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Zero in morphology: a means of making up for phonological losses?\(^1\)

1.1.1 If one compares generative-transformational grammar to the grammatical model it has more or less superseded, viz. taxonomic linguistics, one notices a remarkable difference in the role of morphology in these two linguistic models. In the heydays of classical structuralism, syntax was considered a subsection of morphology taken in a broad sense, which in turn was opposed to phonology; and grammar itself was defined as consisting of “(1) the morphemes used in the language, and (2) the arrangements in which these morphemes occur relative to each other in utterances” (Hockett 1958:129; italics by Hockett). In early generative grammar, especially before the development of generative phonology, this view remained essentially unchanged, as is evident from the following statement found in Buckwalter’s Generative grammar of Gothic morphology (1964:2): “The grammar has two divisions: phonology and morphology in the broad sense... The inventory of morphemes and the rules which specify the permitted combinations and alterations of morphemes constitute the morphology in the broad sense. This division in turn contains the two sub-divisions of morphology in the narrow sense [inflection and word-formation, D. K.] and syntax.”

Hockett’s definition of a grammar as quoted above is typical of the Item and Arrangement model of classical structuralism, where the grammatical levels of morphology and phonology were kept strictly apart. But the rivalling Item and Process model (cf. Hockett 1954) already at that time drew attention to the close interrelation between morphology and phonology in that it replaced the morpheme alternants of IA by corresponding morphophonemic processes. The development of generative phonology as a system of rules relating underlying morphophonemic (i.e. systematic phonemic) representations to systematic phonetic (i.e. surface) representations in conjunction with the abandoning of the phoneme as a relevant linguistic unit finally led to a complete reassessment of the role of morphology in the grammar. Many generative linguists now no longer recognize a separate morphological component, but distribute its functions between the phonological component and the
readjustment rules, which adapt the output of the syntactic component to the requirements of the phonological component (cf., e.g., Chomsky — Halle 1968:9ff.). As a consequence, the various surface realizations of a morpheme, i.e., its allomorphs, will be derived in different components of the grammar. Thus the purely phonologically conditioned allomorphs will automatically be derived in the phonological component from underlying systematic phonemic (morphophonemic) base forms by phonological rules needed elsewhere. The base forms in turn are probably introduced by the readjustment rules, although this is not quite clear. Morphologically conditioned allomorphs are either also derived in the phonological component by phonological rules governed by morphological exception features on lexical items, or they are introduced directly by some of the readjustment rules. And for some realizations, e.g., the zero allomorph postulated in taxonomic linguistics as representations of the morphemes [PRET (ERITE)] and [PART (ICIPLE) II] with verbs such as bet, bid, cut, etc., it is questionable whether they can be accounted for at all in the present framework. It is this problem which forms the background of this paper, which will investigate the description of these verbs both from a synchronic and a diachronic point of view.

1.1.2 One of the major problems with this model is the status of the readjustment rules, which was never really made clear, as Barnes (1971:7ff.) correctly pointed out. On the one hand, readjustment rules seem to contain those morphological rules which replace morphosyntactic features by the appropriate morphemes, and the latter by the corresponding morphophonemic base forms of the phonologically conditioned allomorphs, or by the morphologically conditioned allomorphs. But on the other hand, they are also said to contain rules which reduce or “flatten” syntactic surface structure; and Chomsky — Halle (1968:371) state “that it is very difficult to separate the study of these processes from the study of the theory of performance in any principled way.” If these latter rules indeed account for factors of performance — and this seems to be the case — the set of readjustment rules postulated by Chomsky — Halle would no longer form a homogeneous component, since the morphological rules mentioned above definitely refer to the speaker’s competence, and not to his performance.

Furthermore, the distribution of the derivations of the various surface representations of one linguistic item (morpheme) among several components of the grammar may have the effect of destroying the functional unity of this item, which is due to its paradigmatic surface status, as was pointed out by Dik (1967). Several generative linguists, e.g. Barnes (1971:7ff.), Bierwisch (1967), Leitner (1972; 1974:18), Wurzel (1970:18ff.), and myself (Kastovsky 1971:7ff.) have therefore suggested retaining a separate morphological component. There, inflectional (and probably also derivational) morphemes will be inserted for the respective morphosyntactic features or feature combinations. These morphemes are then replaced by their respective morphophonemic base forms (i.e. those underlying the various phonologically conditioned allomorphs) or by those morphologically conditioned allomorphs which cannot be derived by phonological rules, even in conjunction with a morphological exception feature as, e.g., the zero allomorph of the morpheme [PLURAL] in sheep, trout, grous, etc., or the allomorph /t/ of [PRET], [PART II] in dealt, bought, built, sent, etc. Allomorphs which are derivable by general or morphologically conditioned phonological rules of the phonological component will be derived from their common morphophonemic base form. This functions as a uniting factor for the various surface representations, since these can be traced back to this underlying representation, which in turn is linked to the morphologically conditioned allomorphs and ultimately to the respective abstract morpheme by the rules of the morphological component. In this manner, the functional unity of linguistic items having several surface representations can be preserved in spite of the fact that some of them are derived in the phonological component.

1.2.1 The setting up of zero elements as surface representations of morphological categories is based mainly on functional considerations. In structuralist morphology, such elements were used to mark a significant absence of an element in a paradigm, as, e.g., with the preterite/second participle of the verbs cut, hit, bid, etc., or the plural of the nouns sheep, trout, grous, etc.; there, zero was justified by the comparison of these forms with the preterites/second participles sliced, payed, wanted and the plurals cats, dogs, horses, etc., respectively. This use of zero has an old tradition reaching as far back as Pāṇini (cf. Allen 1955; Saussure 1973:380; Schifko 1973:1, fn. 4); but, as Schifko (1973:1) quite rightly points out, it was only after the publication of Ferdinand de Saussure’s Cours de linguistique générale (1916) that it was employed on a larger scale.

Some remarks as to the conditions on setting up zero elements seem to be required at this stage, although a detailed discussion of this problem is not possible here.2 Saussure based his zero signs ultimately on the claim that the functioning of language as a system of signs rests on the paradigmatic oppositions and syntagmatic contrasts of these signs. Signs therefore are not characterized positively by what they are, but negatively by their differences from other signs: “dans la langue, il n’y a que des
différences” (Saussure 1916:166). But the signs taking part in these oppositions need not all be explicit, because “la langue peut se contenter de l’opposition de quelque chose avec rien” (Saussure 1916:124). This then has to be interpreted as the meaningful absence of an element in a paradigm in a syntagmatic position where one would normally expect an overt marker of the respective category. Saussure exemplified this with the Czech example žen (gen. pl.) of žena (nom. sg.) “woman,” ženu (acc. sg.), ženy (nom. pl.), where žen is said to contain a “signe zéro”. Historically speaking, this zero sign replaces a phonologically overt formative, because the Old Church Slavonic form of the gen. pl. is žení, where i is the continuation of the corresponding IE inflectional ending. Saussure thus postulates a zero sign for structural reasons in order to account for the fact that a certain morphological category in a paradigm has no corresponding formal exponent. Zero is thus used to regularize a paradigm, i.e. to make it symmetrical. Furthermore, it is interesting to note that zero takes the place of a formative which at an earlier stage of the language was realized overtly, but was subsequently lost due to certain regular sound changes.

1.2.2 Saussure’s definition of a zero sign has to be modified, however, since it suggests that zero may be based on any privative opposition, a situation which would invariably lead to an uncontrollable proliferation of zero elements. This conclusion was in fact drawn by Frei (1950), who set up zeros wherever the possibility of privative oppositions existed. He therefore postulated a complex structure O- père-O on the basis of an opposition between père, beau-père and père-adoptif, or a zero element in je O chante because of its opposition to je ne chante pas. But these zero elements obviously have no functional content. Godel (1953) therefore argued that the basic criterion for zero should be the non-equivalence of a and a-O (or O-a), both of which are not identical with the bare stem. Consequently zero can only be established on the basis of a proportional opposition of the type a : a-O = b : bc, where O is functionally (or semantically) equivalent to c. This restriction was taken over by Bally, whose definition of zero will be adopted for the present purpose: “Un signe zéro est donc un signe qui, sans signifiant positif, figure avec une valeur déterminée à une place déterminée d’un syntagme échangeable avec un ou plusieurs syntagmes de même espèce ou ce suffixe a une forme explicite” (Bally 1944:160).

2.1 In structuralist descriptions of English morphology, it was customary to postulate zero allomorphs as representations of the morphemes (PRET), (PART II), and (PLURAL) in cases such as cut, hit, bid, or sheep, trout, etc. A zero allomorph of {GEN (ITIVE)} was furthermore assumed to occur in James’s in the pronunciation [jeymz], as well as in the plural form boys’, girls’, etc.

The justification of these zero allomorphs from a surface structural point of view is relatively easy, since there are always overt realizations of the same morphological category in other environments. The justification of zero morphemes is somewhat more difficult, however. Zero morphemes are usually postulated in derivational morphology for the process termed conversion by some linguists, but more appropriately called zero derivation (cf. Jespersen 1942:85; Kastovsky 1968:31ff.; Marchand 1969:359ff.). Such zero morphemes characterize verbs such as clean (< clean adj.), cash (< cash sb.), or nouns such as cheat (< cheat vb.), stop (< stop vb.), etc. These cases will not be discussed in this paper, however.

In early generative-transformational grammar, zero morphemes were also set up for the singular of nouns and the plural of verbs (Chomsky 1957:29, fn. 3; 39; 64). However, this was done solely in order to simplify the formulation of certain transformations, e.g. DO-Insertion, and not on the basis of a structural analysis of the relevant morphological oppositions. The status of these zero morphemes is highly suspect, therefore, because they do not satisfy the definition of zero quoted above, but remind one of the zero elements postulated on the basis of a simple privative opposition by Frei. It seems preferable, therefore, to treat singular nouns and present tense verbs in English as unmarked forms, from which the few inflected forms are derived by adding the respective morphemes. The only exceptions to this are the copula be and the personal pronouns, which have preserved some of the former inflectional categories. These will best be treated as separate lexical categories, which do not characterize the overall morphological pattern of the language.

