GRAMMATICAL BOUNDARIES IN PHONOLOGY

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Abstract: This paper[1] is divided into two main parts:
(1) on grammatical boundaries in generative
phonology, including an overview of boundaries
in the phonology of French, and (2) which con-
centrates on the evidence for grammatical
boundaries, and where both French and Danish
examples are discussed. This bipartition is
mainly made for expository reasons, and there
is a considerable overlapping in the contents
of the two sections.

1. Grammatical boundaries in generative phonology

1.1 Boundaries in relation to syntax

Within the transformational-generative paradigm questions
like the following are central for the discussion of boundaries:
By which convention(s) are boundaries inserted? Are they in-
serted on the basis of the syntactic surface structure alone
(possibly in the readjustment component), or does the insertion
of boundaries depend on information which is available only on
deeper syntactic levels? If the latter is the case, are the
boundaries moved (by movement-transformations) together with
the material they delimit, or are they left behind? How are
the boundaries affected by the readjustment rules? I shall not
try to discuss these and similar questions here (let alone try
to answer them), since this approach implies the serious danger

of over-axiomatising empirical issues (cf. Derwing 1973, Linell
1974). I.e., so long as the theory of transformational-generative
grammar is not more well-established empirically than seems to
be the case for the moment, the answers to the questions raised
in this paragraph must remain equally uncertain.[1] It seems wiser
to me to take an alternative point of departure as mentioned
below.

1.2 Boundaries in relation to phonology

1.2.1 Inventory of boundaries

According to the principle of 'Occam's razor', no more
structure should be postulated than is necessary to account for
the observed data. Concerning boundaries, the 'null-hypothesis'
which, accordingly, should be tried before we move to more com-
plex hypotheses, is that no grammatical boundaries are phono-
logically relevant. Each proposed distinction in boundaries
(i.e. each new boundary type introduced) must be separately justi-
fied on purely phonological grounds.[2]

1.2.2 Function of boundaries in phonological rules

According to Chomsky/Halle 1968, boundaries are units (in
the phonological string) which are cross-classified by distinc-
tive features (viz. the features [word boundary (WB)] and
[formative boundary (FB)]). In addition to # ([+WB, -FB]) and
+ ([-WB, +FB]), they operate with a = ([-WB, -FB]), a boundary

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1) Furthermore, the use of syntactic surface structure (SS) in
   phonology also implies the danger of circularity, since facts
of pronunciation (e.g. intonation and stress) are sometimes used
as clues for SS.

2) Thus I do not accept an argument like the following: We can
   define a large number of different boundary types on grammati-
cal grounds, and each of these boundaries is potentially a phono-
logically relevant boundary which can be used at will (without
any 'cost', i.e. added complexity) by the phonological component,
since the input to phonology is the syntactic component (possibly
via the readjustment component).

the postulation of which has been (justly) criticized from many
sides (apparently Chomsky/Halle do not consider the possibility
of a boundary [+WB, +FB]). If a specific boundary is mentioned
in the SD of a phonological rule, it only applies to strings
containing the mentioned boundary at the indicated place. Apart
from that, all occurrences of + in the input string to a rule
are irrelevant for the application of the rule, whereas all
occurrences of #, on the other hand, block its application
(unless, of course, a # is included in the SD at the appropri-
ate place).

McCawley 1968, in contradistinction to Chomsky/Halle 1968,
proposes that boundaries be (linearly) ordered in a strength-
hierarchy. The main function of boundaries is, according to
him, that they serve to define the domain of rules. Thus, each
phonological rule has a certain boundary as its "rank", and
each occurrence of a boundary of this rank as well as of a
stronger one serves to delimit (on one side) the extension of
each chunk to be compared with the SD of the phonological rule.
This has become known as the ranking function of boundaries.
I think it is more or less agreed today that McCawley's hier-
archical model of boundaries is superior to the SPE-model.

Stanley 1973 distinguishes between three functions of
boundaries with respect to phonological rules: (1) rules
ranked by a certain boundary (or stronger ones), i.e. the func-
tion proposed by McCawley; (2) rules delineated by a certain
boundary (or stronger ones), e.g. the rule which devoices final
obstruents in German; and (3) rules requiring a specific
boundary in their SD. Stanley furthermore argues that if rules
are formulated by means of variables, e.g. the mentioned final
devoicing rule not as: [-son] ⟶ [-voi] /___ #
but instead as: X [-son]   RANK: #
                         ↓
                     [-voi]

(where X indicates that segments may occur at the left-hand side

of the environment and, consequently, the lack of a variable
to the right of [-son] indicates that the obstruent must be
<u>final</u> in the relevant chain $\#$ ___ $\#$), then (1) and (2) above
reduce to one type. (According to the conventions of Chomsky/
Halle, on the other hand, rules of type (2) reduce to type (3),
since stronger boundaries than $\#$ are symbolized by a sequence
of $\#$'s; the SD [-son] $\#$ is thus also satisfied by [-son] $\#$ $\#$
etc.)

The examples adduced as support for Stanley's type (3),
i.e. rules requiring a specific boundary in their SD, seem
dubious to me: they are mostly taken from the analysis of English
stress and vowel shift by Chomsky/Halle, and their account of
these phenomena seems dubious by any standard. Thus, it may be
concluded that the only well-established function (or at least
the central function) of boundaries is ranking, presupposing,
as already mentioned, that variables are used in the notation
of phonological rules, in the way suggested by Stanley.

