XXI. LINGUISTICS*

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A. ON NONCYCLIC TRANSFORMATIONAL GRAMMARS

The conventions concerning the applications of the transformations in the transformational component of a generative grammar which are proposed by Chomsky[1] are as follows: The only recursive symbol in the phrase structure base is S; in processing a deep structure the transformations all apply within the domain of each S bracket of the deep structure, and they apply from the most deeply embedded S-dominated substrings of the deep structure upward until the entire deep structure has been processed. As all the transformations are available for application within each S-dominated substring, and there may be more than one such substring in a given deep structure, one speaks of this form of application of the transformations as the transformational cycle. (For the motivations for this proposal, see Chomsky.[2]) We shall refer to grammars in which the transformations apply as described above as cyclic transformational grammars, or cyclic grammars.

On the basis of research conducted with G. Lakoff, John R. Ross has advanced for consideration a change in the convention under which transformations apply to deep

*This work was supported principally by the U.S. Air Force (Electronics Systems Division) under Contract AF 19(628)-2487; and in part by the Joint Services Electronics Programs (U.S. Army, U.S. Navy, and U.S. Air Force) under Contract DA 28-043-AMC-02536(E), the National Science Foundation (Grant GK-835), the National Institutes of Health (Grant 2 PO1 MH-04737-06), and the National Aeronautics and Space Administration (Grant NsG-496).

structures in the course of derivations. Under the changes considered, the transformational component of a grammar would consist of a linearly ordered finite set of transformations, as before, but each transformation would apply to the whole deep structure processing S-dominated substrings from the bottom up. After a transformation had applied, it would not be available for further processing of a given deep structure. We shall call grammars in which the transformations apply in the manner described here noncyclic transformational grammars.

We will not give a formal definition of either of the kinds of grammars discussed above, but for purposes of exposition we shall carry out transformational derivations of a given deep structure in a particular grammar according to the cyclic and noncyclic conventions. The rules for the grammar are as follows:

Phrase structure: $S \longrightarrow abc\ S$

$S \longrightarrow abc\ s$

Transformations: $T_1\ X\ a\ b\ Y \longrightarrow X\ b+a\ \emptyset\ Y$

$T_2\ X\ a\ c\ Y \longrightarrow X\ \emptyset\ c+a\ Y$

A cyclic derivation in this grammar would go as follows:

$[a\ b\ c\ [a\ b\ c\ [a\ b\ c\ s]_S]_S]_S$ Base string

$[a\ b\ c\ [a\ b\ c\ [b\ a\ c\ s]_S]_S]_S$ T_1 – first cycle

$[a\ b\ c\ [a\ b\ c\ [b\ c\ a\ s]_S]_S]_S$ T_2 – first cycle

$[a\ b\ c\ [b\ a\ c\ [b\ c\ a\ s]_S]_S]_S$ T_1 – second cycle

$[a\ b\ c\ [b\ c\ a\ [b\ c\ a\ s]_S]_S]_S$ T_2 – second cycle

$[b\ a\ c\ [b\ c\ b\ a\ [c\ a\ s]_S]_S]_S$ T_1 – third cycle

$[b\ c\ a\ [b\ c\ b\ [c\ a\ a\ s]_S]_S]_S$ T_2 – third cycle

The noncyclic derivation of the same base string is as follows:

$[a\ b\ c\ [a\ b\ c\ [a\ b\ c\ s]_S]_S]_S$ Base string

$[a\ b\ c\ [a\ b\ c\ [b\ a\ c\ s]_S]_S]_S$ T_1 – within lowest S

$[a\ b\ c\ [b\ a\ c\ [b\ a\ c\ s]_S]_S]_S$ T_1 – within second lowest S

$[b\ a\ c\ [b\ a\ c\ [b\ a\ c\ s]_S]_S]_S$ T_1 – within highest S

$[b\ a\ c\ [b\ a\ c\ [b\ c\ a\ s]_S]_S]_S$ T_2 – within lowest S

$[b\ a\ c\ [b\ c\ a\ [b\ c\ a\ s]_S]_S]_S$ $\quad T_2$ – within second S

$[b\ c\ a\ [b\ c\ a\ [b\ c\ a\ s]_S]_S]_S$ $\quad T_2$ – within highest S

Thus, in general, in a grammar G with transformations $T_1 \ldots T_k$ a cyclic derivation of a deep-structure string will have a transformational history which is some word in the regular language $(T_1 \cup T_2 \cup \ldots \cup T_k)^*$, whereas a noncyclic derivation will have a transformational history which is some work in the regular language $(T_1)^* \ldots (T_k)^*$.