2.2 It was mentioned above that Saussure exemplified the use of zero signs with the Czech form žen, where the zero sign replaces an explicit inflectional ending present at an earlier stage in the language but subsequently lost by some phonological change. Zero in this case could thus be regarded as a descriptive device which for the purposes of a synchronic description is set up to fill a gap in the paradigm, differentiating the respective form from the bare stem and marking its inflectional function. From a diachronic point of view, it could also be interpreted as a descriptive device which is set up to compensate for the loss of phonological material having morphological relevance, thus again preserving the functional oppositions within the paradigm. In the following I will try to show that the same is true of the zero allomorphs postulated in English as
surface representations of the morphemes {PRET}, \{PART II\} with the
verbs \texttt{beat}, \texttt{bet}, \texttt{bid}, \texttt{burst}, \texttt{cast}, \texttt{cost}, \texttt{cut}, \texttt{hit}, \texttt{hurt}, \texttt{let}, \texttt{put}, \texttt{quit}, \texttt{rid}, \texttt{set}, \texttt{shed}, \texttt{shut} (\texttt{ted}), \texttt{shut}, \texttt{split} (\texttt{ted}), \texttt{split}, \texttt{split}, \texttt{spread}, \texttt{sweat} (\texttt{ted}), \texttt{thrust}, \texttt{wed} (\texttt{ded}), \texttt{wet}. Here, too, the postulation of a zero allomorph is made
necessary by the loss of phonological material having morphological
relevance. Furthermore, it can be shown that this loss is synchronically
recoverable, i.e. the historical process is still reflected by the morpho-
phonemic rules of the language.\textsuperscript{7}

The description of these forms presented in this paper should also be
seen as an attempt to reconcile the surface-structural analysis of tax-
onomically linguistics with the process-oriented approach of generative
grammar, which relates underlying representations to surface represen-
tations by a system of syntactic, morphological, and phonological rules.
So far, no one has disputed that surface structure has to be regarded as a
relevant linguistic level exhibiting its own type of structure, and one task
of the rules deriving the surface representations of sentences is in fact
to account for their internal structures. This applies not only to syntactic,
but also to morphological structures. We will therefore have to ask how
the rules of generative-transformational grammar account for morphological
surface structures established independently on the basis of the func-
tional morphological oppositions characterizing a language. As will be
shown in the following, the preterites/second participles of verbs such as
\texttt{bet}, \texttt{bid}, \texttt{cut}, etc. prove to be of particular interest in this respect, since
with these verbs, the respective morphemes are not realized overtly. This
creates certain problems for the generative description of the respective
forms.

2.3.1 Generative morphology so far has not been concerned specifically
with the derivation of these forms, but has mainly dealt with the derivation
of the explicit allomorphs of the respective morphemes, especially
\texttt{id}, \texttt{id}, and \texttt{id}, and the corresponding surface realizations of the so-called
sibilant morphemes \{PLURAL\}, \{GENITIVE\}, and \{3. PERS. SG.\}, viz.
\texttt{id}, \texttt{id}, and \texttt{id}. The specific problem posed by these allomorphs is the choice
of their underlying representation, from which the various surface
representations can be derived by general phonological rules.

Two major alternatives are discussed in the literature:\textsuperscript{6} (1) one of the
vowelless forms, usually \texttt{id}, is assumed as basic, and \texttt{id} is derived by a
rule which inserts a vowel between a stem-final dental stop and this base
form; (2) the form containing a vowel, i.e. \texttt{id}, is assumed as basic, and
the vowelless forms are derived by a rule deleting the vowel. In both cases,
the form \texttt{id} is derived by a rule assimilating \texttt{id} to a preceding stem-final
voiceless consonant\textsuperscript{10}, since English does not tolerate the immediate

succession of two stops or fricatives contrasting in the feature [voice] in
word-final position. The same options exist for the sibilant morphemes.

Vowel Insertion is usually justified by referring to general phonotactic
restrictions of English, which exclude clusters consisting of two identical
consonants in certain positions. According to this analysis, a vowel \texttt{id}
would automatically be inserted into the underlying representation
\texttt{id} of \texttt{nodded} in order to break up this consonant cluster yielding
\texttt{id}. The alternation \texttt{id}--\texttt{id}--\texttt{id} could then be treated as completely
automatic.\textsuperscript{11}

However, the status of phonotactic surface constraints with regard to
phonological rules is less than clear (Zwicky 1974:210). Moreover,
Vowel Deletion has the additional advantage of also accounting for the
reduced forms of \texttt{is} in \texttt{he's} here, \texttt{it's} here, \texttt{John's} here, as against \texttt{Charles}
here. And finally Vowel Deletion is parallel to the historical process of
Vowel Syncopeation, which has brought about the present distribution of
the respective allomorphs (Kastovsky 1971:65-123; Miner 1975:350f.).
In fact, Vowel Insertion would have to assume restructuring, since the
original underlying representations of these morphemes, viz. \texttt{id}, \texttt{id},
would have to be replaced by the new base forms \texttt{id}, \texttt{id}. But according to
Miner (1975:351), there is no evidence that restructuring has taken
place, and medieval spelling practice generalizing the spelling -ed unam-
biguously points to \texttt{id} as the underlying representation at this stage.
Thus the Vowel Deletion hypothesis on the whole seems to be more
plausible than the Vowel Insertion hypothesis and will therefore be
adopted here.

2.3.2.1 The verbs \texttt{bet}, \texttt{bid}, \texttt{burst}, etc., are exceptional in both analyses
with regard to the formation of their preterites and second participles in
that these do not show an overt inflectional ending. They will therefore
have to be provided with a suitable exception feature in the lexicon.

It could be argued that the simplest solution would be to specify these
verbs as selecting a zero allomorph of the respective morphological
categories, and to derive their surface forms by an appropriate rule in the
morphological component, i.e. to treat this zero allomorph as completely
morphologically conditioned. It would thus be handled in the same way as
the surface representation \texttt{id} occurring in \texttt{dealt}, \texttt{built}, \texttt{bent}, etc. But this
solution is inadequate, since it does not relate the occurrence of zero to
the fact that only verbs ending in a dental stop have this zero allomorph.
On its own, this would not provide a cogent argument for the proposed
phonological rules. Rather, we would be confronted with the same
situation as with Hoard and Sloats rule of devoicing (cf. note 10), which was
rejected as ad hoc, because, although it was stabile in phonological
terms, it was morphologically governed, and was not needed elsewhere. I therefore argued for treating /l/ as a purely morphologically conditioned allomorph, which should be introduced directly in the morphological component. The same arguments would be valid here, if it were not for an additional factor which suggests that the presence of a zero allomorph is indeed related to the type of consonant occurring in final position. This additional factor is the behavior of the allomorphs representing [GEN]. This morpheme is realized as zero if it is preceded by one of the regular plural allomorphs /iz/ ~ /z/ ~ /si/, i.e. by an allomorph containing a sibilant, cf. mothers', sisters', aunts', nieces', etc., as against men's, chil- dren's, addenda's, etc., where the plural is formed by one of the irregular non-sibilant allomorphs.12 Furthermore, there is free variation between /iz/ and zero with singular proper names ending in a sibilant, cf. Charles', Dickens's, etc. There is thus an obvious correlation between the occurrence of zero allomorphs, the stem-final consonant and the consonant of the inflectional base form in that zero is more or less restricted to cases where the stem-final consonant and the consonant of the inflectional ending belong to the same class, i.e. are both dental stops or sibilants.13

2.3.2.2 This relationship should somehow be captured by the morphophonemic rules deriving the surface representations of the reductive morphemes. The simplest way to do this is to use the independently motivated rule of Cluster Simplification,14 which specifies that one of two identical consonants is deleted (Chomsky — Halle 1968:46, 221). In this form, the rule is an overgeneralization, and I will return to its more exact formulation below. The clusters required as input to this rule arise in connection with the rule of Vowel Deletion (or Vowel Insertion). As a preliminary hypothesis, it could be argued that in the framework using Vowel Deletion, the respective verbs bet, bid, burst, etc. are characterized by an exception feature in the lexicon marking them as obligatorily undergoing this rule, although they contradict its structural description, which states that this rule is inapplicable if the verb ends in a dental stop. Similarly, (GEN) would be marked as obligatorily deleting the vowel of its base form if preceded by [PLURAL], which in turn (just as the genitive singular) does not delete its vowel if the stem-final consonant is a sibilant. Vowel Deletion itself could best be formulated in terms of a negative environment statement, expressed by the condition which in the following formulation (1) is introduced by "except" (cf. Zwicky 1974:214 and fn. 7).

In the framework using Vowel Insertion, the respective verbs (and (GEN)) would have to be marked as not permitting Vowel Insertion, although its structural description is met. Here the relevant environment could be specified positively. We thus have the two alternatives of negative environment and positive exception feature or positive environment and negative exception feature; in 2.3.4 below, however, a different solution in terms of boundary features will be proposed. Vowel Deletion applied to the items marked as exceptions produces unacceptable consonant clusters, cf.

(1) $i \rightarrow \emptyset / # \quad \begin{array}{c} + \text{son} \end{array} \quad \begin{array}{c} + \text{cor} \end{array} \quad \begin{array}{c} - \text{dist} \end{array} \quad \begin{array}{c} + \text{cor} \end{array} \quad \begin{array}{c} - \text{dist} \end{array} \quad \begin{array}{c} + \text{cor} \end{array}$

The same is true in case Vowel Insertion is omitted under the same circumstances. Only what in (2) appears as output will be the underlying representation in this alternative analysis.

For example (2a), we need Voice Assimilation as an additional rule in order to produce a cluster of identical consonants, which would then provide the input to the Cluster Simplification rule. Voice Assimilation is also needed to derive the surface representations kissed [kist], lacked [lækt], cats [kæts], puffs [pʌfs] from the intermediate representations /kis#d/, /lækt#, /kæts#, /pʌfs#. Since Voice Assimilation is needed anyway, its application to cases such as (2a) seems rather more plausible than the addition of a specification to Cluster Simplification, which states that it is insensitive to voice differences between the adjacent consonants, as is proposed by Hoard and Sloet (1971:51).

Now Cluster Simplification applies and deletes one of the identical consonants, thus producing the surface representations [bet], [bid], bosses' [bəsiz].

2.3.3.1 Let us now turn to a closer examination of Cluster Simplification. This rule, which in phonetic terms could be described as complete assimilation, is in fact the phonological process (both synchronically and diachronically) for which the zero allomorphs postulated in bet, hit, etc. can be considered as the morphological surface compensation in the sense discussed in 1.2.1 and 2.2 above.