1.3   An example: boundaries in French phonology

1.3.1   Inter-word boundaries

The 'null-hypothesis' concerning inter-word boundaries,
i.e. that no inter-word boundaries are phonologically relevant,
has never, to my knowledge, been seriously proposed. Nor have
other very simple hypotheses, e.g. that <u>all</u> inter-word boundaries
have the same phonological effect.

Selkirk (1972) found a distinction between two types of
inter-word boundaries which she (following Chomsky/Halle 1968)
formulated as $\#$ (separating words in a 'liaison-context'; they
may be called 'weak word-boundaries') and $\#$ $\#$ (separating words
in a 'non-liaison context'; they may be called 'strong word-
boundaries'). She found that the notion 'liaison-context' was
relevant for the application of several phonological rules.
(I shall not discuss her evidence here.)

Selkirk viewed her results as a striking support of the basic claims by Chomsky/Halle concerning boundaries, in the following two respects: (1) There is (in French) only a distinction between # and # #, which follows from Chomsky/Halle's principles of # -insertion (where # is inserted on both sides of a major lexical category, i.e. N, V and A, and on both sides of categories dominating a major lexical category), together with their principles of reduction of sequences of #'s longer than two. (2) She found, in agreement with the principles of Chomsky/Halle, that there was never more than one # between a non-major lexical category and an adjacent major lexical category belonging to the same phrase, e.g. between a preposition and a following noun in a prepositional phrase, or between an article and a following noun in an NP. In order to account for the liaison-phenomena which are highly dependent on style level (briefly: the higher the style, the more instances of liaison), she had to introduce a number of rules with the effect of reducing # # to # in a given style, under certain grammatical conditions. E.g. the sentence le petit homme prend un instrument affreux is in labelled bracketing notation:

[[le [petit] [homme]] [[prend] [un [instrument] [affreux]]]]
S NP A   N   NNP VP V   V NP N   N A   A NP VP S

It receives the following boundary structure (in two tempi) according to the Chomsky/Halle principles (taken over by Selkirk):

#le # petit##homme# # ##prend##un#instrument##affreux# # #
              # #   # #

In casual style, a rule reduces # # to # between an A and a following N in an NP (i.e. petit # # homme ⟶ petit # homme);

in higher styles, # # is reduced to # <u>also</u> between V and NP
in a VP (i.e. prend # #un ⟶ prend # un); only in a very high
style, however, is # # reduced to # <u>also</u> between an N and a
following A in an NP (i.e. instrument # #affreux ⟶ instrument
affreux) (these facts of pronunciation can be found in most
traditional textbooks, by Grammont and others).

    I have three observations to make on this issue:
(1) Selkirk's evidence, of course, does not at all concern the
specific two-step derivation of boundaries by Chomsky/Halle
(cf. Wurzel's (1970) alternative one-step derivation, containing
features taken over from Bierwisch 1966). It only concerns the
general claim that not more than two different types of sentence-
internal inter-word boundaries may occur. (2) According to
Chomsky/Halle/Selkirk it should be completely <u>excluded</u>, in <u>any</u>
level of style, that # # could occur between an adverb in their
theory belonging to a non-major lexical category, and the
adjective (or participle) it modifies. This is true of <u>très</u>
(<u>très aimable</u> has obligatory liaison, cf. the old spelling con-
vention <u>très-aimable</u>), but in casual spoken French there need
not always be liaison after <u>bien</u> (<u>bien évident</u>), and after
<u>beaucoup</u> liaison is quite often not made (<u>beaucoup aimé</u>).
(3) According to several investigations of "word-reduction"-
phenomena (e.g. by Wolfgang Dressler and Håkon Eriksson, cf.
Linell 1974, p. 67 ff (with references)), it appears generally
to be the case that <u>the more casual or "reduced" the style</u>
<u>level becomes, the more grammatical boundaries lose their effect.</u>
But in Selkirk's framework, exactly the opposite is the case:
the higher and more distinct the level of style becomes, the
more instances of # # are reduced to # . This problem will
be taken up in section 2.5 below.

    The sentence boundary can be phonologically relevant also
in French, as discussed by Dell (1973). I propose the notation
for a sentence boundary, in agreement with the notations
and # for strong and weak sentence-internal inter-word

boundaries, respectively. This notation directly shows the
rank of the sentence boundary (cf. section 1.2 above); and
according to the Chomsky/Halle conventions it codifies the
hypothesis that a process taking place before a word-boundary
also applies if the word is sentence-final, whereas a process
taking place only sentence-finally does not apply word-finally
if the word occurs in the middle of the sentence.

1.3.2 Intra-word boundaries

The 'null-hypothesis' can be easily dismissed. Dell 1973
uses the plus sign (+, i.e. 'morpheme boundary') for all word-
internal boundaries, and no others. If this use of + is con-
sidered to be an automatic consequence of the definition of +,
it is of course empirically vacuous and hence infalsifiable.
But if, on the other hand, it is considered to be a testable
hypothesis, it can be rephrased like this: "all word-internal
boundaries have the same phonological effect, and this differs
from the effect of all inter-word boundaries". This interesting
hypothesis cannot stand up to the testing (see below).