Note that in the grammar specified above, the language generated by the grammar when the transformations are applied cyclically is different from the language generated when the transformations are applied noncyclically. Thus, in giving a formal treatment of noncyclic grammars we want to compare the generative capacity of noncyclic grammars with that of cyclic grammars. It has been shown[3] that a context-free based cyclic grammar with filter and post cyclic transformations can generate any recursively enumerable language. This result has been extended,[4] in that it has been shown that a regular-based cyclic grammar with filter and post cyclic transformations can generate any recursively enumerable language. In this report we shall modify the methods of proof of these earlier reports to show that a context-free based noncyclic grammar with filter transformations can generate any recursively enumerable language; and, although the details of the proof are not given here, it is clear that a regular-based noncyclic grammar with filter transformations can generate any recursively enumerable language. We can then conclude that any language generated by a cyclic grammar can be generated by a noncyclic grammar, and conversely.

In the statement of the following theorem we intersect the language generated by the noncyclic grammar with a regular language in producing the r.e. (recursively enumerable) language. The reader is referred to previous work[3,4] to see how the operation of filter and post cyclic transformations is effected by such intersection. In fact, since the notion 'post cyclic transformation' has no obvious application for noncyclic grammars, the proof that follows shows that a noncyclic grammar with filter transformations can generate any r.e. language. (All grammars discussed in this report are assumed to meet the condition on recoverability of deletions.)

Theorem: There exists a fixed regular language H such that for any r.e. set of positive integers N there exists a context-free based noncyclic grammar G over the terminal alphabet $\{a\}$ such that $\underline{n} \in N$ iff $a^n \in L(G) \cap H$.

The proof relies on a lemma that is due to Leonard Haines.

Lemma: There exists a fixed context-free language L_1 and a fixed homomorphism λ such that for any r.e. set of positive integers N there exists a context-free language L_2 such that $\lambda(L_1 \cap L_2) = \{a^n / n \in N\}$.

We do not repeat the proof of this lemma here; it will suffice to remark that the

terminal alphabet of L_1 is the set $\{a, b \ldots g\}$, and that λ is defined as follows:

$\lambda(a) = a, \quad \lambda(b) = e, \ldots \lambda(g) = e;$ where e is the null string.

The outline of the Proof is as follows: Given the set N, we are given L_2 by Haines' lemma. In the base P of the noncyclic grammar G that 'generates' N is generated strings of the form (STV), where $S \in L_1$, $T \in L_2$, and V is an arbitrary string over the alphabet $\{a, \ldots g\}$. The first transformation checks, one symbol at a time, that S = T = V, and progressively deletes S and T simultaneously. The second transformation checks that V is not merely a proper initial part of both S and T. The third transformation performs the operation of λ on the string V. If either of the first two transformations fails to apply, the string is filtered out by virtue of the construction of the regular language H. All deletions are in accordance with the principle of recoverability, since we delete symbols in S and T only as they are equal to symbols in V, and the third transformation deletes symbols in V in effecting the operation of λ by virtue of equality with one of a finite number of terminal strings.

Given N, and therefore L_2, the grammar that 'generates' N is constructed as follows: The base P of the grammar has the following rules in addition to the rules generating L_1 and L_2:

$$S \longrightarrow S \begin{Bmatrix} a \\ \vdots \\ g \end{Bmatrix} \beta_1$$

$$S \longrightarrow S_1 \, S_2 \begin{Bmatrix} a \\ \vdots \\ g \end{Bmatrix} \beta_1 \, \beta_2$$

where S_1 and S_2 are the initial symbols of the context-free grammars that generate L_1 and L_2, respectively. The transformations of the grammar are

T_1	Analysis:	$[x\ X]_{S_1}\ [y\ Y]_{S_2}\ Z\ z\ \beta_1\ (\beta_2)$
	such that	(i) x, y, and z are single terminal symbols (ii) X, Y, and Z are any strings, including e. (iii) x = y = z.
	Operation:	delete x, y and β_1.
T_2	Analysis:	$z\ \beta_2$
	such that	(i) z is a single-terminal symbol
	Operation:	delete β_2.

T_3 Analysis: Z z

such that (i) z is a single-terminal symbol in the set {b...g}

(ii) Z is any string, possibly e

Operation: delete z.

Let H consist of all strings of the form a^n, $n > 0$.

The language generated by the base is of the form $[\ldots[[x_1 \ldots x_n]_{S_1} [y_1 \ldots y_m]_{S_2} z_1 \beta_1 \beta_2]_S z_2 \beta_1]_S \cdots z_k \beta_1]$. T_1 checks within each S that $x_i = y_i = z_i$, and erases the first two and β_1. If the equality fails at some point or if either $n < k$ or $m < k$, then T_1 will fail to apply, β_1 will be left in the interior of the string, and the string will be excluded by nonmembership in H. If either $n > k$ or $m > k$, then T_2 will fail to apply on the lowest S as its structural description will not have been satisfied, β_2 will be left in the interior of the string, and the string will be excluded by nonmembership in H. T_3 then operates, deleting just those symbols deleted by λ. It is evident, then, that for all strings x, $x \in \lambda(L_1 \cap L_2)$ iff $x \in L(G) \cap H$.

