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Stratification in the Phonology of German

by

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Abstract
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Recent formulations of generative phonologies have most often been based on the transformational model; this thesis, however, utilizes the theory of language advanced by Sydney M. Lamb to develop the phonological subcomponent, exclusive of stress and intonation, of a stratificational grammar of Modern Standard German. An explicit account in graphic notation is given of the morphonic alternation pattern as well as of the hypophonemic and phonemic strata.
Recent formulations of generative phonologies have been based on two kinds of models, either transformational or stratificational. Their differences are many and substantial; perhaps most bitterly striking is the insistence of the transformationalists that between morphophonemics ('systematic phonemics') and ('systematic') phonetics there exists no legitimate level of ('autonomous') phonemics, where criteria of contrast/complementary distribution, biuniqueness, etc. determine the relationships which establish this level. Therefore the transformational apparatus is simpler than the stratificational and hence, from a theoretical standpoint, preferable to it.

This claim has been demonstrated in many places, most recently by Robert D. King in his *Historical Linguistics and Generative Grammar* (Englewood Cliffs, N. J., 1969). King takes the Monachi example of Sydney Lamb in which one dialect shows an alternation between allophones [m] and [w], another the same alternation but between [m] and [w]; in both dialects the second allophone occurs only after vowels, the first never after vowels, and both segments are always followed by vowels. Moreover, each dialect also has a phoneme /w/ which does not alternate with [m] or [w] in the first, but whose phonetic realization is identical with the [w] allophone of /m/ in the second dialect. Thus the alternation in the second dialect is morpho-
phonemic. Now the data as described above can be accurately predicted without involving three levels if one ascribes to the phonologies of both dialects this rule:

1. \[ +\text{nasal} \begin{array}{c} \text{-coronal} \end{array} \rightarrow [\text{-consonantal}] / \_ \_ \_ \_ \_ \_ \_ \_

and orders after it, in the second dialect, the following rule:

2. \[ -\text{vocalic} \begin{array}{c} \text{-consonantal} \end{array} \rightarrow [\text{-nasal}] \]

Rule 1. derives [\text{\textit{\text@}}] from [\text{\textit{\text@}}] (or 'underlying' /\text{\textit{\text@}}/), and Rule 2. states that any glide in the second dialect cannot be nasalized. King asserts that at one point the second dialect did not exist and came to be only by adding Rule 2. to its phonology. So apart from very simply and adequately predicting the phonetic data, the two ordered rules correspond to what may probably have been the historical development of Monachi. In summary:

If we recognize an autonomous phonemic level intermediate between the systematic phonemic and systematic phonetic levels in our grammar, then the two (dialects') grammars differ at two levels: the morphophonemic and the allophon-ic. We have seen that the difference can be described simply as the addition of a single rule in a generative grammar that posits no level of representation intervening between

2
the systematic phonemic and the systematic phonetic. In particular, this example demonstrates that meaningful dialect comparison does not necessarily emerge from comparing the phonemic inventories of two dialects, for in this case the phonemic inventories -- whether autonomous or systematic phonemic -- are identical, and whatever differences there are arise via rules that state realizations of phonemes. (pp. 38-39.)

The stratificational view in this situation allows for process or rewrite rules as above, but only in a diachronic description where language actually changes from one stage to another. The use of rewrite rules in synchronic descriptions, however, is held to be a misrepresentation of the facts of linguistic structure; empirical evidence and observation as well as the demands of generality on the simplicity criterion require the establishment of a level of autonomous phonemics within the realizational framework. And given the stratificationalist's far less prescriptive attitude towards linguistic universals, his phonology will be constructed according to considerations of other levels in the grammar and to phenomena peculiar to the individual language, rather than according to the dictates of arbitrary statistical "universals."

Without further reference to the stratificational vis-à-vis transformational approaches to phonology,
this study seeks to develop the phonological sub-component, exclusive of stress and intonation, of a stratificational grammar of Modern Standard German. It incorporates some recent alterations of the theory, but is, in the main, a description based on Sydney Lamb's "Prolegomena to a Theory of Phonology."

According to stratificational theory, language is a system of relationships. It represents these relationships by means of two kinds of notations, algebraic and graphic. The second is considered primary and better suited to a clear formulation of the two lower strata, the hypophonemic and and the phonemic (phonetic and 'classical' phonemic.) Figure 1. shows the sorts of relationships which the theory expresses, and includes the new AND-OR node as well as the representation for OPTIONAL. UPWARD means "towards meaning," and DOWNWARD means "towards expression." ORDERED with respect to OR indicates preference of the leftmost line over the other(s); with respect to AND, sequential left to right occurrence; UNORDERED with OR indicates free variation; with AND, simultaneous occurrence. The AND-OR node can be ordered or unordered, upward or downward; OPTIONAL replaces UNORDERED OR's with a zero option.
One additional kind of node has achieved recognition at the phonological level— the DIAMOND, which replaces the UPWARD AND's of the knot pattern.