Lisa Selkirk (1972) operates with a word-internal boundary
=, in addition to +. = is supposed to occur between prefixes
like in-, con- and learned stems, thus accounting for the drop-
ping, she suggests, of the prefix-final nasal before stems be-
ginning with a sonorant consonant, e.g. illégal, commémoratif.
I find this use of = no better motivated than the similar use
of = in English by Chomsky/Halle, since these learned formations
are predictable, by the very fact that the stem is [+savant],
a categorization which is needed anyhow to account for a lot of
learned morphology in French (and to introduce the boundary =!),
cf. native words like immangeable [ɛ̃mãʒablı].

In a forthcoming paper, I have discussed word-internal
grammatical boundaries in French extensively. In the present
paper, I shall therefore limit myself to a brief summary, and
refer the reader to Basbøll forthcoming for further discussion
and documentation.

I propose a distinction between two types of word-internal grammatical boundaries in French, which can be symbolized by + and # , respectively. + is considered irrelevant for the application of phonological rules proper (as a consequence, no phonological rule contains a + in its SD). + may be relevant only for principles of structuring the phonological chain, i.e. for morpheme structure conditions and for principles of phonological syllabification. # , on the other hand, can block certain phonological rules (see below), and, as the notation implies, the word-internal occurrences of # have the same phonological effects as the # occurring between words in a 'liaison-context', as will be further clarified below.

The principles predicting the occurrence of # vs. + are: # occurs after prefixes and before the (obstruent) endings /z/ and /t/. (/t/ is the 3^d ps. ending, and /z/ the non-third (i.e. 1st and 2^d) ps. ending, as well as the plural ending in nouns, adjectives etc.; these endings can thus be defined <u>grammatically</u>, and the phonological characterization is probably only to be considered a short-hand device, cf. Basbøll forthcoming. It should not be excluded <u>a priori</u>, however, that an obstruent can more easily be separated phonologically from the rest of the word.) + occurs before (other) suffixes. # occurs after proclitics and before enclitics, except that there is only a + before an enclitic subject pronoun. This can be (informally) abbreviated in the following formula for a 'major phonological word' in French (see below) - the notation presupposes that none of the # -reduction rules (# # $\longrightarrow$ # in a given style under certain grammatical conditions) proposed by Selkirk (see section 1.3.1 above) have been applied:

$$\# \, \# (\text{proclitic} \, \#)_o \, (\text{prefix} \, \#)_o \, \text{stem} \, (\text{+suffix})_o (\# \begin{Bmatrix} z \\ t \end{Bmatrix}) \begin{Bmatrix} (\text{+enclitic subject}) \\ (\# \text{enclitic non-subj.})_o \end{Bmatrix} \# \, \#$$

(o means that the content of ( ) is present zero, one or more times.) — The formula is slightly inaccurate in one respect: a form like <u>parlé-je</u>, which is # #parl+ə# z # ʒə # # (I argue in Basbøll forthcoming that the personal ending /z/ should be present in the underlying form (and later be deleted by the truncation rule), but whether this claim is true or not, is completely irrelevant in the present context) immediately after the application of subject-clitic-inversion (which is, according to Kayne, a syntactic transformation distinct from the other clitic movement transformations), is converted into # # parl+ə+z+ʒə # # , i.e. <u>all</u> internal # 's are reduced to + in such forms, cf. Basbøll forthcoming.

This model should be interpreted in <u>relative</u> (as opposed to absolute) terms: it predicts e.g. that there is a <u>stronger</u> boundary between prefix and stem than between stem and suffix, and, in parallel fashion, that there is a stronger boundary between a verb and an encliticized <u>object</u> pronoun, compared to an encliticized subject pronoun. E.g. in most styles a stem-final high vowel is desyllabified before a suffix beginning with a vowel (e.g. <u>niant</u>, <u>maniaque</u> [njã, manjak]), but not a prefix-final high vowel before a stem beginning with a vowel (e.g. <u>antiatomique</u>, <u>biannuel</u> [ãtiatɔmik, bianɥɛl], <u>not</u> *[ãtjatɔmik, bjanɥɛl]); and there are no styles which permit glide formation in the latter but not in the former case. Similarly, in many styles there is vowel harmony between a stem and a suffix (under certain phonological conditions), e.g. <u>cédant</u> [sɛdã, sedã], but not between a prefix and a stem (under identical <u>phonological</u> conditions), e.g. <u>prétend</u> [pʁetã], <u>not</u> *[pʁɛtã]; and there are no styles which permit vowel harmony in the latter but not in the former case. This offers evidence for the stronger boundary between prefix and stem compared to stem and suffix. But it does not, of course, exclude that in <u>much more reduced</u> styles there can be glide formation and vowel harmony in all the situations mentioned.

Our parallel treatment of prefixes and proclitic "words"
is supported e.g. by the identical treatment of en in both
functions, compare enivrer, en avril [ãnivʁe, ãnavʁil], emmener,
en Mauritanie [ãmne, ãmoʁitani].

The independent status of the endings /z/ and /t/ is shown
by the fact that the part of the word before these endings is
in all respects treated as if it occurred independently, e.g.
with respect to schwa-treatment and stress. One may also refer
to the pronunciation [zami] (in non-standard French) for amis!
which suggests that /z/ is reanalysed as a plural-prefix.
Finally, a great simplification of French verb morphology is
obtained by the proposed analysis.