The result of this theorem and of those remarked upon above is that any language weakly generated by a noncyclic grammar can be weakly generated by a cyclic grammar, and vice versa. The linguistic interest of this kind of gross comparison, however, is quite limited. But what is striking about certain current formulations of the transformational grammar of English is that, modulo some reorderings, the languages generated when the transformations are applied cyclically and noncyclically are essentially the same. In general, the language generated by a transformational grammar is not invariant under cyclic and noncyclic applications of the transformations. Thus, we should like to make precise the empirical claims about language which are involved in stating that the transformations apply either cyclically or noncyclically. One avenue of investigation is to give a formal characterization of those grammars whose languages remain invariant under cyclic and noncyclic application of transformations. Having specified the defining features of such grammars, we will know that it is just these features which are relevant to the empirical questions involved in cyclic or non-cyclic application of transformations.

J. P. Kimball

References

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2. Ibid., see Chap. 3.
3. J. P. Kimball, "On the Intersection of Regular Languages and Languages Generated by Transformational Grammars," Quarterly Progress Report No. 83, Research Laboratory of Electronics, M. I. T., October 15, 1966, pp. 117-128.
4. J. P. Kimball, "Predicates Definable over Transformational Derivations by Intersection with Regular Languages" (forthcoming, Information and Control).

B. LITHUANIAN MORPHOPHONEMICS

I shall present and discuss briefly some phonological rules of Lithuanian. They are by no means all that are needed for a complete account of Lithuanian morphophonemics. I think, however, that they permit us to derive the paradigms of at least the primary verbs and nouns (that is, those with monosyllabic stems).

I assume that no long vowels occur in lexical representations. Vowels that appear as long in their final phonetic form are represented in the lexicon as sequences of two identical short vowels that are contracted to a single long vowel by a comparatively late rule. Thus a short vowel is meant wherever the symbol V appears.

For accent rules two conventions apply:

1. The accent can fall on any vowel and on l, m, n, r — on the latter, however, only when they stand immediately before a consonant and are not preceded by more than one vowel. The symbol M is used to represent all segments capable of bearing the accent.

2. When an M is accented, all preceding M's in the same word are accented also. This convention makes possible certain simplifications in the formulation of accent rules. A late rule, not stated here, will erase all accent specifications, except the rightmost in each word. Other rules, likewise not discussed here, will have to introduce what in traditional grammar is known as Silbenton or Wortintonation; in other words, they must interpret sequences MḾ as rising (~ in the normal orthography) and sequences ḾM as falling (´ in the normal orthography). It is clear that these rules must apply before the operation of the contraction rule.

For the accent rules to apply, grammatical morphemes must be specified for the lexical feature strong, and stems must be specified for the lexical feature strong susceptible. Furthermore, stems must be specified for the feature post stem (a term used here for the traditional oxytone). It is a fact about verb stems that the features strong susceptible and post stem are not independent: a verb stem may only be $\begin{bmatrix}+\text{strong susceptible}\\+\text{post stem}\end{bmatrix}$ or $\begin{bmatrix}-\text{strong susceptible}\\-\text{post stem}\end{bmatrix}$. In noun stems, on the other hand, no such restrictions obtain.

The order of the rules given here cannot be considered as fully established at the present stage. Although the ordering of a given rule with respect to some others can often be strictly motivated, its placement relative to the remaining rules is, to some extent, arbitrary. Some of the considerations relevant to the ordering will be briefly discussed in connection with individual rules.

The rules:

(1) Palatalization:

All consonants (including l, m, n, r) are palatalized before front vowels.

(2) Assimilation:

An n is completely assimilated to a preceding vowel when followed by word boundary or a sibilant (s, š, z, ž) or the sonorants l, m, r. Although there is, to the best of my

knowledge, no example for the occurrence of the sequence Vn before an n, we may include the n in the environment specification in order to gain greater generality. The vowel sequence resulting from the application of the assimilation rule is nasalized. If two identical vowels precede the n, both are nasalized.

$$V1(V1)n \longrightarrow V_{\mathfrak{z}1}(V_{\mathfrak{z}1})\,V_{\mathfrak{z}1} \;/\; \text{———} \left\{ \begin{matrix} [+\text{sonorant}] \\ -\text{sonorant} \\ +\text{strident} \\ \# \end{matrix} \right\}$$

Typical examples are the verbs with nasal infix in the present tense (banla → b$\underset{\mathfrak{z}}{a}\underset{\mathfrak{z}}{a}$la, finally b$\tilde{a}$la) and the accusative singular (e.g., uiir + a + an → uiir + $\underset{\mathfrak{z}}{a}$ + $\underset{\mathfrak{z}}{a}\underset{\mathfrak{z}}{a}$, finally v$\bar{i}\bar{r}\bar{a}$).

The rule does not apply before the future tense marker si.

As for the ordering, assimilation must operate before the final shortening rule (8), because a vowel derived from an n by rule (2) can be subject to rule (9).