A stratum is defined by a knot or diamond pattern of emes which is connected to a syntax or tactics, and by sign and alternation patterns below it. These last two patterns connect the emes of one stratum to the ons of the next. In this presentation ons will always be enclosed in vertical lines and labeled by a capital letter (representing the stratum to which the on belongs,) followed by 'n', as in phonon $P_n$ |Lb|, for 'Labiality' (phonons and hypophonemes are always designated by a capital letter followed by a lower case letter); emes will be enclosed in slant lines and labeled by a representative capital letter, as in hypophoneme $H_{/Lb/}$, or phoneme $P_{/b/}$.

For German I posit twenty-nine phonemes as shown in the phonemic diamond pattern of Figure 2. They are related to their components, or phonons, via the phonemic sign pattern. The phonons, labeled according to mnemonic convenience, have the following articulatory correlates:

$|Ap|$ (Apicality): the involvement of the apex.

$|Lm|$ (Laminality): the involvement of the front of the tongue.
Phonemic Diamond Pattern:

Phonemic Sign Pattern:

Figure 2.
| Ds | (Dorsality): the involvement of the dorsum. |
| Lb | (Labiality): the involvement of the lower lip. |
| St | (Stopness): closure at some point in the oral cavity with the velic closed. |
| Ns | (Nasality): closure at some point in the oral cavity with the velic open. |
| Sp | (Spirantness): close proximity at some point in the oral cavity causing local turbulence in the breath stream. |
| Lo | (Lowness): low position of the tongue relative to the palate. |
| As | (Aspiration): strong voiceless exhalation. |
| Sy | (Syllabicicy): high relative sonority. |
| Ts | (Tenseness): high relative muscular tenseness. |

The DOWNWARD ORDERED AND's of the phonemic sign pattern are connected directly to the phonons— for the sake of legibility I have instead labeled these nodes. P /, j, w, l, h, θ/ consist of only one phonon each and therefore have no AND node in the sign pattern.

As Lamb has demonstrated, "... some morphophonemic alternations are more easily described in terms of components than segments, while others are more easily described in terms of segments." The alternations in German, then, between voiced/voiceless (lax/tense) obstruents word-finally, or between plain and umlauted vowels, would appear to be most easily described on the
component level (hypophonemics). This is of course a possibility; but a more economical analysis of these alternations is to be had on the next higher stratum, because: 1) the tactics of the phonemic diamond pattern is the syllable structure—here the conditioning phonological environments are already maximally specified (in the case of umlauted vs plain vowels, the morphemic stratum would need to be taken into consideration in order to specify grammatical environments, e.g. singular vs plural); 2) \( P_n \) is manifested in the morphonic alternation pattern as \( M_n \) in order to distinguish tense (long) from lax (short) vowels—since this component-sized entity is already present in the upper levels, it is convenient to account for Auslautsverhärtung morphonically.

What alternations, then, should the hypophonemic stratum represent? Lamb states that the tactics of the hypophonemic diamond pattern "... seems to be concerned primarily with the structure of clusters, i.e. segments."

This stratum must therefore accommodate all segmental constraints, and only those sequential constraints which are not handled by the phonotactics: since in German no morphophonemic alternations occur in the hypophonemic stratum,
only alternations among allophones remain to be considered. These can be accounted for quite elegantly here, but the solution is admittedly ad hoc—what are the parameters of a "cluster"?, why select one over another?

The alternative is to restrict the task of the hypophonemic stratum to defining segments and explain all alternations among allophones at the phonemic stratum. The motivation for this would be that segments behave differently from non-simple clusters (up to the size of syllable); but the severe loss of generalization involved in this approach precludes its adoption. This is, in a way, similar to the transformational view, where segmental status is relegated to merely that of a simultaneous occurring bundle of distinctive features, i.e. no phonemic level.

In apparent contrast to Lamb, then, I propose that morphophonemic alternations be resolved at the phonemic stratum and that phonemic alternations (among allophones) be handled exclusively by hypophonemics, where conditioning environments are provided in terms of arbitrary clusters. This offers a clear separation of levels and is, at least for German, the most economical solution.