The particularly tight connexion between a verb and an
encliticized subject pronoun is indicated by the following
facts: (1) /ə/ is regularly deleted in -je, -ce, etc.
(suis-je, est-ce [sɥi:ʒ, ɛs], etc.), whereas it bears the word-
stress and is never deleted in e.g. prends-le, sur ce, parce que!
and others. (2) Vowel harmony may occur, even in relatively
high styles (acceptable to Grammont!) in est-il, es-tu [etil,
ety], but only if the enclitic is subject. (3) The distinction
between /e, ɛ, ə/ is always neutralized in favour of ɛ in
phonologically closed syllables (a notion which is defined in
Basbøll forthcoming). If the vowel is immediately followed by
 # , the syllable is never (phonologically) closed. Thus there
is neutralization in favour of ɛ in parlé-je (prés.), parlai-je
(ps. simple), parlais-je (impft.), all pronounced [paʁlɛ:ʒ]
(with vowel length conditioned by the following homosyllabic ʒ,
which agrees well with the hypothesis that je is treated as a
suffix); on the other hand, /ə/ is kept as /ə/ in parles, parlent,
/parl+ə # z, parl+ə # t/.

1.3.3 Ranking of some French phonological rules

The boundaries discussed here, i.e. the sentence boundary # # #, the strong word boundary # #, the weak word boundary (identical to the strong word-internal boundary) #, and the morpheme boundary (i.e. the weak (or irrelevant) word-internal boundary) +, define four possible ranks of phonological rules (principles of structuring, in the case of +) in French.

A fifth boundary, of a different type, is the syllable boundary $ (cf. Basbøll 1974). Thus we have established five possible ranks, each defining the extension of a phonological chain which can serve as the domain for phonological processes. Below I shall enumerate these five phonological chains and in each case mention one or more processes which can apply to the chains in question. As mentioned in section 1.3.2 above, in-creasing "word-reduction" implies that more and more processes apply to longer and longer chains (corresponding to a decreasing effect of the boundaries in question). This phenomenon is dis-regarded in the following, where we only consider a rather distinct level of style (with a high degree of segmentalization, cf. Linell 1974, p. 66 ff).

(1) 'Phonological sentence'. Rules of rank # # # : phenomena in the beginning and end of (phonological) sentences, concerning schwa-dropping (cf. Dell 1973); in lower levels of style, certain "word-reductions" (such as assimilations) apply with the phonological sentence as their domain.

(2) 'Major phonological word'. Rules of rank # # : liaison and stress ('accent du syntagme'); the 'major phono-logical word' includes pro- and enclitics.

(3) 'Minor phonological word'. Rules of rank # : word stress, vowel harmony and glide formation. 'Minor phonological words' are the parts of the 'major phonological words', e.g. 'bound pronouns' (except encliticized subjects) and particles,

but also, according to the present definition, prefixes and
the endings /z/ and /t/ (and the rest when all these morphemes
are subtracted from the 'major phonological word', viz. a stem
or a stem plus suffix(es)).

(4) <u>The morpheme (or formative)</u>. There are no phono-
logical rules proper of the rank +, but morpheme structure
conditions (MSC) have + as their rank. It should be emphasized,
however, that MSC are "abstract rules" and thus of dubious
(psychological) relevance. (The principles of phonological
syllabification (as proposed in Basbøll forthcoming) have #
as their rank, but under very restricted conditions they pay
attention to a + in their structural description.)

(5) <u>The syllable</u>. Rule of rank $: "closed syllable
adjustment", i.e. the neutralization of /e, ɛ, ə/ in phono-
logically closed syllables in favour of ɛ. On more concrete
levels, the syllable seems to play an even more important
role (cf., e.g., Schane 1973, p. 52 ff). It may be added that
phonetic syllables represent a structuring of the linguistic
expression (Hjelmslev's term) so that it becomes easier to
en- and decode (whereas grammatical boundaries merely repre-
sent a <u>projection</u> of higher level information onto the sound
chain).

These ranks seem to occur frequently in other languages,
and it might be possible to identify them on a cross-linguistic
basis, including their function as domain for rules. E.g.
the 'phonological sentence' may be defined as the <u>maximal</u>
domain for rules, and the 'minor phonological word' as the
<u>minimal</u> domain of phonological rules proper, disregarding the
syllable which can be defined on independent grounds. The
'major phonological word' can then be characterized by means
of its relative position in between the 'phonological sentence'
and the 'minor phonological word'. The morpheme (or formative),
just like the syllable, can be defined independently of its
function as a rule domain. Let me finally mention that the

notions 'pro- and enclisis' seem to be relevant in many
languages, and they follow in a natural way from the use of
ranks discussed here.

Note that the rules mentioned under (1), (2) and (3)
above represent productive processes, not abstract morphemic
relationships.

2. Evidence for grammatical boundaries in phonology

2.1 Descriptive convenience

If the postulation of a given grammatical boundary only
serves to define the domain of one rule it is, of course,
circular. But if several rules require the same boundary
structure, which furthermore does not complicate the descrip-
tion of any other rules, then a simplification of description
can be obtained by using boundaries (as in the French example).
Notice that this "simplicity" argument makes no claims as to
psychological reality of the boundaries in question.