(3) i/y:

The glides y and w will be treated as the prevocalic realizations of the vowels i and u. The latter are converted by the following rule:

i, u → y, w/ ——— V

Examples: 1. sing. pret. buu + a + au → buw + a + au (finally buva$\tilde{u}$)
1. sing. pret. lii + a + au → liy + a + au (finally lija$\tilde{u}$)

It seems that two further restrictions apply to rule (3): $\tilde{i}$ does not go to y before i, and u does not go to w before u or when preceded by certain consonants.

The rule must apply before metathesis, (rule 4), as can be seen in the nom. plur. of the pronoun jis:
iei → (3) → yei → (4) → yie, not: iei → (4) *iie with rule (3) now being inapplicable.

(4) Metathesis (this rule does not operate across formative boundary):

au and ei go to ua and ie, respectively.

A majority of stems with au as their root vocalism, and a substantial minority of stems with ei are exceptions to this rule. I know of only one grammatical morpheme, however, that is an exception – the gen. sing. of u-stems:
suun + u + au + sV → s$\bar{u}$nausus.

Metathesis must operate before the accent rules and before the e/a rule (5) because an au resulting from the application of rule (5) is not metathesized.

(5) e/a:

An e goes to a before u:

$$e \longrightarrow a \;/\; \text{———} \begin{bmatrix} +\text{voc.} \\ +\text{grv.} \\ +\text{diff.} \end{bmatrix}.$$

Since e never occurs before a at the stage in the derivation where this rule applies, we can make the rule more general by omitting the feature specification [+diff.]. It now applies before all back vowels, though nonvacuously only before u.

The following rules deal with the assignment of the accent. Recall that, by the convention mentioned above, all M's preceding the M that receives the accent by one of the accent rules are also accented.

(6) The accent is placed on the second M from the left in stems specified as [-post stem].

(7) For stems specified as [+post stem] the accent is placed on the M immediately following the stem.

(8) The accent is retracted by one M.

(10) If an ending is [+strong] and the preceding stem is [+strong susceptible], then the accent is placed on the rightmost M of the ending (that is, rightmost at this stage in the derivation).

To show in greater detail how these rules operate, I shall select examples from nouns of the a-declension. All nouns are divided into four classes determined by the two features [post stem], [strong susceptible]:

[-post stem] — [-strong susceptible] (e.g., vyras) (a)

[-post stem] — [+strong susceptible] (e.g., langas) (b)

[+post stem] — [-strong susceptible] (e.g., pirštas) (c)

[+post stem] — [+strong susceptible] (e.g., dievas) (d)

(a) corresponds to the traditional class 1, (b) to class 3, (c) to class 2, and (d) to class 4. The first two accent rules differentiate [-post stem] and [+post stem]-stems. The former receive an accent on the stem, the latter after the stem by rules (6) and (7), respectively.

e.g., Nom. plur. (after operation of metathesis and i/y

$$[\text{-post stem}]\begin{Bmatrix}\text{viir + a + ie}\\ \text{lang + a + ie}\end{Bmatrix} \xrightarrow{(6)} \begin{Bmatrix}\acute{\acute{\text{v}}}\text{iir + a + ie}\\ \text{láńg + a + ie}\end{Bmatrix}$$

$$[\text{+post stem}]\begin{Bmatrix}\text{pirš + a + ie}\\ \text{diew + a + ie}\end{Bmatrix} \xrightarrow{(7)} \begin{Bmatrix}\acute{\acute{\text{p}}}\text{irš + á + ie}\\ \acute{\text{d}}\text{iew + á + ie}\end{Bmatrix}$$

Note that there are no [-post stem]-stems with fewer than two M's in their stem syllable. This is a regularity of morpheme structure still to be accounted for.

The accent retraction rule (8), which follows, is not conditioned by feature specifications as are (6) and (7), but operates in all environments. It yields the following results: All [-post stem]-stems have the accent on the first M of the stem throughout the

paradigm. This can later be interpreted as acute on the stem. All [+post stem]-stems have the accent on the last M of the stem. This can later be interpreted as circumflex or grave, depending on whether the stem syllable is long or short.

The nominative plural forms now become:

$$[\text{-post stem}]\begin{cases} \acute{\text{v}}\text{iir} + \text{a} + \text{ie} \\ \acute{\text{l}}\text{ang} + \text{a} + \text{ie} \end{cases}$$

$$[\text{+post stem}]\begin{cases} \text{p}\acute{\text{i}}\check{\text{r}}\text{st} + \text{a} + \text{ie} \\ \text{d}\acute{\text{i}}\text{ew} + \text{a} + \text{ie} \end{cases}$$