Figure 3 gives the connections of phonons to the
hypophonemic diamond pattern via the phononic alternation pattern. $P_n | Ds, Sp, Sy$ are subjected to
DOWNWARD ORDERED OR's. If these phonons are connected via the hypophonemes to an environment displayed in the hypophonotactics, the left branch of the respective OR is selected; otherwise the mandatory choice is $\beta$-- the phonons occur, in other words, only where specified in a cluster. Below the diamond pattern are UPWARD UN- $H$ ORDERED OR's connected to $/St, Ds, Lb, Lm, Lo/$ which relate directly to the hypophonotactics and indicate non-distinctive features, or determined hypophonemes.

In Figure 4, the hypophonotactics describes the structure of all segments and clusters exclusive of restrictions placed on their co-occurrence by the phonotactics one stratum higher. Note that the class of clusters is specified by a DOWNWARD ORDERED OR whose last member can be selected only after all of the other possibilities have been attempted. Reading from left to right, then, a cluster is either:

1) an optional instance of plus juncture $H$ followed by automatically inserted $/St/$ (a line curving sharply to the left and up represents a bypass of the diamond pattern; $/St/$ occurring alone will be interpreted as glottal by the sub-hypophonemic stratum) followed by a vowel which subdivides into
either 13): /Lm/ simultaneous with $\_1^{14}$, followed optionally by a preferred selection of /Ts/, or

14): /Sy/ simultaneous with optionally either $\_1^{15}$, or $\_1^{15}$, followed by /Ts/ in the event this was not chosen earlier. $\_1^{13}$ specifies the class of front vowels, $\_1^{14}$ all other vowels-- note especially that the possibility of combining /Sy/ alone with /Ts/ is precluded (there is no tense schwa); the AND-OR 15): allows /Lo/, /Lb/, or simultaneous occurrence of these two hypophonemes.

Or 2): a simultaneous occurrence of preferred $\_1^H$ /Sp/ and /Ds/ followed by a vowel-- in any other environment the zero alternate of $\_1^Pn$ /Sp/ in the alternation pattern must be chosen, and in that event, the tactics automatically provides determined /Lo/; this is the alternation between allophones $\_1^H$ [r], $\_1^H$ [Sp], and $\_1^H$ [Lo].

Or 3): either a non-front vowel or simultaneous $\_1^H$ occurring /Lb/ and determined /Ds/ ([w]) followed by $\_1^9$, which is here of importance in that it 11): states that 16): dorsal (labial and apical are the other points of articulation) 17): stops, nasals, or voiceless spirants which do not fit the environment (after back vowels) are automatically laminal rather
Cluster

Figure 4.
than dorsal in accordance with the specification of the phononic alternation pattern; \(c_3\) also states that voiceless stops are aspirated in this environment, which is not necessarily the case—this problem is resolved by the ordering of \(c_{10}\).

Or 4): an occurrence simultaneously of \(\text{/St/}\), 
optional \(\text{/Ts/}\) with preferred (again) \(\text{/As/}\), and \(19\): 
either \(\text{/Lb/}\) or \(\text{/Ds/}\) (if the environment fits; otherwise \(\text{/Lm/}\) is automatically provided) or \(\text{/Ap/}\), followed by a non-front vowel. In other words, dorsal stops are fronted if they don't occur before back vowels (but recall \(c_3\)).

Or simply \(5\): \(\text{/Lm/}\), or \(6\): \(\text{/Lb/}\) simultaneous with determined \(\text{/Ds/}\), or \(7\): \(\text{/Ap/}\), or \(8\): \(\text{/As/}\).

Or 9): either \(11\) (simultaneous \(19\), and \(17\), \(12\): \(\text{/Ts/}\) simultaneous with \(\text{/Sp/}\) and \(\text{/Lm/}\) and determined \(\text{/Lb/}\) (laminal voiceless spirant is rounded), or \(18\): a labial or apical voiced spirant—by establishing the class \(17\) vs \(18\), the dorsal/determined laminal alternation does not operate on \(\text{/r/}\).

Or, finally, after all (if any) of the above have been treated by the tactics, \(10\): a sequential occurrence of plus juncture, voiceless aspirated stop (at any point of articulation), optional dorsal spirant ([\(r\)]), and vowel. The fact that \(10\) is ordered after all other choices permits the proper selection of \(\text{/Ds/}\) vs \(\text{/Lm/}\) as well as \(\text{/As/}\) vs \(\phi\), i.e. \(\text{/k/}\) may be fronted as well as aspirated.
To recapitulate, the eleven phonons of German are realized as hypophonemes which co-occur as segments only as defined and permitted by the hypophonotactics; included in these restrictions are three sequentially delimited alternations with $\text{P}_n$, $\text{Ds}$, $\text{Sp}$, $\text{As}$, which represent respectively the allophonic variations of the following phonemes: /x, g, k, b, r, p, t, k/. The hypophonemic sign pattern shows glottal catch to be a determined feature between plus juncture and a vowel; [w] is non-distinctively dorsal; [g] is non-distinctively labial; [g] and fronted /g, k, r/ are non-distinctively laminal; and [A] is non-distinctively low.