Within the generative paradigm, it would be considered
very important whether the boundaries postulated are part of
a universally proposed inventory, and, more generally, whether
the principles of boundary structure follow (at least in part)
from 'linguistic theory'. Thus it would not be considered
circular, within this paradigm, to operate with a grammatical
boundary which only had an effect on one phonological rule,
if the occurrence (and location) of this boundary could be
predicted from the theory (boundaries should not be postulated
on the basis of phonological criteria alone, i.e. in the ab-
sence of any syntactic-semantic evidence for some sign boundary
at the given location).

2.2 Independent definability of the boundaries

In the case of French, the boundaries can be defined independently of their phonological impact (which motivated the phonological use of the boundaries in the first place); this definition, furthermore, does not presuppose knowledge of individual lexical items: it only refers to notions like 'prefix, suffix, subject (and possibly obstruent)'. These notions are probably learnable (cf. Derwing).

2.3 Speculations on linguistic evidence of a non-phonological kind

In French, prefixes seem to be phonologically more independent of the stem than suffixes. This may be related to the following observations: (1) prefixes (in French) often appear to have more content than suffixes, (2) suffixes typically change the word-class of the stem (while not affecting the meaning of the stem), in contradistinction to prefixes, (3) prefixes are often lexically identical to separate words (e.g. par, pour, de, à), in contradistinction to suffixes.

There is a distinction between il y a meaning 'he (etc.) has there' and 'there is', respectively: [il i a] (son argent, à la banque) vs. [il j a] (du monde ici). This difference in pronunciation agrees with an analysis of the former case as (il #) y # a, where y is an independent word, meaning 'there' (standing for "à+PRO" under certain conditions), and where any other combination of subject-verb might have occurred instead. In the second case I suggest an analysis (il+)y+a, in agreement with the completely frozen behaviour syntactically and semantically, cf. that il y a is often referred to as a 'particle' (in agreement with its lack of declinability in number and person).

2.4 Manifestation of boundaries

Another point is that $\#\ \#$ and $\#\ \#\ \#$ are probably
potential pauses. This raises the further question whether all
boundaries can be manifested (in a more direct way than by
their impact on phonological rules like those mentioned above).
If certain quantity- (and other, e.g. F_0 or intensity) relations
obtain in respect to boundaries, this may 'count' (for the
language user) as 'manifestation (of the boundary)'. This im-
portant issue is very much open. I thus do not agree with the
(somewhat unclear) claim of Chomsky/Halle and others that all
grammatical boundaries must be erased at the end of the phono-
logical component: If the phonological component (in this con-
text) is meant to exclude 'phonetic detail-rules', then all
boundaries cannot be erased at the end of the phonological com-
ponent since the phonetic detail rules undoubtedly presuppose
the boundaries for their correct specification of the phonetic
output (e.g. as to the quantity of initial vs. final allophones).
If phonetic detail rules are included in the phonological com-
ponent, on the other hand, it is hard to see that the output of
this component could be the mentally relevant phonetic structure,
since we do not generally perceive the mentioned quantity re-
lations as such, but instead use this information to structure
the sound chain. (A quite different problem here is the distinc-
tion between languages like French and German, where phonetic
syllabification is highly dependent on word boundaries in German
but not in French. This distinction might be easier accounted
for if word boundaries are erased at different levels in French
and German, but this is, of course, highly speculative.)

2.5 Psychological reality of boundaries

Psychological reality of phonological constructs is no well-defined property: it has several 'layers', and the question can be approached by different means which need not give uniform results (cf. Linell 1974 with references). The general problem cannot be dealt with here. Concerning boundaries, one aspect of the question is the analyzability of complex forms which might be revealed by means of psychological tests.

As already mentioned, there is a formal distinction between the function of boundaries with respect to level of style pointed out in section 1.3.1 above, viz. that $\#\#$ are reduced to $\#$ in higher styles according to Selkirk's description of liaison, whereas word reductions (belonging to lower style levels) normally become more and more radical when boundaries are weakened (or erased). It is common for liaison and word reduction that <u>absence of segments</u> belongs to lower (as opposed to higher) styles. It is also common for liaison and word reduction that <u>application of the rule</u> belongs to lower (as opposed to higher) styles, which seems to be the normal case for optional rules (in agreement with the <u>diachronic</u> fact that people who do not have a "new" pronunciation generally find it "vulgar"). Thus, what is common to the two cases has to do with the <u>process</u> of "reduction", not with the environment in which it occurs. The formal distinction can be reduced to the fact that the $\#$ -reduction rule in a case like $C\#\#V \longrightarrow C\#V$ <u>bleeds</u> the truncation rule which applies to $C\#\#$ (and to $C\#C$), but not to $C\#V$ (whereas a boundary deletion will normally <u>feed</u> other rules). The psychological relevancy of this observation is not clear, but the possibility should be examined that the optional <u>phonological rules</u> (in casu: truncation (i.e. non-liaison) as well as word reduction processes) are more relevant psychologically than $\#$ -reduction rules of the type proposed by Selkirk. This seems rather plausible to me.

Below, I shall briefly discuss some Danish examples from
the standpoint of productivity, and furthermore mention data
from sound change and optional rules which appear to suggest the
reality of some but not all intra-word grammatical boundaries.