This rule is introduced by Chomsky and Halle (1968:46) in order to simplify the final consonant cluster in the underlying representations of
carōss, harāss, viz. kVress, hVrass, which is required for the explanation of the stress pattern of these words. Phonetically, these words contain a weak final syllable, to which the Main Stress Rule could not have assigned the stress; but the assumption of two underlying final consonants makes the final cluster strong, and the Main Stress Rule will then correctly assign the stress to this syllable. The correct surface representation is derived by the rule of Cluster Simplification, which in informal terms states that “the first of two identical consonants is deleted”, i.e. it can be represented as

(3) $C \rightarrow \emptyset$ before an identical consonant


This rule also simplifies the identical consonant clusters present in $\text{/æs=sist/}, \text{ /æs=semb/}$, etc. (intermediate representations of assist, assemble, etc.), which protect these words from undergoing voicing of intervocalic $/s/$, cf. resist, resemble, design, presume with $[z]$ as against consist, semblance, consign, consume with $[s]$, where $[z]$ is derived from underlying $/s/ by this voicing rule.$^{19}$ $\text{ /æs=sist/}$, etc. in turn are derived from $/æd=sist/$, etc. by a rule that assimilates $/æd=es/ to the following consonant under certain conditions, thus producing the identical consonant clusters. This Assimilation Rule, together with Cluster Simplification, is also involved in the derivation of attest $[\text{ætest}] < /æt=test/$, appear $[\text{æpɪər}] < /æp=ɛr/ < /æb=ɛr/$, etc. (Chomsky — Halle 1968:222).

Chomsky and Halle's formulation of Cluster Simplification is, however, unduly simplified. Not all sequences of identical consonants are affected, nor does the rule always delete the first consonant of a given cluster.

2.3.3.2 Cluster Simplification does not normally function across word boundaries, cf. went to, met Tom, where the two consonants are usually preserved. Only when the word boundary ($#$) is weakened, i.e. replaced by the weaker formative boundary (+) (cf. Chomsky — Halle 1968:66f.; 369f.), does Cluster Simplification apply, as in the derivation of got of to $< \text{got to<$ want to$}. The same applies to compounds and derivatives, both prefixed, and suffixed. Thus hop picker, gas stove, blood disease, blood donor contain an internal # boundary, since they consist of words bounded by #. The same is true of prefixed derivatives such as unnerve, unnatural, un navigable, misspell (i.e. un#nerve, etc.), or suffixed derivatives like oneness, openness, evenness (i.e. one #ness), where the presence of two identical consonants at the level of phonetic representation points to # as the internal boundary. Cluster Simplification thus seems to be blocked by #.

This is corroborated by the behaviour of the prefixes dis- and in-. With dis-, we have to distinguish two cases, viz. dis- as an etymological element having no constant semantic value as in dissemble, dissect, dissent, dissident, etc., and dis- as a productive word-formative prefix with negative, ablative, or reversionary meaning, which is attached to adjectives, nouns, and verbs also occurring independently in English, as in dissimilar, dissatisfy, dissever, etc. The former is invariably subject to Cluster Simplification and may undergo Intervocalic Voicing, cf. disaster, dissolve with internal [z], which points to the presence of the boundary = (as in re=solve [ri'zolv] vs. against re#solve [ri'zolv]; Chomsky — Halle 1968:95) rather than + or #. Contrary to Chomsky and Halle (1968:94), who assume morphological analysability in these cases, dis- here is a purely phonological, not a morphological unit. With productive dis-, on the other hand, pronunciation varies, i.e. some speakers preserve the identical consonant cluster, while some have Cluster Simplification; and some even have both forms. Thus Windsor Lewis (1972) only lists forms with simple [s], whereas Jones (1958) in many cases gives alternative pronunciations with or without Cluster Simplification, and even quotes [di'za:m], [di'zeib] with internal voicing as possible alternatives. This can be explained by assuming that all words containing etymological dis- will be listed in the lexicon as words containing the = boundary, while the productive prefix dis- will be added to the respective adjectives, nouns, and verbs by the morphological component as a lexicalization of the semantic features underlying this prefix. This will produce a structure $[\text{# dis}^\lambda \# \text{ similar } #^\lambda #^\lambda]$, where # will block Cluster Simplification. We could now assume that speakers having Cluster Simplification in these cases have generalized the = boundary occurring with dis- in dissemble to all occurrences of dis-. A better solution, however, would be to assume that productive dis- (as against phonological etymological dis-) is invariably entered as dis/#, but that speakers having Cluster Simplification weaken the boundary between this prefix and the stem to =, after which Cluster Simplification is regularly applicable. Speakers using [di'za:m] rather than [dis'a:m] will have an additional rule feature triggering Intervocalic Voicing. This rule of Boundary Weakening, which is needed elsewhere (see below), is triggered by a positive rule feature in lexical items (including prefixes and suffixes) undergoing it, while items not affected by this rule are not specified with regard to it. In the case of dis-, its presence is obviously due to the analogy with etymological dis- as in dissemble, etc. In this manner, the two functionally different elements dis- can be formally distinguished, and
the relationship between Cluster Simplification and boundary types can be preserved.

The prefix in-, on the other hand, always involves Cluster Simplification, regardless of whether it is present as a purely etymological-phonological unit in lexical representations, as in immaculate, innocent, illicit, etc., or is introduced by the morphological component as a word-formative prefix representing NEG, as in illogical, irregular, impossible, innumerable. Assimilation and Cluster Simplification thus require the absence of #; and while innocent, illicit, etc. are represented with = already in the lexical representation, word-formative in- may be specified as obligatorily undergoing Boundary Weakening to =. There is one exceptional case, however, viz. inoperative, which is listed in Jones (1958) with the alternative pronunciation[‘ɪn-operətɪv]. Here, Boundary Weakening does not take place, probably in direct analogy to the rivaling form unmanageable, where # is present as in all un- formations.

Thus Cluster Simplification seems to be blocked if # intervenes between two consonants, but may occur across a weaker boundary (= as in the above examples, or +, see below).

2.3.3.3 There is one additional factor, however, which complicates the situation. Chomsky and Halle have argued that Cluster Simplification deletes the first of two identical consonants. The examples quoted so far corroborate this, i.e. it is intuitively more plausible to interpret illogical, innumerable, dissimilar as having lost the consonant of the prefix rather than the stem-initial consonant. For harass and careess, no such intuitive judgement seems possible, so here the choice seems to be free. But Chomsky and Halle are not consistent in applying Cluster Simplification only to the first of two identical consonants. Thus they state that singly [ˈsɪŋli] is derived from “phonological /sɪŋl/#/y/, with the /l/ of /#l/ dropping after /Cl/” (1968:85). It is thus normal to normally, casually, really, civilly, fully, etc., where the identical consonant cluster is also simplified, whereas it is preserved in frailly, palely, gently, servilely, futilely, hostely, vilely, wholly, solely, droolly, foully, coolly, etc. Chomsky and Halle restrict their discussion to singly, however. Now this dropping of /l/ after /Cl/ (and in the other environments) bears a remarkable resemblance to Cluster Simplification, except for three points: (1) it affects the second of two identical consonants; (2) it requires the specification of some phonological environment beyond the identical consonant (i.e. this must be preceded by another consonant as in singly, or a vowel, as in normally, civilly, fully, etc., but it may not be preceded by a glide, i.e. by [w] or [y] (these additional conditions are not mentioned by Chomsky and Halle); and (3) it operates across #. Chomsky and Halle do not subsume this process under Cluster Simplification, probably because this rule in their formulation does not apply to clusters where the identical consonants are separated by #. But they do not say this explicitly.

It is logical to assume that it would be preferable if all processes resulting in the loss of one of two identical consonants could be treated by one rule. In order to do this, however, we will have to account for the three factors distinguishing the simplification of /l/#l/ from the instances of Cluster Simplification discussed above.

2.3.3.4 The first point mentioned above concerned the fact that according to Chomsky and Halle it is the second consonant which is deleted in singly. And indeed it cannot be denied that intuitively it is the second of the two consonants which is lost in this case, just as it seems intuitively more justified to speak of the deletion of the second consonant in bet+t (<bet+d), bid+d, burst+t (<burst+d), the forms underlying the preterites/second participles bet, bid, burst, etc. rather than assuming deletion of the first, stem-final consonant. In view of these latter cases, Hoard and Sloat (1971:51) opt for the deletion of the second consonant in all instances of Cluster Simplification. But this decision is obviously just as questionable as Chomsky and Halle’s proposal to always delete the first consonant, because, as has already been mentioned, it seems intuitively more plausible to interpret dissimilar, etc. as instances where the first of the two identical consonants is deleted.

There is one feature, however, which these cases have in common, and which permits us to treat Cluster Simplification, despite the seeming differences, as a unified process. In all the examples cited, i.e. in dissimilar, illogical (deletion of the first consonant), as well as in singly, bet (deletion of the second consonant), it is the consonant forming part of the affix which is deleted, while the consonant belonging to the word-stem is preserved. Now there is a widespread tendency, according to which stems are much more resistant to phonological change than affixes, and the phenomenon under discussion seems to be a reflex of this tendency. It is likely that Cluster Simplification itself is a homogeneous process, but that the result of its application is determined by the morphological status of the formatives to which it is applied. It will therefore have to be constrained so as to delete the consonant of the affix rather than that of the stem if the two identical consonants are separated by a boundary, i.e. by + or =, since, as will be remembered, Cluster Simplification is blocked by #.