The results just described are not quite correct; it is a well-known fact that in the [+post stem]-paradigm the endings of the instr. sing., loc. sing., and acc. plur. retain the accent. This can easily be accounted for by assigning to these three case endings the exception feature [-Rule (8)]. The derivation of the acc. plur., for example, is now as follows:

$$[\text{+post stem}]\begin{cases} \text{pir}\check{\text{s}}\text{t} + \text{aus} \longrightarrow (4) + \text{uas} \longrightarrow (7) & + \acute{\text{u}}\text{as} \longrightarrow (8)\ \text{inapplicable} \\ \text{diew} + \text{aus} \longrightarrow (4) + \text{uas} \longrightarrow (7) & + \acute{\text{u}}\text{as} \longrightarrow (8)\ \text{inapplicable} \end{cases}$$

After rule (8) a rule of segmental phonology intervenes, namely the final shortening rule, which drops an unaccented final vowel before a word boundary or when separated from a word boundary only by an s:

$$(9)\quad \underset{[\text{-acc.}]}{\text{V}} \longrightarrow \emptyset / \text{\_\_\_\_} (\text{s})\ \#$$

(A certain problem associated with this rule will be discussed below.)

Our example, the nom. plur., is now represented:

$\acute{\text{v}}\text{iir} + \text{a} + \text{i}$

$\acute{\text{l}}\text{ang} + \text{a} + \text{i}$

$\text{p}\acute{\text{i}}\check{\text{r}}\text{st} + \text{a} + \text{i}$

$\acute{\text{d}}\text{iew} + \text{a} + \text{i}$

As we have seen, both the [-post stem] and [+post stem]-classes are further divided into [-strong susceptible] and [+strong susceptible]-subclasses. The strong case rule (10) now assigns an accentual interpretation to this subdivision by accenting the final (after application of (9)) M of strong endings preceded by strong susceptible stems. The endings of the a-declension specified as strong are:

Loc. sing. (eV → (9) → e)

Nom. plur. (a + ei → (4) → a + ie → (9) → a + i)

Gen. plur. (a + uun → (2) → a + $u_3u_3u_3$ → (9) → a + u_3u_3)

Dat. plur. (a + ms)

Instr. plur. (a + isV → (9) → a + is)

Loc. plur. (au + seV → (4) → ua + seV → (9) → ua + se).

It should be pointed out that there is no general way to predict whether an ending is strong or not. There is variation from declension to declension; the nom. plur., for example, is [+strong] in the a-declension, but [-strong] in the aa-declension.

Rule (10) brings about two accent shifts: in stem specified as [-post stem, +strong susceptible] the accent goes from the first M of the stem to the last M of the ending; in stems specified as [+post stem, +strong susceptible] from the last M of the stem to the last M of the ending:

e.g., lanǵ + a + i [+strong] → láńg + á + ĩ (finally langaĩ)

diéw + a + i [+strong] → diéw + á + ĩ (finally dievaĩ)

An interesting case is the loc. sing., which is both [-Rule (8)] and [+strong]. The loc. sing. of dievas is derived as follows (after i/y and metathesis):

diew + eV → (7) → diéw + éV → (8) inapplicable → (9) → diéw + é → (10) → diéw + é.

It can be seen that the strong case rule (10) applies vacuously here. The loc. sing., incidentally, was crucial to my ordering of the final shortening rule with respect to the accent rules. It is easy to see that for all other cases the same correct results could be arrived at with the ordering: (6), (7), (10), (8), (9). Note, however, that this alternative ordering would give us an incorrect result for the loc. sing.:

diew + eV [+strong, -Rule (8)] → (7) → diéw + éV → (10 → diéw + éV →

(8) inapplicable → (9) inapplicable (that is, finally something like *dievẽ).

To summarize: The accent rules yield the fourfold paradigm:

1) [-post stem, -strong susceptible] e.g., výras – accent on the first M of the stem throughout the paradigm.
2) [-post stem, +strong susceptible] e.g., lángas – accent on the first M of the stem, but on the ending in strong cases.
3) [+post stem, -strong susceptible] e.g., pir̃stas – accent on the last M of the stem, except in the case of endings with the exception feature [-Rule (8)], where the accent is on the first M after the stem.
4) [+post stem, +strong susceptible] e.g., dievas – accent as in pir̃stas, but with accent on the last M of the ending in strong cases.

Now let us return to the final shortening rule. If my analysis of certain verb forms

is correct, this rule requires a further specification. Consider the following reflexive forms (after application of metathesis):

1. sing. a-pres.: pin + ug + si pin + ua̰ E si (finally pinúosi)
3. sing. a-pres.: pin + a + V̰ + si → pin + a + ∅ + si (finally pìnasi)
4. sing. aa-pres.: žvalg + a + ug + si → žvalg̰ + a + u∅̰ + si (finally žvalgaũsi)

The dropping of the vowel of the personal ending before the reflexive particle si in pìnasi and žvalgausi, as well as the retention of the final vowel in the reflexive particle itself, is not immediately explainable by rule (9). Both cases seem to be exceptions. But a certain regularity may be observed: the final vowel of the personal ending is dropped before si when the personal ending itself begins with a vowel and is immediately preceded by a vowel. This suggests the following modification in the environment specification of rule (9):

$$\underset{[-\text{acc.}]}{V} \longrightarrow \emptyset / \langle V+(V) \rangle \_\_\_\_ (s\langle i \rangle)\ \#$$

But even this formulation leaves at least one problem unsolved, the treatment of the final i of the reflexive particle.