2.6 An example: some suggested evidence for some grammatical boundaries in Danish phonology

2.6.1 The distinction between # and #

In Danish (like in French) there seems to be a distinction
between "strong" and "weak" word boundaries (which can be sym-
bolized by # # and # , respectively). 'Minor phonological
words' are pro- and encliticized, i.e. become members of a
'major phonological word', e.g. på # gáden, gør # det (there
even exists a particular encliticized form of det, viz. [əð]
(together with [də]) with special stødconditions, cf. gør det
[gɶ̞ŋde, gɶ̞ŋdə, gɶ̞ŋʔəð]). That enclitics behave like parts of
the major phonological word, not only with respect to stress,
is shown by the optional rule (in conservative Danish) gd → xd:
fægt, kog+t, skæg # t, fik # det [fɛg/xd, kʌg/xt, sgɛ:ʔg/xd,
fḛg/xdə], which never applies across # #; i.e., the only inter-
word boundaries which allow the rule to apply before them, are
the boundaries before enclitics. The distinction between # #
and # will not be considered any further here (notice that it
is difficult to use intonation and stress as direct evidence
for this distinction, since these suprasegmental phenomena may
be directly dependent upon the syntactic structure, without the
use of grammatical boundaries; cf. Rischel's demonstration
(1972) that compound stress can be deduced from the syntactic
surface structure without any "cycle").

2.6.2 The distinction between + and

(i) Preliminaries

With respect to stress, there is a distinction between compound stress (i.e. the normal stress pattern of compounds and of derived words with a heavy native suffix like -hed, -dom, -skab) and non-compound stress (the elsewhere case). If compound stress must be assigned in terms of boundaries, an additional boundary (which does not, of course, explain anything) should be set up for this purpose. I leave this issue open here.

Throughout this discussion, we have presupposed the location of all sign boundaries known, and this is, of course, an oversimplification. Within the present framework where the distinction between + and # is supposed to represent the distinction between a phonologically irrelevant and relevant boundary, respectively, this problem is not too serious, since the dubious sign boundaries (if they are recognized at all) will generally be instances of + (i.e. phonologically irrelevant).

(ii) Examples of the proposed boundary structure

I suggest that the boundary # occurs e.g.: (1) before stems (i.e. between the parts of a compound, and between a prefix and the stem, e.g. sól # skìn, úd # gầ, be # víse); (2) before (primary or secondary) stressed native suffixes, e.g. ven # índe, dúm # hèd (before the primary-stressed suffix inde, certain conservative varieties of Danish only seem to have + , cf. lærerinde [lɛ(:)ʌɛ́nə, lɛ(:)ʌʁɛ́nə] ; before secondary-stressed suffixes, which are always native, # appears to be obligatory);   (3) before certain obstruent endings, like /t/ (neuter) and /s/ (genitive).

On the other hand, the boundary + occurs e.g.:

(1) before foreign stressed suffixes like át, í, íst, ísse
(e.g. lektorat, perfidi, kontorist, abbedisse);

(2) before unstressed native suffixes like sel, ne (inchoative),
me, re (iterative) (e.g. fødsel, gulne, fedme, bladre);

(3) before certain obstruent endings like /t/ (substantivizing).

(iii) Some descriptive evidence

The syllable boundary between two vowels (with inter-
mediate consonants) belonging to different morphemes always
occurs at the morpheme boundary if it is #, but not (neces-
sarily) if it is + (in that case the location of $ depends on
the sequence of segments). All rules having the syllable as
their domain (cf. Basbøll 1974) thus support the different
"phonological strength" of the proposed boundaries.

The case of long vowels occurring before a hetero-mor-
phemic cluster in conservative standard Danish are highly re-
stricted (cf. Brink/Lund forthcoming). Our proposed boundary
structure restricts this occurrence to $\overline{V}C \# C$-sequences
(furthermore there are a handful of isolated roots with $\overline{V}CC$,
but there are heavy restrictions on the clusters allowed).

According to Rischel 1970, forms with the ending /t/
either undergo both vowel shortening and consonant gradation
(e.g. jagt, stift; cf. jage, stiv), or none of them (e.g.
vagt, adj., lavt; cf. vag, lav, adj.). He proposes that the
mentioned processes constitute "one complex rule" (although its
two "parts" have no intrinsic connection). Within the present
framework vagt, adj.: jagt, sb. are vag # t, jag+t, and both
rules (i.e. vowel shortening and consonant gradation) are of
the rank # . vag # t [væ:ʔɣd] is treated as vag [væ:ʔɣ], and
jag+t [jɑgd] as a monomorphemic word like tragt [tʁɑgd].

(iv) Productivity

The natural <u>psychological</u> interpretation of the proposed
distinction <u>jag+t</u> : <u>vag#t</u> (adj.) is that the latter is formed
<u>productively</u> from <u>vag</u> plus <u>t</u>, whereas the former is stored as a
<u>unit</u> (this does not exclude that the language user may be able
to perceive the morphological relationship between <u>jage</u> and
<u>jagt</u>, but it suggests that the relation is an <u>abstract</u> one).
Notice that the neuter /t/ is a <u>productive</u> ending in the lingui-
stic sense, i.e. it can be added to recent loanwords (and to con-
structed nonsense-words). The substantivizing ending /t/, on the
other hand, is unproductive, and the relation between the morpho-
logical pairs in question is often not transparent, or at least
not unambiguous (both semantically and phonologically), e.g.
<u>grave</u> 'dig' : <u>grøft</u> 'ditch', <u>skrive</u> 'write' : <u>skrift</u> 'writing'
(although a certain relatedness of sense may be felt in such
cases, the nouns in question must generally be considered <u>lexi-</u>
<u>calized</u> on <u>purely semantic</u> grounds, cf. below).