The phonological structure of German is further defined by the two connections at the top of the phonemic diamond pattern. Figure 5 gives the composition of the morphonic alternation pattern and shows that the voiced obstruents, when immediately followed by $\text{M}_n$, are realized as the corresponding voiceless obstruents; that $\text{M}_n$ followed by $\text{M}_n$ has the realization /y/; and that $\text{M}_n$ preceding $\text{M}_n$ are realized phonemically as /e, ü, ö/ ([e, y, ö]). The rest of the morphonic alternation pattern is simply the one to one correspondence between morphons and phonemes, except
that those same obstruent morphons which combine with \(\text{Mn} \mid i\) also alternate with that combination in accordance with the DOWNWARD ORDERED OR's, i.e. whenever the voiced, or lax, varieties are not permitted by the tactics. The fact that these alternations are between emes is made obvious by the morphonic alternation pattern, and equally obvious is the nature of the alternation— in each case the same single component-sized morphon, \(\text{Mn} \mid i\).

Lamb has proposed a non-graphic notation which can account for inter-stratal alternations of segment-sized emes in terms of components. The unordered realizational rules for the non-trivial part of the German morphonic alternations would then take the following form:

\[
\begin{align*}
\langle X \rangle & \ | \ | --^0 \ \boxed{} \\
| | | P--(O, \&) & \ \boxed{} \\
| | | --/ \langle X \rangle \boxed{} \\
| | n & \ | --g^o/ \ y \boxed{} \\
| | --/ \ n \boxed{}
\end{align*}
\]

\[
\begin{align*}
\langle Sy \rangle & \ | \ | --^o/ \ \boxed{} \\
| | | \langle Sy \rangle \boxed{} \\
| | | --/ \ \boxed{}
\end{align*}
\]

\(\text{X: St vs Sp}
\)

\(\text{P: Peak}
\)

\(\text{O: Onset}
\)

\(\text{\(\text{\bar{Pn}' : any phonon (not } \phi \text{) other than } \text{Pn}'\)}
\)
Morphonic Alternation Pattern:

Phonemic Diamond Pattern:

Figure 5.
Pointed brackets are a reference to a lower stratum, so that any morphon having the components \(|St|\) or \(|Sp|\) has the phonemic realization of those same components simultaneous with \(|Ts|\) if the morphon occurs either:
in an environment before \(Mn\) (note the superscript), which the zero super-
script specifies is not to be realized in this partic-
ular environment— it serves here only as a condition-
ing factor; or if the environment is after syllable
peak and before either syllable onset or plus juncture,
i.e. word finally. Otherwise the phonemic realization,
in terms of components, is the same as the morphonic
realize. \(Mn\) before \(P\) (note the superscript)
is realized phonemically as /r̩/, otherwise as /n/.
Morphons having components \(|Sy|\) but not \(|Lm|\) are re-
alized simultaneous with this latter feature when
occurring immediately before \(Mn\) (note superscript),
otherwise they do not have \(|Lm|\) in their realizations.

These rules do nicely capture the generality
apparent in the alternations, but so does the relation-
al network simulator. The distinct advantage of the
latter lies in its presentation of the relationships
as a unified structural whole, and it does this without
the added cost of establishing cover symbols and the
like as integral elements of the structure. The fact
that the most economical analysis of each phonological stratum bears out the proper selection of ': ' as a morphon as well as a unit to be found at lower levels shows that indirect reference conventions, as above with the pointed brackets, serve to conflate rather than distinguish the several levels in the grammar. Indeed, such techniques are not at all representative of stratification in the sense that it is understood here. Consequently no morphophonemic alternations were incorporated into the hypophonemic stratum of German; but before such a restriction can be applied to stratificational theory generally, a good many other languages must be investigated in line with the precepts of stratification.