(11) After the application of the i/y rule and the final shortening rule the sequence Vy can occur at the end of a word. This sequence is converted to a true diphthong, that is, y is revocalized as i:

$$[-\text{cons.}] \longrightarrow [+\text{voc.}] / [\text{——}]\ \#$$

E.g., Dative singular of the aa-stems:

dein + a + ia → (3) → dein + a + ya → (4) → dien + a + ya → (9) → dien + a + y → (11) → dien + a + i (finally dienai).

Note that the rule as stated above also covers the parallel case of w → u in this position, although no examples are known to me at the moment.

For the ordering of (11) see below.

(12) Sequences of more than two consecutive vowels are not permitted in Lithuanian. If after the final shortening rule such a sequence still occurs, the following rule applies:

$$V \rightarrow \emptyset / \_\_\_\_ \quad VV$$

Halle and Zeps (Quarterly Progress Report No. 83, pages 105-112) have established for Latvian rules similar to (9) and (12) which can be combined into a single rule. I believe it can be shown, however, that such a combination is impossible in Lithuanian, where both rules can apply to a single string with (11) necessarily intervening. Consider the dative singular of a-stems:

stem + a + u + ia

stem + a + u + ya by rule (3)

stem + a + u + y by rule (9)

stem + a + u + i by rule (11)

stem + $\not\phi$ + u + i by rule (12)

Note that unless (11) operates before (12), the environment conditions of rule (12) are not met. Furthermore, it is impossible for rule (11) to operate before the final a has been dropped by rule (9).

(13) Through the operation of the palatalization rule (1) and the i/y rule (3) sequences Cjy can arise. Such sequences are realized phonetically simply as palatalized consonants, that is, y is dropped after Cj.

(14) The palatalized dentals tj and dj are affricated before back vowels: t_j, d_j → $\check{c}'$ $dz\check{'}$/_____ back vowel.

(15) Sequences of two identical vowels are contracted to a single long vowel, which is always tense.

The rules which, as mentioned above, interpret V$\acute{V}$ as rising and $\acute{V}$V as falling, will have to apply before (15).

(16) Long non-nasalized $\bar{a}$ goes to $\bar{o}$ in all environments. The underlying representation of phonetic $\bar{o}$ as aa is required by morphophonemic considerations (e.g., parallelism in ablaut pattern u : $\bar{u}$, a : $\bar{o}$).

(17) All vowels, whether long or short, are denasalized.

In the sequel I shall give the abstract phonemic representation of the paradigms of primary nouns and verbs, together with the rules that must apply to them. The final results are given in their orthographic form.

aa-stems (example dein $\begin{bmatrix}+\text{post stem}\\+\text{strong susceptible}\end{bmatrix}$)

Nom.	dein + aa $\begin{bmatrix}+\text{strong}\\-\text{R(8)}\end{bmatrix}$	(1, 4, 7, 9, 10)	dienà
Gen.	dein + aa + sV [+strong]	(1, 4, 7, 8, 9, 10, 15, 16)	dienõs
Dat.	dein + a + ia	(1, 3, 4, 7, 8, 9, 11)	dienai
Acc.	dein + a + an	(1, 2, 4, 7, 8, 9, 15, 17)	diena$_{\text{ɔ}}$

Instr.	dein + a + n [-R(8)]	(1,2,4,7,9,17)	dienà
Loc.	dein + aa + ieV [+strong]	(1,3,4,7,8,9,10,15,16)	dienojè

Plural

Nom.	dein + aa + sV	(1,4,7,8,9,15,16)	dienos
Gen.	dein + a + uun [+strong]	(1,2,4,7,8,9,10,12,15,17)	dienų
Dat.	dein + aa + ms [+strong]	(1,4,7,8,10,15,16)	dienóms
Acc.	dein + a + ns [-R(8)]	(1,2,4,7,9,17)	dienàs
Instr.	dein + aa + meis [+strong]	(1,4,7,8,9,10,15,16)	dienòmis
Loc.	dein + aa + seV [+strong]	(1,4,7,8,9,10,15,16)	dienosè

The ee-stems parallel the aa-stems more or less exactly. Only the nominative singular demands special attention: unlike aa-stems, the ee-stems in the nominative singular require that an additional vowel be attached to the ending ee, in order to account for the final phonetic length of this ending, as well as for the phonetic circumflex.

a-stems (example lang [-post stem, +strong susceptible])

Singular

Nom.	lang + a + sV	(6,8,9)	lángas
Gen.	lang + a + aa	(6,8,9,15,16)	lángo
Dat.	lang + a + u + ia	(3,6,8,9,11,12)	lángui
Acc.	lang + a + an	(2,6,8,9,15,17)	lángą
Instr.	lang + au	(4,6,8,9)	lángu
Loc.	lang + eV [+strong]	(1,6,8,9,10)	langè