2.3.3.5 This still leaves us with the problem that Cluster Simplification in singly occurs across a # boundary and requires an additional environ-
ment specification. These two facts are obviously related. In order to save our hypothesis that Cluster Simplification is nevertheless involved in singly, we have to find an explanation for these exceptions. One possibility would be to assume that Cluster Simplification is directly related to some environment specification of the type

\[
\begin{cases}
  + \text{son} \\
  - \text{cons} \\
  + \text{voc} \\
  - \text{son} \\
  + \text{cons} \\
  - \text{voc} \\
\end{cases}
1 \# \quad 
\]

Such a solution does not work, however. The contrast between singly ['sɪŋli] vs. Wrinkleless ['wɪŋkləs] shows that Cluster Simplification cannot be made dependent on a purely phonological environment, since despite the practically identical phonological structure the two words behave differently with regard to this rule. Thus it seems that some morphological feature is involved, relating Cluster Simplification directly to the suffix -ly, but not to-less. Now above we were confronted with a similar situation in connection with the discussion of the prefixes dis- and in-, where Cluster Simplification also occurs in cases where one would expect a # boundary to intervene between identical consonants, as, e.g., in dis#similar, in#numerable. There the problem was solved by postulating the application of Boundary Weakening, which depended on a morphological feature present in the affixes. It is obvious that a similar solution is required here in order to explain the different behaviour of the suffixes -ly and -less with regard to Cluster Simplification. Thus, rather than specifying Cluster Simplification for additional environments, the affixes themselves will be provided with an appropriate rule feature. But -ly will not be specified by a feature making direct reference to Cluster Simplification, because this would miss the obvious generalization that Cluster Simplification depends on the boundary separating the two identical consonants. Therefore, Boundary Weakening must be involved again, as with dis- and in-, and consequently the suffix -ly will be marked as undergoing Boundary Weakening at least in the environments specified above with reference to Cluster Simplification. A simpler formulation, however, would make -ly subject to Boundary Weakening everywhere except if it is preceded by /l/, and this in turn is preceded by a glide. Cluster Simplification in singly, civilly, normally, fully, etc. is thus accounted for by the previous application of Boundary Weakening and does not require any additional environmental specification.

Cluster Simplification can thus be treated as a unified phonological process, which is blocked if # intervenes between two identical consonants, and in which affixal consonants have deletion priority over consonants belonging to stems. It presupposes a rule of Boundary Weakening, which, however, is well-motivated.

2.3.4.1 We will now have to reconsider the derivation of the preterites and second participles bet, bid, burst, etc. in the light of the restriction placed on Cluster Simplification. Regardless of our decision whether Vowel Insertion or Vowel Deletion accounts for the surface forms of the respective morphemes, the representations immediately preceeding the application of Cluster Simplification so far are /bet#əl/, /bid#dəl/, etc., because inflectional endings in English are always preceded by # at the level of underlying representation. But Cluster Simplification is not applicable to these representations because of the intervening # boundary. It would of course be possible to add a condition to this rule making it obligatory in word-final position irrespective of an intervening # boundary. But the exceptional status of the verbs involved does not justify this solution, since it would only be on their account that such an additional specification of the rule would be required. The obvious solution is therefore to use the already well-motivated rule of Boundary Weakening. That this solution is correct is corroborated by the behaviour of some other types of irregular verbs.

In one class of irregular verbs instance by keep — kept, sleep — slept, weep — wept, etc., the stem-vowel alternates between /i/ and /e/. Originally, these verbs had the vowel /e/ in all forms, cf. OE: cępan — cępte, etc., but this vowel was shortened in the preterite/second participle forms in Middle English by a fairly regular process affecting long vowels before certain mainly non-dental consonant clusters. This development in conjunction with the changes caused by the Great Vowel Shift led to the Modern English alternation. Now Chomsky and Halle, in order to account for these alternations, assume the existence of a Laxing rule in Modern English, which in fact is a synchronic reflex of this historical development:

\[
V \to [-\text{tense}] /- [+\text{cons}] [+\text{cons}] _\text{voc}
\]

(Chomsky — Halle 1968: 241, Rule 20. III; cf. also 175).
This rule does not apply, however, if the consonant cluster mentioned in the environment contains a # boundary, cf. wiped [waept] < /wip#/t/ < /wip#d/ vs. produce [pro3’djuws] — produce [prəd’kət]. The vowel alternation in the above-mentioned verbs can be explained by assuming that the underlying representation of, e.g., kept, viz. [v, #[kęp], d], must be replaced by [v, #[kęp+d]], where the + boundary now no longer blocks the application of the Laxing rule (4). Chomsky and Hale consider two alternatives to account for this replacement, i.e. elimination of # by a language-specific rule “the applicability of which defines the subcategory of irregular verbs that contains keep, lose, weep, etc.” (1968:369), or elimination of the internal structure of these verbs, i.e. the internal brackets, before the insertion of #. They assume furthermore that this boundary symbol “is automatically inserted at the beginning and end of every string dominated by a major category” (Chomsky — Hale 1968:366). The latter alternative replaces [v, kęp], d, by [v, kęp+d], where the lack of internal structure and the presence of + blocks the insertion of a boundary between kęp and d. For morphological reasons it seems preferable, however, to retain the internal structure, thus preserving the structural parallelism with the other verbs and also the morphological status of the affix. These verbs will therefore, according to the first alternative, be marked in the lexicon as undergoing Boundary Weakening if followed by {PRET}, {PART II}. After the replacement of # by +, the Laxing rule applies, quite regularly deriving the correct surface forms.

There is another group of verbs, exhibiting the same type of alternation as keep — kept, but distinct insofar as they select the purely morphologically conditioned allomorph /t/ (cf. 2.3.2.1) viz. deal, kneel, feel, lose, lean, etc. These verbs are also marked for Boundary Weakening in order to provide the environment for the application of Laxing, but in addition they will have to be positively specified for this latter rule, since most of them end in dental clusters, and Laxing usually does not take place before dental clusters, cf. bind, wind, kind, mild, gold, field, etc.

It seems reasonable to assume that the verbs bet, bid, burst, etc. in fact belong to the same subclass of verbs, all of which are characterized by Boundary Weakening before the morphemes {PRET}, {PART II}. Whereas this process makes the first two subsets eligible for the application of the Laxing rule, the latter subgroup can now be subjected to Cluster Simplification. Beat is exceptional in that it does not undergo Laxing and must therefore be marked accordingly in the lexicon (cf. Hoard — Sloat 1971:51); otherwise, it would pattern like bleed — bled. This is corroborated by a fourth group of verbs, viz. bleed — bled, lead — led, read — read, feed — fed, hide — hid, slide — slid, shoot — shot, etc., which might be described as undergoing all three rules, viz. Boundary Weakening, Laxing and Cluster Simplification. Cluster Simplification thus need not be complicated by any additional specification, since the assumption of Boundary Weakening creates the necessary input to this rule and at the same time accounts for the similar behaviour of a substantial subset of irregular verbs, which have the morphological rule feature [+ Boundary Weakening] in common.

2.3.4.2 We must now once again return to the rule of Vowel Deletion (the same would apply to Vowel Insertion, if this alternative is chosen), which will have to be modified so as to take the above analysis based on Boundary Weakening into account. It is now no longer necessary to provide bet, bid, burst, etc. with an exception feature referring to Vowel Deletion. Instead, this rule itself will make reference to the type of boundary by allowing it to operate after # as well as +:

\[
\begin{array}{c}
+ \rightarrow \emptyset \\
\text{except} \\
\end{array}
\]

This addition of + in the environmental specification guarantees that the rule will delete /i/ between a dental or a sibilant, if it is preceded by +, while the exception feature of the rule blocks it from applying after # in this environment. Thus it correctly derives /bet+d/ from /bet+id/ (after Boundary Weakening), but does not affect /flit#id/ (without Boundary Weakening).

2.3.4.3 Vowel Deletion, Voice Assimilation, and Cluster Simplification are phonological rules having morphological consequences in that they derive surface variants of certain inflectional morphemes. Of these, Vowel Deletion and Voice Assimilation are unproblematic, since they still leave a phonological trace of the underlying representation: the remaining consonants (i.e. /t/, /s/ or /d/, /t/) are easily identifiable as the representations of the respective morphemes. The same is true of Cluster Simplification, as long as it deletes only part of the phonological representation of a morpheme, as in dissimilar, illogical, singly, where it creates a surface alternant, i.e. /disli/ besides /disl/, /il/ besides /’il/, or /’sli/ besides /’sli/. But in bet, bid, etc., Cluster Simplification eliminates the last phonological trace of the underlying representations /id/, /i/ of the respective
morphemes, so that these morphemes no longer have any surface representations with these verbs. This is the effect if Cluster Simplification is formulated as a purely phonological rule, e.g. in the following tentative formalization:

$$(6) \quad C_i \rightarrow \emptyset \% \left[ C_i (=) \right]_{stem}$$

$\emptyset$ in this formulation only denotes that the item to the left of the arrow is deleted under certain conditions, not that it is replaced by zero. The resulting surface forms would thus be $\text{bet}$, $\text{bid}$, $\text{burst}$, $\text{bosses}'$' [bɔziz], etc. This is obvious from the general function of phonological rules, which are set up to derive phonetic surface representations. As was pointed out above (2.1, 2.2), however, the morphological surface analysis on the basis of the functional oppositio of the language results in postulating zero allomorphs of the respective morphemes, i.e. the meaningful absence of an element in a morphologically relevant position. Morphologically, we therefore have the surface representations $\text{bet-}\emptyset$, $\text{bid-}\emptyset$ $\text{bosses-}\emptyset$, etc. If it is assumed that morphological surface structure is a relevant linguistic level — and the widespread phenomenon of analogical levelling within and between inflectional paradigms strongly argues in favour of this assumption — then we are faced with a problem, because our rules so far do not account for the respective morphological surface structure in the case of $\text{bet}$, $\text{bid}$, $\text{bosses}'$, etc. We can solve this problem, and at the same time reconcile taxonomic surface morphology and generative morphology in this respect, by postulating the following general convention:

$$(7) \quad \text{Zero Convention}$$

If a phonological rule deletes a segment which exhaustively represents a formative, then $\emptyset$ resulting from the deletion operation has morphological surface status.

This convention thus states that the respective segment is not simply deleted, but in fact is replaced by $\emptyset$, which can be regarded as a descriptive device signalling the absence of a phonological surface representation of a formative (morpheme). It is not unlikely that this convention belongs to the formal universal characterizing phonological theory, and the interaction between phonology and morphology. 27 With this convention added to the general theory, the output of rule (6) in the case of $[\text{dis-}=\text{simila}]$ would still be $[\text{di-}=\text{simila}]$, since /s/, the deleted segment, does not exhaustively represent a formative, but is only part of the representation of a formative. But with $[\text{bet}+t']$, the output would now be $[\text{bet}+\emptyset]$, because $[t]$ in $[\text{bet}+t]$ represents $\{\text{PRET}\}$, $\{\text{PART} II\}$ ($<</d/ by \text{Voice Assimilation} <</d/ by \text{Vowel Deletion})$. This now also explains, why zero in certain cases may in fact be regarded as a surface-structural descriptive device compensating for phonological losses: this is exactly what rule (6) in conjunction with (7) does in the case of $\text{ber}$, etc.; a phonological rule replaces a phonological representation of a morpheme by zero, i.e. its meaningful absence.