The tactics of the phonemic stratum complete the connections to the phonemic diamond pattern. This tactics defines the structure of the syllable, as illustrated in the Figure 6. diagram of syllable onset. Reading left to right, onset may be either:

\[ \text{P} /s, k/ \text{ followed by } \text{P} /n, v/, \text{ or } \text{P} /x, z, h, j, r, l/ . \]

\[ \text{Or: either } /v, d, t/ \text{ or } /b, g, s, p, k, f/ -- \text{ any of these may be followed by } /r/, \text{ only the second group may be followed by } /l/ . \]

\[ \text{Or: } /m, n/, \text{ or } /t/ \text{ followed by } /s/ \text{ optionally} \]

20
Figure 6.
followed by /v/, or /p/ followed by /f/ followed
optionally by either /r/ or /l/.

Or: /s/ followed by either: /m/, /p/ fol-
lowed by either /r/ or /l/ (or /p, r, l/), or /t/
followed optionally by /r/.

Syllable onset is integrated into the frame of the
total syllable in Figure 7. Onset is optional when
followed by the class of vowels /a, e, i, ü, u, ö, o/;
it is mandatory when followed by the class of vowels
whose members include /ə/ in addition to the preceding
set. This serves to show that schwa does not occur as
the first element of the (stressed) syllable.

Syllable coda is defined as either:

The AND-OR node whose first member is /;i, a, w, r, l/ and whose second member is /l, k, s, t/
or the AND-OR nodes /m p f/ and /n f, x/, or /y/
followed optionally by /k/. The use of UPWARD OR-
DERED OR's with /1, s, s, t/ precludes the possibility
of these phonemes occurring in immediate succession;
note that the AND-OR nodes are ordered (if both or
all selections are made, they must occur in the seco-
quency given.)

A kind of "sub-coda" can be optionally present
after the above possibilities. It consists of:
Figure 7.
AND-OR node with ordered members $P \lor s \land t \land s$. Finally, the syllable may optionally loop upward and back into itself an arbitrary number of times (although there does seem to be some practical limit, say, fifteen or twenty times.) All this is then bounded by junctures and fills the category I call 'micrsegment'. After the factors of stress and intonation have been taken fully into account, the exact nature of the top of the phonotactics can be determined; for the present these are disregarded.

The phonotactics allows for the generation of all well-formed German syllables; the coda structure, however, permits certain sequences which never occur. It is possible, for example, to produce the coda $/m \ p f s t s/$, or $/n f s t s/$. This apparent inadequacy in the tactics of the syllable structure, or, perhaps, in the theory of stratificational phonology, must be somehow explained or justified.

Peter Reich has shown that transformational generative grammar suffers from this kind of inadequacy, too: the syntactic component of English grammar generates, by recursion, an infinite number of centrally embedded relative clauses—Reich finds that those sentences in which this embedding occurs more than once are nonsensical; the transformationalist would agree

$\text{24}$
with Reich's observation, but insists on the distinction between 'grammatical' and 'acceptable' (an unacceptable distinction for Reich), i.e. the nonsensical sentences in this instance are judged grammatical according to the theory of competence, but are not acceptable according to the requirements of a theory of performance. Now, even though Reich is able to define the operation of the nodes in a Lambian relational network simulator such that central embedding can occur once only (as opposed to other, iterative kinds of syntactic expansion) as a natural function of the dynamics of these nodes, I find the grammatical/acceptable distinction to be a quite reasonable solution to the coda problem of this presentation. A coda /mpfśsts/ is thus clearly unacceptable, but intuitively much more grammatical than another of length seven, say, /pxtlsřś/. Codas in German are in fact limited to length five, but this is a limitation I ascribe to performance.

German coda structure can of course, within the stratificational framework, be so restricted as to exclude unacceptable sequences. This would demand a very substantial complication of the phonotactics and elimination of the AND-OR's in the coda structure, classes which present themselves as natural reflections
of what are the phonological realities of German.
Notes


4 AND-OR and OPTIONAL were proposed as extensions of the theoretical apparatus by Peter A. Reich, "Symbols, Relations, and Structural Complexity," Language Automation Project (New Haven, June 1968).


7 This list of the eleven phonons is taken from James E. Copeland, "Two-Dimensional Phonotactics in a Generative Grammar of German," Rice University Studies, LV, iii (Summer 1969), 1-7. For his glottality I have substituted tenseness because the latter feature permits a simpler stratificational description—further testimony to the relevance of phonological universals in stratificational theory.

9 ibid.

10 Plus Juncture is taken to be a cover symbol whose function is to serve as a conditioning environment for various phonological phenomena, but whose ultimate realization is everywhere zero. This of course means that its presence or absence is specified by strata above the phonological, i.e. '+' is a "grammatical prerequisite."


A Selected Bibliography