Plural

Nom.	lang + a + ai [+strong]	(4,6,8,9,10)	langai
Gen.	lang + a + uun [+strong]	(2,6,8,9,10,12,15,17)	láng
Dat.	lang + a + ms [+strong]	(6,8,10)	lángams
Acc.	lang + au + s [-R(8)]	(4,6,8,9)	lángus

Instr.	lang + a + isV [+strong]	(6, 8, 9, 10)	langaĩs
Loc.	lang + au + seV [+strong]	(1, 4, 6, 8, 9, 10)	languosè

The locative singular is somewhat exceptional, insofar as the ending shows no trace of the stem vowel a. Nevertheless, I see no possibility for an alternative representation.

i-stems (example šird [-post stem, +strong susceptible])

Masculine and feminine substantives of the i-declension differ only in the dative and instrumental singular. I give one example for each case. The genitive plural of certain substantives is formed without the stem vowel i. This irregularity must be accounted for in some way either in the lexicon or in the morphological component.

Singular

Nom.		šird + i + sV [+strong]	(1, 6, 8, 9, 10)	širdìs
Gen.		šird + i + ei + sV [+strong]	(1, 3, 4, 6, 8, 9, 10, 13)	širdiẽs
Dat.	fem.	šird + i + a + ia	(1, 3, 6, 8, 9, 11, 13, 14)	širdžiai
	masc.	dant + i + u + ia [+post stem, +strong susceptible]	(1, 3, 7, 8, 9, 11, 13, 14)	dančiui
Acc.		sird + i + in	(1, 2, 6, 8, 9, 15, 17)	širdį
Instr.	fem.	sird + i + mei [+strong]	(1, 4, 6, 8, 9, 10)	širdimì
	masc.	dant + i + au [+post stem][-R(8)]	(1, 3, 4, 7, 9, 13, 14)	dančiù
Loc.		šird + ii + ieV [+strong]	(1, 3, 6, 8, 9, 10, 15)	širdyjè

Plural

Nom.		šird + ii + sV	(1, 6, 8, 9, 15)	širdys
Gen.		šird + i + uun [+strong]	(1, 2, 3, 6, 8, 9, 10, 13, 14, 15, 17)	širdžiũ
	irregular	dant + uun [+post stem, +strg. susc.] [+strong]	(2, 7, 8, 9, 10, 15, 17)	dantũ
Dat.		šird + i + ms [+strong]	(1, 6, 8, 10)	širdìms
Acc.		šird + i + ns [-R(8)]	(1, 2, 6, 8, 9, 17)	širdìs

Instr.	ˇsird + i + meis [+strong]	(1, 4, 6, 8, 9, 10)	ˇsirdimis
Loc.	ˇsird + ii + seV [+strong]	(1, 6, 8, 9, 10, 15)	ˇsirdyse

u-stems (example turg [+post stem, -strong susceptible])

Singular

Nom.	turg + u + sV [+strong]	(7, 8, 9)	turgus
Gen.	turg + u + au + sV [+strong, -R(4)]	(7, 8, 9, 12)	turgaus
Dat.	turg + u + ia	(3, 7, 8, 9, 11)	turgui
Acc.	turg + u + un	(2, 7, 8, 9, 15, 17)	turgų
Instr.	turg + u + mei [+strong]	(1, 4, 7, 8, 9)	turgumi
Loc.	turg + u + ieV [+strong]	(3, 7, 8, 9)	turguje

Plural

Nom.	turg + uu + sV	(7, 8, 9, 15)	turgūs
Gen.	turg + u + uun [+strong]	(2, 7, 8, 9, 12, 15, 17)	turgų
Dat.	turg + u + ms [+strong]	(7, 8)	turgums
Acc.	turg + u + ns [-R(8)]	(2, 7, 9, 17)	turgùs
Instr.	turg + u + meis [+strong]	(1, 4, 7, 8, 9)	turgumis
Loc.	turg + u + au + seV	(1, 4, 7, 8, 9, 12)	turguose

It will have been noted that the dative plural of the a, i and u-declensions (a + ms, i + ms, u + ms) behaves somewhat exceptionally with respect to the strong case rule, insofar as the accent is placed not on the last M of the ending (which would be the m), but on the vowel preceding the last M. At the moment, I do not quite see how to account for this.

The Adjective:

Adjectives behave, in principle, exactly like nouns, except that in a few cases, which are listed below, a pronominal ending appears for a nominal one:

Example: staar [-post stem, +strong susceptible]

Dat. sing. masc. staar + amV [+strong] → storám

Loc. sing. masc.	staar + ameV [+strong]	⟶ storamè
Nom. plur. masc.	staar + ei [+strong]	⟶ storì
Dat. pl. masc.	staar + eims [+strong]	⟶ storiems

The corresponding forms of adjectives with u or ia as stem vowel are quite parallel.