2.3.4.4 Above it was suggested that verbs such as $\text{bleed}$ — $\text{bled}$, $\text{feed}$ — $\text{fed}$, $\text{hide}$ — $\text{hid}$, etc. may be analysed parallel to $\text{bet}$ — $\text{ber}$ and $\text{deal}$ — $\text{deal}$. The same applies to $\text{bend}$ — $\text{ bent}$, $\text{send}$ — $\text{sent}$, etc. But such an analysis again results in a contradiction. According to the analysis presented above, $\text{bled}$ and $\text{lent}$ would be derived as follows:

$$(8) \begin{align*}
\text{a. } [\text{bled}\#t] & \rightarrow \text{ Boundary Weakening} \\
[\text{bled}+\text{id}] & \rightarrow \text{ Vowel Deletion} \\
[\text{bled}+\text{d}] & \rightarrow \text{ Laxing} \\
[\text{bled}+\text{d}] & \rightarrow \text{ Cluster Simplification} \\
[\text{bled}+\text{t}] & \\
\text{b. } [\text{lend}\#t] & \rightarrow \text{ Boundary Weakening} \\
[\text{lend}+\text{t}] & \rightarrow \text{ Voice Assimilation} \\
[\text{lent}+\text{t}] & \rightarrow \text{ Cluster Simplification} \\
[\text{lent}+\text{t}] & \\
\end{align*}$$

Surface-structurally, we would thus get the forms $\text{bled-}\emptyset$ and $\text{lent-}\emptyset$, where $\text{bled}$ and $\text{lent}$ would have to be regarded as morphologically conditioned allomorphs of $\{\text{BLEED}\}$, $\{\text{LEND}\}$, occurring before $\emptyset$ (the conditioning factor), whereas elsewhere the forms /bled/ and /lend/ are found. This in fact is the analysis already proposed by Bloch (1947:407). But as was already pointed out by Nida (1948:415, 427; cf. also Hockett 1947:340), it would be counterintuitive to locate the functional difference between present and preterite/second participle in an invisible zero, and treat the formal, i.e. phonological, difference $\text{bly} / \text{ey} / \text{id} / \text{id} / \text{t}$ as non-functional. 29 Consequently, these forms were reanalysed as containing the replacees /e $\leftrightarrow$ /ey/, /t$\leftrightarrow$ /d/ as representations of the respective inflectional morphemes. Is there any possibility of reconciling the structural (surface) analysis of these forms with the generative description presented above in the same way as the structural and the generative descriptions of $\text{bet}$, $\text{bid}$, etc. could be matched? For the type $\text{bled}$ — $\text{bled}$, etc. there seems to be an attractive solution in terms of restructuring. English has a number of verbs forming their preterites and second participles by
vowel change, e.g. sing — sang — sung, hang — hung — hung, etc., a reflex of the Indo-European ablaut pattern. It is therefore reasonable to assume that the verbs bleed — bled, etc. — despite their historical origin as weak verbs and the applicability of the rules discussed above — in Modern English have changed their inflectional class and joined the verbs having ablaut pattern, thus introducing a new alternation into this group. Restructuring here thus concerns the morphological features of the verbs.\(^{28}\) I am not sure, however, whether the type bend — bent should be treated in the same way, since the alteration type is so far restricted to vocalic alternations. There would thus be no parallel pattern which could have caused this restructuring by analogy. On the other hand, the similarity to the type leave — left, mean — meant, etc., rather argues in favour of classing bend — bent, etc. with the non-vocalic preterite formations. I will therefore assume that bend, lend, etc. have not undergone restructuring, and derive their preterites/past participles as illustrated in (8b).

2.3.4.5 As a conclusion to this discussion of the synchronic relationship between morphological zero and phonological rules it should be added that the zero allomorphs in sheep, trout, fish, etc. cannot be explained in the same way in Modern English, since there is no phonological basis for their derivation. They will therefore have to be introduced directly by a morphological rule as purely morphologically conditioned variants of the plural morpheme. The same is obviously true for the zero morphemes set up in word-formation to characterize cheat sb., clean vb., cash vb. as against cheat vb., clean adj., cash sb. It is likely, however, that at an earlier stage of the language these zero allomorphs had a status similar to those discussed above.

3.1 Synchronic morphophonemic or phonological rules such as those discussed above in most cases have a historical rationale. This was in fact one of the arguments presented in favour of Vowel Deletion. The same is true of Cluster Simplification, and, moreover, just as Vowel Deletion and Cluster Simplification interact synchronically in that the former feeds the latter, so Vowel Syncopation and Shortening of long consonants, their diachronic counterparts, are both responsible for the historical origin of the inflectional pattern bet — bet — bet.

The relevant phonological changes took place mainly in pre-Old English, but are reflected in the Old English phonological system. Thus the best starting-point for the historical investigation of this pattern is Old English, although only one half of the verbs exhibiting it in Modern English are in fact Old English. Of these beat, bid, burst, let, shed, shit originally belonged to the inflectional class of vocalic (strong) verbs and first adopted this pattern in Middle English, so that only hit (late Old English < ON hita), set, shut, spit, spread, sweat, wet, knit, and probably slit (not attested in Old English, but cf. G schlitten), cut and put (both not attested in Old English, but probably of Old English origin) are direct continuations of the Old English forms. Bet, cast, cost, hurt, quit, split, and thrust are later loans mainly from Old Norse and Old French (split is MDu).

3.2 The pattern originated with Class 1 weak (consonantal) verbs, which on account of various phonological processes exhibited several subclasses characterized by certain morphophonemic alternations, while Class 2 verbs were completely regular.\(^{40}\) Both verb classes exhibit the following morphological structural form:

\[
\begin{align*}
(9) & \quad \text{a. root + stem formative}^{11} (+ \text{preterite}) + \text{person/number} \\
& \quad \text{b. root + stem formative + 2nd part. (+ stem formative)} \\
& \quad \text{(+ case/number)}
\end{align*}
\]

which is evident in the preterites frem +e+d+e 'supported', luf +o+d+e 'loved'.

The stem formatives here are -e- and -o-, respectively, which act as markers of the inflectional class to which the verb belongs. They thus form part of the stem\(^ {28}\), and the base form of the preterite/second participle morphemes at this stage is /d/. In the following, I will only be concerned with Class I verbs, which are characterized by i-mutation, cf. the pairs dōm — dūman, full — fyllan, fōd — fēdan, gram — gremman, etc. This can be accounted for by assuming that the stem formative originally was a palatal, viz. /i/, and in a synchronic description of Old English morphophonemics it is also postulated that /i/ underlies the surface representation [e] of this formative (cf. Wagner 1969:220; Erdmann 1972).

This stem-formative element probably was originally a derivational affix, which, however, already in Old English had lost its function and served as an inflectional class marker. Due to this functional shift, we will have to assume that in the denominal and deadjectival verbs dōman < *dōm-ja-n : dōm, trymman < *trum-ja-n : trum, etc., the derivational marker in Old English is zero, as it is in Modern English clean adj, < clean/Ø vb., etc. on account of the parallel with legal : legalize. In this case we thus have a substitution of zero for an explicit element for functional, not phonological reasons.

This underlying representation /i/ appears as /iː/ after a heavy or unstressed syllable (Erdmann 1972:410f.), as /ɪ/ (surface-structurally [e])
before a consonant such as the base form /d/ of the preterite and second participle morphemes, and as /j/ elsewhere. In all environments it produces i-mutation, and /j/ additionally lengthens a preceding stem-final consonant (except /j/) in a short stressed syllable, cf. trum : trymman vs. andswaru : andswarian; /j/ is then lost except after /j/, cf. döman vs. nerian.

Weak verbs are thus generally characterized by stem formatives (thematic vowels, verbal extensions). There are certain exceptions, however. A small class of verbs including bringan — bröhte and the preterite—presents ägan — öhte, magan — meahite, etc. never had a stem formative and will therefore have to be analysed as a class of its own. Another group of verbs, traditionally regarded as a subclass of Class 1 verbs, i.e. those characterized by the so-called "Rükmumlaut", and instanced by sêcan — söhte, bygcan — bohte, pêncan — pôhte, pyncon — pûhte, wyrcon — worhte, had the stem formative /j/ only in the present stem but not in the stem underlying the preterite/second participle. This is evident from the lack of i-mutation in the latter forms. For these we will assume a separate stem formative (Wagner's verbal extension [2 Ext], cf. Wagner 1969:220), which has the two morphologically conditioned variants Ø and /j/. Their distribution will not be handled by a phonological rule, but by the following morphological rule:

\[ \text{(10)} \]

3.3 In the transition from Common Germanic to Old English, the representation /i/ of the stem formative /j/ (= Wagner's [1 Ext], characterizing the bulk of Class 1 verbs) was either reduced to [e], or it was syncopated in certain environments. We have to distinguish two stages in this development, according to whether syncopation took place before or after i-mutation became effective and resulted in the phonemization of the mutated vowels. With a number of verbs ending in /i/ or /u/, i-syncopation occurred before i-mutation verbs had become phonemized, thus removing the factor conditioning i-mutation in the preterites and second participles of these verbs. This produced the Old English alternations cwecean — cwæhte 'shake', drecean — dreahite 'afflict', leccan — leahite 'moisten', reccan — reahite 'narrate', streccan — streahite 'stretch', pêccan — peahite 'cover', weccan — weahite 'wake' rêccan — rôhte 'reach', têccan — râhte 'teach', cwellan — cwælde 'kill', dweilan — dwealdæ 'hinder', sellan — sealdæ 'sell', stellan — steldæ 'place', tellan —

tealdæ 'count'. After the loss of /i/, these verbs closely resembled those of the type sêcan — söhte, and it is reasonable to assume that they changed their class marker (verbal extension) from [1 Ext] to [2 Ext]. Thus at this stage no rule of Vowel Deletion need yet be added to the phonological rules; the respective alternations can still be handled on the purely morphological level in terms of a verbal stem extension with the alternants /j/ and Ø.

