productivity should confine itself to the study of words that are produced unintentionally (Schultink 1961). This rules out entirely the study of unproductive morphology, which resembles more marginal forms of word creation like the formation of blends (e.g. *smog* as a blend of *smoke* and *fog*) or acronyms (e.g. *laser* formed from the initial letters of the phrase *Light Amplification by Stimulated Emission of Radar*), in being more likely to be intentional or noticed. However, less than fully productive morphological patterns are pervasive in language, and they seem to serve a function that arises from their very unproductivity. When we compare the set of words formed by means of a less productive affix to the set formed by a rival affix in the same morphological environment, we generally find that the meanings of the less productively formed set are less predictable, making the entire set less *coherent* semantically. This difference in coherence carries over to newly coined words: the meaning of a new word formed by means of a less productive affix will be less predictable semantically. For that reason, less productive affixes may easily be used to coin special or narrowly technical terms (Aronoff 1982). For example, the word *specialism* has come into use quite recently in British English in the very restricted sense of 'what a (usually medical) specialist practises'. Similarly, we linguists (and participants in other technical fields like economics) use the technical term *productivity* instead of the more productively formed *productiveness*, because the very unproductiveness of the affix allows it to be used in more specialized senses. Horn (1984, 1993) explains this use of less productive affixes in terms of the interaction of two Gricean pragmatic principles. The principle of relation (say no more than you must) leads the speaker not to use the less productive form in most instances, because the more productive form is more readily available; but the principle of quantity (say as much as you can) will interact with that of relation, and lead the speaker to use the less productive affix in order to make a special point or to call attention to some aspect of the word. What the speaker is usually calling attention to is a special sense, which the less productive affix is more likely to allow. Thus we find that morphology and pragmatics act together to enrich language's expressive potential. In Horn's own words: "there is always (given the Division of Labor) a sufficient reason, but it is not always the same reason." Horn's account also helps us to understand why the productivity of inflectional affixes is generally more polarized: they are likely to be either completely productive or completely unproductive, and there are very few in-between cases resembling *-ity*. In the case of inflection, whose role

is the realization of morphosyntactic information, which is always compositional, there is nothing for the speaker to call attention to, and hence less productive morphology has no role. Only productive morphology or lexicalized forms will surface.

NOTES

1   For reasons of simplicity, we will couch our discussion of morphology in terms of affixes throughout this paper. In fact, none of the issues that we discuss here bears heavily on the issue of whether the morphology is organized in terms of affixes or in terms of operations.

2   We will use examples from English for the most part, for ease of exposition, and also because most of the work done on the topics covered here has dealt with English data.

3   There is evidence, though, that some regular words can gain entry into the lexicon simply on grounds of familiarity or frequency (Stemberger and MacWhinney 1986b, 1988).