Productivity is thus a complex phenomenon, and the term
'productive' has been used in different senses. In the following
I try to illustrate some different aspects of 'productivity',
but I do not know to which degree they ought to be split up or
coalesced, i.e., I do not claim that the different aspects below
suggest a natural logical system.

When we consider the nature of the linguistic process, e.g.
in a psycho-linguistic test situation, we may ask: Is the free
form XY (where X and Y are morphemes belonging to the same word)
formed <u>productively</u> by the speaker in <u>the given situation</u>, e.g.
is the form XY in a concrete test situation formed productively
or taken directly from the 'lexicon'? There is hardly any doubt
that this question can be investigated empirically, e.g. if the
ending Y can be adjoined to constructed nonsense-words, then it
is productive, in this sense, at least in the test situation.

If the ending Y <u>can</u> be adjoined to constructed nonsense-
words (i.e., if it is productive, in the present sense), we might

try to investigate whether the free form XY is constructed, in the speech situation, <u>by rule</u> or <u>by analogy</u>. E.g., if a reference paradigm presented in connection with the test significantly influences the results, this may be taken as indicative of the importance of analogy, at least under such test situations. (Pilot tests of this type have been made by John Ohala.)

And although there are undoubtedly enormous problems in undertaking tests which are representative of the normal speech situation, I think, nevertheless, that the question whether rule or analogy is used at a given occasion is a genuine empirical problem.

If a given linguistic device is not used productively in the above sense, I think it is quite misconceived (i.e. bad research strategy, in the present state of our knowledge) to investigate further into the "psychological reality" of the device in question and to make hasty conclusions on the speakers' awareness or non-awareness of this linguistic device.

The term 'productive' is very often used about a linguistic 'device' (e.g. an ending) in the sense 'which can be added to new words which enter the language'. This is what I call 'the linguistic sense (of 'productivity')'. It is an open question whether this phenomenon is identical to one or both aspect(s) of productivity mentioned above. The very fact that rule-productivity and analogy-productivity might, <u>in principle</u>, be distinguished in the test situation leaves room for doubt (and investigation!) concerning the precise nature of 'productivity in the linguistic sense'. To find out whether a given linguistic device is productive or not in this sense, we need not make psycho-linguistic tests, but we should investigate the lexicon of the language during a certain span of time (it is clear that the situation can be found that certain meanings of an ending which is completely productive with regard to its phonological shape and morphology, are unproductive).

Finally, the words 'productive' and 'predictable' sometimes appear to have been used interchangeably, but this seems to me an unhappy choice of terminology since, in principle, these concepts are distinct: an ending like -ning (in Danish) is productive (cf. kodning 'coding', (ned)frysning 'freezing (back)'), but its meaning is not (completely) predictable (cf. skabning 'creature', vejning 'weighing', holdning 'attitude'), and it seems unrevealing to speak of homonymy in the case of the (deverbal substantivizing) suffix -ning as -ning$_1$, -ning$_2$, etc. [a] These forms are better accounted for by assuming that skabning, holdning, etc. are lexicalized, i.e., the meaning of these specific forms must be available in the lexicon (although they are completely regular as to pronunciation).[1]

This is not the place for a general discussion of the linguistic uses (and misuses) of the term 'lexicalization'. I should only like to point to a completely different way of using this term, in addition to the use made above which was, roughly, that a linguistic 'entity' is lexicalized if it contains unpredictable features (one may thus speak of lexicalization for phonological, morphological, syntactic and/or semantic reasons, or, more briefly: an entity may be phonologically, semantically etc. lexicalized, in the present sense).[2]

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1) Similarly, the lexicon must contain information as to the preterite form mødte 'met', with an (optional) short vowel as opposed to fødte 'bore', since the former word is phonologically unpredictable although it is semantically predictable. In a sense, the form mødte might thus be termed 'lexicalized (phonologically)'.

2) This very general use of the term 'lexicalization' may, of course, be partitioned into a number of special types of lexicalization, e.g. the case (which is particularly interesting from the phonological point of view of the present paper) that a grammatical boundary is (exceptionally) ignored for phonological purposes, as we saw in words like jagt discussed above (cf. compounds like ståltråd 'wire' [sdʌltʁɔ:ʔð]).

a) Also in cases where several of the meanings of an ending are productive (e.g. the nominalizing suffix -er), this ending is, of course, semantically unpredictable (even when only the productive meanings are taken into consideration).

The quite different use of 'lexicalization' alluded to above occurs when one claims that a certain meaning can (or cannot) be lexicalized, in the sense 'qualify as a lexical entry' (e.g., with an example discussed by Richard Carter, the meaning 'be in a certain bodily position' can be lexicalized in English (<u>stand</u>, <u>sit</u>, etc.), but not in French (<u>être debout</u>, <u>être assis</u>, etc.), cf. also the universal constraints on 'possible lexical items' discussed by James McCawley in connection with <u>kill</u> = <u>cause-become-not-alive</u>). It should be noticed that this sense of 'lexicalization' might also cover phonological and morphological structure (since the notion 'possible lexical entry' includes phonological etc. aspects), although the term has most often been used covering semantic constraints only.