The second stage of i-syncopation, however, occurs after i-mutation immediately before the beginning of the Old English period, and causes the addition of a new phonological rule to the existing rule system, viz. Vowel Deletion. This rule captures the historical development according to which /i/ representing the stem formative before a consonant, e.g. before /d/ as the base form of [PRET], [PART II], is lost after having caused i-mutation. Syncopation is restricted to certain environments, however; /i/ is generally syncopated only after long syllables (i.e. those containing a long vowel or ending in a consonant cluster), if /i/ is followed in turn by a vowel, and after short syllables ending in a dental stop, again if /i/ is followed by a vowel; it is optionally syncopated after dental stops (both in long and short syllables), when /i/ is followed by #, i.e. in uninflected participles, and when /i/ is followed by a consonant, i.e. in inflected participles where the inflectional ending begins with a consonant. Elsewhere, /i/ is retained and changed to [e]. These developments result in the following Old English surface patterns:

\[ \text{(11)} \]

a. ner+i+an — ner+e+d+e — ge+ner+e+d — ge+ner+e+d+ne (short stem, no Vowel Deletion)
b. dêm+i+an — dêm+d+e — ge+dêm+e+d — ge+dêm+d+ne (long stem, Vowel Deletion in the preterite)
c. send+i+an — send+e — ge+send+e+d+ge+send — ge+send+e+d+ne (long stem ending in a dental stop; Vowel Deletion in the preterite obligatory, in the participle optional)
d. set+i+an — set+t+e — ge+set+t+e+d+ge+set+t+e — ge+set+t+e+d+ne (short stem ending in a dental stop; Vowel Deletion in the preterite obligatory, in the participle optional)

This loss of the stem-forming vowel in certain positions, which is captured in Old English by a purely phonologically conditioned rule at least in the earlier period, is the origin of the Modern English rule of Vowel Deletion. It was only in late Old English, when Vowel Deletion was extended to other environments as well, and especially in Middle
English, where the conditioning factors were obscured by various phonological changes, that Vowel Deletion came to be a morphonologically conditioned rule for some time (Kastovsky 1971:99ff.). In conjunction with this change, the stem formatives lost their function, since they no longer distinguished the two classes of weak verbs, and became part of the underlying representation of \{PRET\}, \{PART II\}, which from then on had a vocalic segment. Only when Vowel Deletion was generalized did the rule become morphonologically conditioned again.

3.4 For our present purposes, this sketch of the development of Vowel Deletion will suffice. What is really relevant are the results of the various historical changes as mirrored by the Old English phonological rules, especially in those cases where a stem ended in a dental stop. Thus the stems underlying the verbs sendan, settan are /sand+i/, /sat+i/, respectively. Correspondingly, the underlying representations of the preterite and the uninflected second participle are /sand+j+d+a/, /sand+j+d#/ and /sat+j+d+a/, /sat+j+d#, which are converted to /sand+i+d+a/, /sand+i+d#/ and /sat+i+d+a/, /sat+i+d#/ by the rule changing /j/ to /i/ before a following consonant. Then the rule corresponding to the historical process of i-mutation raises the stem vowel to /i/, after which Vowel Deletion applies. Taking into account, furthermore, the changes affecting unstressed vowels, i.e. /i/, /a/ > /i/, the resulting representations are /send+d+c/ and /send+c+d#/. The same alternative forms occur in inflected participles. The sequence /t+d/ is automatically assimilated to /t+/t/ by the rule which still operates in Modern English. Vowel Deletion thus produces clusters of identical consonants, i.e. geminates (long consonants).

So far, the morphemes \{PRET\} and \{PART II\} would still be overtly represented everywhere by a dental stop, which, however, together with the preceding stem-final consonant, forms a long consonant in those instances where Vowel Deletion has applied. Old English, in contrast to Modern English, permitted long consonants in intervocalic position, cf. the contrast between cwelan ‘die’ and cwelian ‘kill’. It originally apparently also had long consonants in word-final position, but these were simplified rather early; in preconsonantal position, long stops and fricatives occurred only before sonorants, cf. applas, betra, etc., but apparently in free variation with simple consonants, cf. the spellings replas, betra, etc.; in post-consonantal position, long consonants were not permitted (cf. Kurath 1956:435f.). We thus have to assume the existence of a rule of Cluster Simplification for Old English as well, for which Wagner (1969:232) proposes the following formulation:

\[
(12) \quad C^* \rightarrow C \text{ if: } <C> \rightarrow <C>.
\]

But this formulation is incomplete, since it does not include a restriction referring to word-final position. A possible restatement, using angled brackets to indicate that the rule operates whenever one of the environmental elements or a combination of them is present, would be

\[
(13) \quad C_i \rightarrow \emptyset / <C> \quad (\approx) \quad < \left\{ \begin{array}{c} [-\text{voc}] \\ \# \end{array} \right\} >
\]

[[-voc]] excludes liquids and vowels from this position, since before these, long consonants were permitted. Alternatively, and much simpler, the rule could be stated in terms of a negative environment as

\[
(14) \quad C_i \rightarrow \emptyset / C_i \quad (\approx) \quad \text{except } /VC_i[+\text{voc}].
\]

In this form, the rules are probably incomplete, because they only deal with clusters in stem-internal position or between a stem and a suffix. In order to cover prefixes as well, the rule will have to be reformulated along the lines of (6), using the mirror image convention and an index referring to “stem”. A complete formulation is not necessary for the present purpose, however. As in (6), only = is explicitly mentioned, so that (13) or (14) also apply across + (cf. note 26), but not across #. The development from Old English to Modern English, characterized by the loss of long consonants, would thus merely consist in the comitamvoc feature placed on the environment.

If we applied this rule to the intermediate representations quoted above without using at the same time the convention stated in (7), we would get /send+c#/; /send#i/; and /set#i/, where the representations of the preterite and second participle morphemes have been completely deleted. We are thus faced with the same problem of accounting for the morphological surface structure as in our discussion of the Modern English equivalents. Morphologically speaking, these forms are analysed as send+∅+e, ge+send+∅, and ge+set+∅, and similarly the inflected participles ge+send+∅+ne, ge+set+∅+ne. This is all the more obvious, since we have allomorphic variation between ∅ and explicit realization of the same morphosyntactic category within one verb. Thus in ge+send+∅ and ge+send+c+d, ge+send+∅+ne and ge+send+c+d+ne, /d/ and ∅ seem to alternate freely; and the same is true in the respective forms of settan. Furthermore, in set+e+t the preterite is realized by /i/, in send+∅+e again by ∅. In order to allow for this morphological surface
Zero in morphology

3.5 Cluster Simplification as formulated above for Old English only makes reference to optional \= as internal boundary, but not to \#. Correspondingly, the input to this rule must not contain \#; in the examples discussed above, the inflectional endings were therefore preceded by +. In Modern English, however, the boundary separating the inflectional affixes from the stem is \#, which requires an additional rule of Boundary Weakening. We must now ask ourselves whether for Old English we should indeed assume + as the internal boundary, or whether the boundary between stem and inflectional ending in fact was not \#, with Boundary Weakening applying throughout. There are, however, strong reasons to adopt the first solution. In Modern English, word and stem are often identical, i.e. even an uninflected word has a rather autonomous status, and at least one inflectional ending, viz. the genitive, may not only be added to words, but also to whole syntactic groups, i.e. sequences of words, e.g. in the Queen of England's grandson. This was not possible in Old English. There, the major word classes, viz. nouns, adjectives, and verbs, exhibited a full set of inflectional endings, often preceded by a stem formative, and in fact could not occur without these elements in sentences, except as stems in word-formation, where they are linked to other stems or derivative suffixes. Thus the stem without inflectional endings had no independent status, and it is therefore highly plausible to assume that a word-boundary only occurred after, but never before inflectional endings. One of the major phonological changes in the history of English, probably in conjunction with the almost total loss of inflectional endings and the resulting identity of stem and word, was therefore the replacement of + by \# before the remaining inflectional endings. This development must have occurred in the course of the general restructuring of the inflectional system during the Middle English period, as will be shown below.

3.6 Two sound changes, the shortening of long vowels in certain environments in the transition from Old to Middle English, and the loss of long consonants during the Middle English period, are of importance for the further development of the verbs under consideration. The first sound change affected verbs having a long stem vowel, e.g. bledan — bledde, fedan — fedde, mētan — mette, lēdan — lêdde, etc., which was shortened before the long consonant, resulting in an alternation between long and short stem vowels. The long stem vowel was later affected by the Great Vowel Shift, which added a qualitative alteration to the quantitative one. These alterations are captured by the Modern English laxing and vowel shift rules. The loss of the final vowels in mette, fedde, etc., and the general loss of long consonants in Middle English produced the Modern English alternation pattern bleed — bled, meet — met, etc. As was suggested above, this should no longer be handled on the basis of an underlying representation /id/ of [PRET], [PART II], but in the same way as the vowel alternations in flung — flung, drink — drank, bound — bound, etc. It has become questionable, however, whether these can really be handled by phonological rules in Modern English.

The loss of long consonants and final unstressed vowels in Middle English is also responsible for the regularization of the Old English alternations set+t+e vs. ge+set+O ~ ge+set+e+d, etc. by reducing set+t+e to set+O and generalizing the forms without inflectional endings in the participle. This pattern involving zero was much more common in Middle English than it is today, since it was extended to a number of originally strong verbs, e.g. bid, burst, let, shed, slit, and was adopted by various loans, e.g. bet, cast, cost, hurt, quit, split. Moreover, many verbs which today are inflected regularly, had preterites and second participles without explicit inflectional endings in Middle English and Early Modern English, e.g. light, start, bolt, lift, etc., and were thus recategorized later on. (For details, cf. Brunner 1962:261ff., and Jespersen 1942:34ff.)

Another interesting phenomenon is also linked to this pattern and illustrates its productivity in Middle English. English in this period borrowed numerous French and Latin participles (or verbs in participial form) ending in -t, e.g. anoint, discomfit, corum, separate, approbate, etc. When these came to be used as verbs, the participles often, although not always, kept their original form, which partly was also extended to the preterite, so that these fitted into the pattern set — set — set. Partly, however, -ed was regularly added in the preterite and participle on analogy with verbs not affected by Vowel Deletion after a dental stop. Now Reuter (1934) assumes that the pattern cut — cut — cut played a major part in this borrowing process, and that it was mainly on analogy with this pattern that the original participles extended their function to the other verbal categories, e.g. the infinitive, present, and preterite, while only at a much later stage -ed was added to the preterites and second participles. Although this is undoubtedly true in a number of cases, the
analogy to the burst, cut, set pattern apparently was not the only factor determining the borrowing process. As Marchand (1969: 256ff.) points out, the correlation between -ate and -ation (create ~ creation) also played an important role, leading to the back-formation of verbs in -ate from nouns ending in -ation. Nevertheless, and this is also admitted by Marchand, surface analogy to cut, burst, put, cast, etc., certainly was involved, too, at least in the earlier stages of the borrowing process. But it is strange that the analogy only worked for a limited period, viz. from about 1225 to about 1475, and from then on the regular pattern automatically adding -ed to a loan ending in -t became the norm. This is actually the major criticism raised by Marchand (1969:257) against Reuter’s hypothesis, who did not explain this change in the behaviour of the loans.

3.7.1 It appears that the solution of this problem involves the rules discussed in connection with the derivation of the preterites/second participles of verbs like bet, cut, burst, etc., in Modern English, viz. Boundary Weakening, Vowel Deletion, and Cluster Simplification. We are now faced with the following phenomena, which require an explanation: 1) replacement of + by # before inflectional endings; 2) greater productivity of the pattern cut — cut — cut in Middle English and later re categorization of many verbs originally following this pattern; 3) prevalence of the pattern ‘borrowed French or Latin participle in -t → homophones infinitive/present/preterite’ from about 1225 to 1475 (Marchand 1969:257, following Reuter), then complete replacement of this pattern by the rivaling pattern adding -ed to the participle and preterite. Since the pattern cut — cut — cut continued to exist with a number of verbs, why was it dropped with the borrowed participles?

I think that there is a definite connection between these latter two phenomena, the change of the boundary before inflectional endings from + to #, and the introduction of /əd/ (or /ɪd/) as the underlying representation of the inflectional morphemes involved, which thus replaced the original base form /d/.

3.7.2 The loss of unstressed vowels in word-final position led to a considerable reduction in the number of inflectional endings, i.e. only those ending in a dental stop or a sibilant were ultimately preserved, except for participial -ing and a few cases ending in -en, as in the strong participles written, broken, etc., or the irregular plurals oxen, children. At the same time, this loss automatically resulted in the replacement of original + separating the stem from the inflectional ending by #, while in those cases where the inflectional endings were preserved, + still remained as boundary. But the loss of the inflectional endings, especially in such syntactically neutral forms as the infinitive or the nominative singular, in conjunction with the replacement of + by #, automatically changed the status of these forms. They were no longer considered as inflected forms among others, but, due to their formally independent status, which was especially obvious on account of the boundary #, became the base forms of the respective inflectional paradigms. More precisely, their status changed from stem plus zero ending to word without inflectional ending, i.e., to an unmarked base form. As a consequence, inflection now no longer operated on the basis of stems followed by +, but on the basis of words bounded by #. This led to the introduction of # also before the remaining inflectional endings, i.e. to the generalization of #. It is obvious that this whole process was gradual and much more involved than this sketch indicates, especially if we take the dialectal variation of Middle English into account. Nevertheless, it seems clear that the loss of final vowels, eliminating many inflectional categories, caused the stem as basic inflectional category to be replaced by the word, which is an autonomous syntactic unit.

3.7.3 At the same time, Vowel Deletion, which in Old English was predictable on the basis of the shape of the stem and thus was a purely phonologically conditioned rule, came to be a purely morphologically conditioned operation, i.e. each verb had to be specified in the lexicon as to whether it permitted Vowel Deletion or not. Thus ME enden — endede — ended (OE endian — endode — geendod) preserves its vowel, while the phonologically parallel ME blenden — blende — (y)blend(y)blent (OE bendan — blende — geblend(ed)) was subject to Vowel Deletion. This situation resulted from the merger of the two classes of old English weak verbs, which was brought about by the coalescence of their different stem formats in /ə/. As a consequence, the stem formats lost their function and ultimately became part of the underlying representations of the inflectional morphemes. Again this process was gradual, and it led to two rivaling patterns for verbs ending in a dental stop, which now no longer were kept apart by different stem formats, i.e. by phonological criteria, but solely by the morphological feature governing Vowel Deletion. It is reasonable to assume that in such a situation phonological surface analogy will have played an important role in determining the categorization of verbs, and that class shifts due to phonological analogy will have been frequent. It is at this stage that French and Latin participles in -t probably were categorized mainly in terms of phonetic similarity to English verbs, and there the pattern cut — cut — cut may have facilitated the borrowing, since no explicit native inflectional ending had to be added to a foreign stem in the preterite and
the second participle. This would explain why in this period the pattern of borrowing involving no addition of -ed to the participle was relatively strong, since the presence or absence of this ending depended solely on the incorporation into one or another almost equally productive class.

Vowel Deletion, being determined by a morphological feature, was independent of the type of boundary separating stem and affix. Moreover, Cluster Simplification gradually was generalized to all positions except those where the two consonants were separated by #, thus reaching the stage formulated in (6). But inflectional endings were not yet generally preceded by #, but, at least in the earlier period, by +, so that Cluster Simplification would operate freely without any additional rule such as Boundary Weakening. Therefore, the pattern cut — cut — cut was completely regular at this stage. It only presupposed a morphological feature [+ Vowel Deletion] present in the lexical entry of the verb, and this feature it shared with many other verbs not ending in a dental stop and thus having explicit realizations of the preterite/second participle morphemes. The deletion of the surface realizations of these morphemes was therefore still completely regular and solely due to the automatic application of Cluster Simplification.

3.7.4 This roughly describes the situation prevailing at the beginning of the 14th century. In the 14th century, however, spreading from the North to the South, Vowel Deletion became more and more general, first leading to free variation between deleted and undeleted forms, until finally the deleted forms won out, except after dental stops and sibilants. The morphological conditioning of Vowel Deletion became phonological again. This stage was reached, according to Strang (1970:178–180), in the late 16th century. But why did this development reduce rather than increase the number of verbs patterning like cut, i.e., why was the vowel preserved after a dental stop (or a sibilant with the sibilant morphemes)? And why did the pattern separate (participle) → separate (verb) suddenly cease to be productive?

The answer to these questions is obviously tied with the introduction of # before inflectional endings, and the reinterpretation of the stem formatives as part of the underlying representations /ad/, /az/ (or already /id/, /iz/) of the respective inflectional morphemes. Both developments must have happened either shortly before the generalization of Vowel Deletion or at least parallel to it. As has been stated above, the loss of unstressed final vowels not protected by a consonant was probably the first development* and established # as the boundary after what in the remaining inflected forms appeared as a stem followed by +. The reinterpretation of the uninflected forms as unmarked base forms must have led to a gradual replacement of + by # also before the remaining inflectional endings. It is not improbable that this boundary change was in fact the ultimate cause of the loss of the vowel in the inflectional endings, i.e. caused the generalization of Vowel Deletion. But two factors now prevented the spread of Vowel Deletion to verbs ending in a dental stop or nouns ending in a sibilant.

In the earlier stages of Middle English, the status of the vowel representing the original stem formatives probably was indeterminate between forming part of the stem and forming part of the inflectional ending, with an increasing tendency towards the latter alternative. Correspondingly, the underlying representations of the inflectional endings gradually changed from /id/ to /ad/ and /as/ (later /ad/, /iz/). During this transition period, there was considerable vacillation from dialect to dialect, and probably even within one and the same idiolect. But eventually /id/ and /iz/ came to be established as base forms everywhere, which is corroborated by the extension of the spelling -ed to cases where Vowel Deletion must have occurred regularly ever since Old English, as in deemed (OE démde), kissed (OE cyste). So /id/ and /iz/ as underlying representations must have had a certain psychological reality, which strengthened their position and made their retention after dental stops and sibilants more likely than the complete deletion of the formative, which would have resulted if Vowel Deletion had applied in this environment. Moreover, Vowel Deletion after the introduction of # before inflectional endings would produce clusters of the type /t##/, /d##/, etc., which could not form the input to Cluster Simplification, except if this rule contained a corresponding specification at this stage. But since apparently Cluster Simplification did not operate across # in Old English, and does not in Modern English either, this assumption is very unlikely. Thus the boundary must have been weakened to + again in order to make Cluster Simplification applicable, or, more precisely, it was never changed to # at all in those cases which permitted Vowel Deletion after a dental stop or sibilant. For a synchronic description, however, this requires the introduction of a new rule, viz. Boundary Weakening, which may have already existed at the time in other morphological patterns, and had only to be made applicable to a new environment. As is obvious from the description of Modern English, this is basically a morphologically conditioned rule. Thus it involves the introduction of a morphological feature governing this rule into the lexical entries of those verbs which were subject to it, while the others neither had this feature nor underwent this rule, a rule, furthermore, which was contrary to the general tendency of separating the inflectional endings from the stem by #. Consequently, the pattern cut — cut — cut for the first time became totally exceptional, which is why the
regular forms in /d/ prevailed. This also explains the death of the pattern 'participle (without -ed) → verb', which was replaced by the regular pattern adding -ed to mark the functions of the participle and preterite overtly. Since this pattern was given up at the end of the 15th century, we may assume that by then the above developments were largely complete. It also explains why many verbs originally inflected like cut, etc., subsequently joined the regular class and added -ed, while only a few monosyllables retained their Middle English inflectional pattern.

4 The above considerations have shown that the zero allomorphs postulated for verbs like cut, bet, burst, etc., are indeed structural compensations for a synchronic and diachronic phonological loss. However, the analysis of the forms in question has also shed some light on certain other aspects of historical English morphology. If the above sketch of the Middle English developments is correct, then the change of inflectional boundaries from + to # played a major role in the generalization of Vowel Deletion, which, contrary to Miner's assumption (Miner 1975:350) was not added to English phonology in the transition from Middle English to Early Modern English, but is much older. What happened at this stage was that the rule became phonologically conditioned again, at the same time marking the verbs preserving Vowel Deletion after dental stops as irregular, whereas before they had been completely regular. Their irregularity in Modern English is best accounted for by making them subject to a rule of Boundary Weakening, thus indicating that they have preserved an earlier morphological pattern which involved + instead of # as the boundary preceding inflectional affixes. The rule of Cluster Simplification, immediately responsible for the zero realizations of the inflectional affixes in cut, etc., reached its present formulation already in Middle English, but in fact also dates back to Old English, where, however, it was less general. If surface structure also plays a role in morphology and not only in syntax, then Cluster Simplification will be subject to a general convention which specifies that Ξ resulting from the deletion of a phonological segment has morphological status, if the deleted segment exhaustively represents a formative. The various analogical changes in the history of the English language, which are mainly due to surface analogy, strongly argue in favour of this assumption.