Finally, one word of caution concerning the psychological reality of boundaries. <u>Even if</u> a form like <u>færdes</u> 'move' [fæɳdəs] is analyzable to the native speaker into /fɛrd/+/ə/+/s/ (cf. the preterite form <u>færdedes</u> [fæɳdəðəs]), it evidently does not follow that <u>færdes</u> is formed productively from /fɛrd/ plus /ə/ plus /s/, and even less that the stem /fɛrd/ is psychologically related to certain other forms, like <u>færd</u> 'travel' [fɛ:ʔɳ]. It can only plausibly be said, I think, that the (psychological) analyzability of a complex form is a <u>necessary</u> condition for it to be formed productively by rule.

(v) Sound change

Sometimes the term "analogy" is used in a wide sense referring to all cases where a sound change is not purely phonetically conditioned, if the "identity of morphemes" can account for the apparent exceptions, also when <u>the crucial sounds belong to different words</u> in the chain (e.g. Brink/Lund forthcoming). Within the present framework this is not to be considered analogy, but is a regular consequence of the fact that sound change generally does <u>not</u> affect <u>sentences</u> but <u>smaller</u> (probably separately stored)

units. Given the proposed sound change XA ⟶ XB, where X, A and
B are sounds (or classes of sounds), we can investigate which
sequences of X-boundary-A are turned into X-boundary-B, and which
are not. From this investigation a certain domain of the sound
change can be established, and this may shed light on the (psycho-
logical) reality of grammatical boundaries in phonology. Most
often, recent sound changes in Danish seem to be blocked by the
occurrence of # (within the present framework), i.e. they do not
apply across the boundaries between the parts of a compound, etc.
For example (cf. Brink/Lund forthcoming), the (diachronic and syn-
chronic) rule ɑ ⟶ [-grave] unless before [+grave] (i.e., roughly,
ɑ becomes a except before velars and labials, /r/-contexts excep-
ted) accounts for the distinction tand 'tooth' [tanʔ] : tam 'tame'
[tɑmʔ], etc.; but ɑ does become a before a velar or a labial which
is separated from ɑ by a # according to the present framework,
e.g. sofapude 'sofa cushion' [sóːfapũːðə]. And the (diachronic
and synchronic) rule ə ⟶ ʌ/___r applies in fiskeri 'fishing',
malerisk 'picturesque' [fesgʌʁíːʔ, mǽːlʌʁisg] (although pronun-
ciations with [ə] can be heard); but in compounds like hellerist-
ning 'rock engraving', taskerem 'bag strap' [hɛ̃lәʁɛ̃sdneŋ, tɑ̃sgə-
ʁæ̃mʔ], pronunciations with [ʌ] instead of [ə] are excluded.

When we find isolated examples of apparent compounds or
phrases which do nonetheless undergo the change in question, this
may be due to the fact that this compound or phrase has been
lexicalized, and this can often be confirmed on semantic grounds.
I shall only mention two particular (and probably uncontroversial)
examples. One is the phrase hvabehar meaning '(beg your) pardon'.
Although it is etymologically identical to hvad behager 'what
pleases (you)' [va(ð)behǽːʔɣʌ], it is pronounced [vɑbəhɑ́ːʔ].
The reduction æː(ʔ)ɣʌ ⟶ ɑːʔ has a number of parallels (old doub-
let forms) which will not be discussed here. But the pronuncia-
tion [vɑbə-] instead of [vabe-] indicates that there should be no
between /a/ and /b/ within our framework. This agrees well

with the fact that the phrase is completely frozen semantically and syntactically. - The other example is <u>frokost</u> 'lunch' which is normally pronounced [fʁɔgʌsd] (or possibly [fʁɔkʌsd]) although it is (etymologically) compounded from <u>fro</u> [fʁo:ʔ] 'early' and <u>kost</u> [kʌsd] 'food' (via MLG). According to the normal principles for the pronunciation of compounds, it should be pronounced [fʁôkᴧ̀sd]. Instead, it is treated as a simplex word where /o/ accordingly is lowered to [ɔ]; the weakening of /k/ to [g] may be due to the reduction (from secondary stress to weak stress) of the second syllable, cf. the possible analysis of unstressed [ʌsd] as a manifestation of /ərsd/ (and cf. <u>chokolade</u> [ʃokolæ:ðə, ʃogo-, ʃogə-] etc.). The phonological treatment of the word agrees well with its semantic unpredictability ('lunch' is not semantically equivalent to 'early food'), and with the fact that the word <u>fro</u> is decidedly archaic.

3. Concluding Remarks

The topic of grammatical boundaries in phonology is a crucial one today when a dominating linguistic paradigm, that of generative grammar, has come under severe (and, in my view, justified) attack for empirical vacuity and unsupported and implausible psychological speculations (cf. Derwing, Linell). (Although it can still be defended as a (in <u>some</u> senses elegant) descriptive system.)

If the formations which generativists claim are created by rule (and thus not stored as separate items) are <u>not</u> analyzable (segmentable) for the native speaker, i.e., if the grammatical boundaries postulated have no psychological reality, then the generativist claims seem very weak. But if there are psychologically real (word-internal) grammatical boundaries, on the other hand, we can start investigating whether the morphemes are

abstract or concrete, etc. This investigation should, of course,
employ scientifically sound methods.

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