Notes
1. I should like to thank Martin D. Pam for many helpful comments on this paper. I am also very grateful for a number of valuable suggestions made by various participants at the conference, notably Mark Aronoff, Broder Carstensen, James Fidalholtz, Joan Hooper, P. Neubauer, Jerzy Rubach and Werner Winter, who helped me to clarify a number of points.
2. But cf. Schane (1971) for a defense of the phoneme concept in order to state relevant surface contrasts.
4. Gödel (1953) adds this to "signe".
5. Cf., e.g., Glason (1961:98, 102).
6. The origin of this principle will be discussed below in 3.7.2.
8. An exception is Hoard and Slot (1971:49 fl.). I did not know their article, however, when I wrote this paper, and I am extremely grateful to James Fidalholtz for bringing it to my attention.
10. This applies to the forms kicked, [kikkt], laughed, [lahht], etc., but not, of course, to cases such as deaf [deft], sent [sent], etc., where /t/ as the surface realization of the respective morphemes has to be introduced directly as a morphologically conditioned allomorph in the morphological component. This seems to be a more appropriate and much simpler solution than postulating an additional, but otherwise quite unmotivated rule of devicing, as is suggested by Hoard and Slot (1973:113–114, fn. 9), viz. d → t [+ consonantal, – syllabic] → #, which has to be morphologically governed in any case in order to differentiate healed, bilted from spolt, dwelt.
11. Cf. already Hockett (1958:280), and the arguments in Shibatani (1973). Hoard and Slot (1971:47 fl.) insert this vowell as part of the stem, thus obtaining [nɔd/ð] as the result of Vowel Inversion, which seems to be rather counterintuitive. There does not seem to be any principled way of choosing between these two alternatives, which adds further weight to the arguments usually adduced against Vowel Inversion.
12. Zwicky (1974:216) lists the nouns feet, teeth, mice, geese, lice "ending in obstruents" as exceptions to this tendency. The latter three could be accounted for by including them in the general derivational framework, if Vowel Deletion is made obligatory for (GEN) preceded by (PLURAL) (cf. also note 25). In this case, Cluster Simplification (see below) would eliminate the overt realization of (GEN) in the same way as in the other genitive plurals. Teeth and feet, however, would have to be regarded as truly exceptional, but then inanimate nouns usually reject the "Saxon genitive" anyway.
13. This does not mean, of course, that zero allomorphs are not found elsewhere, e.g. sheep, trout, grouse, giraffe, etc. Allen (1976) has pointed out, however, that these nouns apparently form a natural semantic class in that they all denote animals which are either regularly used as food, or are hunted as game, and that nouns like giraffe, elephant, etc., select the zero plural in fact only if they are considered as objects of hunting, but require the sibilant allomorphs in all other contexts. In this case, the zero allomorph representing (PLURAL) will have to be introduced directly in the morphological component on the basis of a morphological exception feature. But this feature could be made dependent on a morphological redundancy rule in the lexicon introducing it into the respective lexical items on the basis of their semantic specification, if Allen's generalization proves to be correct.
14. Hoard and Slot (1971:50 fl.) also use Cluster Simplification to account for these forms, but since their base form is /t/ rather than /n/ or /ð/, their treatment of these forms is rather different. In their 1973 article (1973:114, fn. 9), they opt for the base form /d/,
withow, however, considering the consequences this choice has for their overall analysis, and especially for the formulation of Cluster Simplification.

15. This is basically Zwick's rule (9) (1974:214), which is derived from Miner's rule (15) (Miner 1975:356), except for the replacement of /a/ by /i/ to conform to the phonology of British English. The internal boundaries prevent this rule from applying to words such as morbid, acid, or promise, promise, treatise, etc., where /id/ /i/ are not preceded by a boundary, since they are not formatives. This also applies to Vennemann's arguments mentioned in Miner (1975:356, fn. 13), according to which /a/i, /a/i, and a syncopation rule could no longer be motivated for English on account of words such as insipid, rabid, focus, which should undergo vowel deletion but in fact don't. Miner mainly counters this by reference to phonological aspects, i.e., the fact that /id/, /d/ (or /a/), /d/ represent morphemes in one case but not in the other is decisive. Consequently, /id/ in rabid, insipid, etc. will not be preceded by a boundary and thus does not satisfy the structural description of rule (1). Moreover, focus would be pertinent as a problem only in dialects which have /a/i as inflectional endings, i.e. not in British English, where focus ends in /a/i (note the voiceless sibilant!), and the inflectional ending is /i/. But here the same argument involving the lack of an internal boundary applies. Actually, as will be shown below, some restructuring took place in Middle English, but this concerned the removal of the morpheme boundary between the stem-forming (thematic) vowel and the inflectional ending. It was this process which made the vowel part of the underlying representation of these morphemes.

16. Other pairs exhibiting this alternation are gymnast, vs. potassium, music vs. russet (cf. musket).

17. This = boundary is neither a word- nor a formative boundary and is used by Chomsky and Halle (1968:56, fn. 94, 371) to characterize verbs and nouns of the type permit, concur, compel, etc., which etymologically are derived from Latin prefixal verbs, but where neither "prefix" nor "stem" have independent status in the lexicon. This boundary is introduced for purely phonological reasons, i.e. correct stress placement on the final syllable even if this is a weak cluster, as in permit, etc.

18. The following only applies to the negative prefix in-; the situation with the locative particle in- occurring in income, immigrate, etc. is more complicated and seems to involve reference to the distinction between native and foreign formations.

19. I have to thank several participants of the conference, notably Jerzy Rubach and Werner Winter, for pointing out the inadequacies of my original analysis, which, due to insufficient data, included stressed vowels in this environment. As fully shows, this is incorrect. On the other hand, the great number of examples, of which the above instances are only a selection, warrants the analysis in terms of Boundary Weakening suggested below, and thus counters the objection that only very exceptional cases are subject to this rule.

20. The presence of + instead of # in these instances will be explained in 2.3.4 below.

21. Cf. Chomsky — Halle (1968: 369; for an historical explanation of this fact, cf. 3.5, 3.7.2 below.

22. Chomsky and Halle apparently opt for Vowel Insertion.

23. Cf. also Hoard and Sloat (1971:48 f.), who treat these classes as cases of internal sandhi (with a + boundary), as against the completely regular verbs, which exhibit external sandhi, due to the presence of # before the affix.

24. Although this analysis correctly accounts for the surface forms of these verbs, and moreover, reflects their historical development, thus corroborating the above rules, it nevertheless presents serious problems, cf. below 2.3.4.4.

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Zero in morphology

25. The morpheme (GEN) probably contains a similar exception feature specifying that its boundary is weakened to + after the plural morpheme; cf. also Hoard and Sloat (1971:55, fn. 33), who consider a similar solution, but restrict it to the labial allomorphs of (PLURAL), since they do not consider forms such as mice's, lice's, geese's, mentioned in note 12 above.

26. This attempt at formalizing Cluster Simplification uses the mirror image convention as suggested in Anderson (1974:114 ff. It thus is an abbreviation of the following more explicit formulation.

\[
C_i \rightarrow \emptyset \quad \left\{ \begin{array}{l}
\left[ \left[ C_i \right]_{=\text{stem}} \right]_{=\text{stem}} \\
\end{array} \right\}
\]

The index \( i \) indicates that the environmental consonant, i.e. the one not deleted, always must form part of the stem. The boundary = is optional in order to accommodate both dissimilar, illicit, assist, etc. with = and harsh, careus, etc. without intervening boundary between the identical consonants; since in the latter examples both consonants belong to a stem, the rule is applicable. The + boundary need not be mentioned explicitly, if it is assumed that any rule applying "to a string of the form XXYZ also applies to strings of the form X + Y + Z, X + Y + Z, where X, Y, Z stand for sequences of zero or more units and + represents formative boundary" (Chomsky — Halle 1968:364). Since # must be mentioned explicitly in a rule, (6) is excluded from applying to the sequence \( C, #, C \).

27. As Werner Winter pointed out in the discussion of this paper, this convention is in fact a more formalized version of a principle postulated by him in order to restrict the use of morphological zero, cf. "... in the special case that the total phonic substance of a morpheme consists of one phoneme subject to phonologically conditioned partial loss, a zero-allomorph of this one-phoneme morpheme can be admitted" (Winter 1964:16). As the above examples have shown, however, this is only the last step in the progressive reduction of the representation of a morpheme; i.e. Winter's restriction is too strong if it is applied to the underlying representation (base form) of a morpheme directly, which may consist of more than one phoneme, since this may nevertheless ultimately yield a zero allomorph in the course of the application of several different deletion rules.

28. For an extensive discussion of these problems, cf. also Haas (1962).

29. This would then be an instance of the morphologization of a phonological rule, which is described in Wolfgang Wurzel's paper also presented at the Historical Morphology Conference in Poznan (Wurzel, this volume), i.e. an originally purely phonological alternation becomes itself the marker of a morphological opposition.

30. There are a few relics of a third class, e.g. libban, habban, hygenan, which, however, joined the other two classes during Old English, so that for our purposes we need not recognize a separate class to accommodate them.


32. As Erdmann (1974:19) has shown, this analysis can no longer be maintained for the nominal inflection which was originally also based on the pattern "root + stem formative + case/number". Due to various phonological changes, the stem formative was fused with the case/number endings, a process which spread to the verbal paradigm in the transition to Middle English (cf. Kastovsky 1971:98 ff. and 3.3, 3.7.3 below).
33. The prefix ge- /i/ characterizing the second participle is omitted here. The presence of + rather than # before the inflectional endings will be explained in 3.5, 3.7.2 below.

34. Neither was it possible in Middle English, cf. Chaucer’s The wife’s tale of Bath.


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