On the whole, the definite forms of adjectives can be represented as the simple forms plus the correspondings forms of the pronoun jis, e.g., gen. sing. masc.: stem + a + aa + i + aa → stem + ojo. Note that with the suffixation of the pronoun the final shortening rule will no longer apply to the endings of the adjective proper. The accusative plural, for example, is šaltuosius, and not *šaltusius.

As far as their accentuation is concerned, the long forms of the adjective follow the short forms exactly; the accent never falls on the pronominal element. This is explained by a restriction on the domain of the accent rules.

A further peculiarity of the definite declension should be mentioned: the apparent merger of classes 3 and 4 in the acc. pl. (šaltúosius, geruósius) and instr. sing. (šaltúoju, geruóju). We would expect *šáltuosius (cf. indefinite šáltus) and *šáltuoju (cf. šáltu). The obvious solution, the introduction of a readjustment rule saying that a [-post stem]-adjective becomes [+post stem] when suffixed with the pronoun, is impossible, since forms with the accent on the stem always bear an acute in adjectives šaltas. The only way to account for this peculiarity is to specify the acc. plur. and the instr. sing. as [+strong] in the environment in question; that is, we have to add a rule to the morphological component of roughly this form:

$$\left\{\begin{matrix}\text{Instr. sing.}\\ \text{Acc. Plur.}\end{matrix}\right\} \longrightarrow [+\text{strong}] \,/\,]_A + \_\_\_\_ + \text{pronoun.}$$

To be sure, this solution seems a bit ad hoc, but as can be seen in any case, the feature strong is not in general predictable for case endings.

The Verb:

There are 3 markers of the present tense and 2 of the preterite; their distribution must be specified in the morphological component. For our present purposes this problem can be disregarded. There is one peculiarity associated with the present and preterite markers, which, interestingly enough, has been observed in Latvian also. Except in the i-present, the tense marker is, in general, shorter by one vowel before the personal endings of the 1. and 2. sing. than before the remaining personal endings, that is, the present marker a does not appear at all in the 1. and 2. sing., and the present markers aa, ia and the preterite markers aa, ee appear as a, i, a, e, respectively.

In the verb forms given below the tense marker has been affixed directly to the stem; at the moment, it is not clear whether this treatment is correct or whether a special verbalizing suffix should be set up between the stem and the tense marker.

a-present (example pin[+post stem, +strong susceptible])

1.	sing.	pin + au [+strong]	(1,4,7,8,9,10)	pinù
2.	sing.	pin + ei [+strong]	(1,4,7,8,9,10)	pinì
3.	pers.	pin + a + V	(1,7,8,9)	pìna
1.	plur.	pin + a + mee	(1,7,8,9)	pìname
2.	plur.	pin + a + tee	(1,7,8,9)	pìnate

aa-present (example valg[-post stem, -strong susceptible])

1.	sing.	ualg + a + au [+strong]	(3,4,6,8,9)	válgau
2.	sing.	ualg + a + ei [+strong]	(3,4,6,8,9)	válgai
3.	pers.	ualg + aa + V	(3,6,8,9,15,16)	válgo
1.	plur.	ualg + aa + mee	(1,3,6,8,9,15,16)	válgome
2.	plur.	ualg + aa + tee	(1,3,6,8,9,15,16)	válgote

ia-present (example dur[+post stem, + strong susceptible])

1.	sing.	dur + i + au [+strong]	(1,3,4,7,8,9,10,13)	duriù
2.	sing.	dur + i + ei [+strong]	(1,3,4,7,8,9,10,13)	durì
3.	pers.	dur + ia + V	(1,3,7,8,9,13)	dùria
1.	plur.	dur + ia + mee	(1,3,7,8,9,13)	dùriame
2.	plur.	dur + ia + tee	(1,3,7,8,9,13)	dùriate

i-present (example tur[+post stem, +strong susceptible])

1.	sing.	tur + i + au [+strong]	(1,3,4,7,8,9,10,13)	turiù
2.	sing.	tur + i + ei [+strong]	(1,3,4,7,8,9,10,13)	turì
3.	pers.	tur + i + i	(1,7,8,9)	tùri
1.	plur.	tur + i + mee	(1,7,8,9)	tùrime
2.	plur.	tur + i + tee	(1,7,8,9)	tùrite

aa-preterite (example pin]+post stem, +strong susceptible])

1.	sing.	pin + a + au [+strong]	(1,4,7,8,9,10)	pinaũ

2.	sing.	pin + a + ei [+strong]	(1,4,7,8,9,10)	pinaĩ
3.	pers.	pin + aa + V	(1,7,8,9,15,16)	pínо
1.	plur.	pin + aa + mee	(1,7,8,9,15,16)	pínome
2.	plur.	pin + aa + tee	(1,7,8,9,15,16)	pínote

ee-preterite (example valg[-post stem, -strong susceptible])

1.	sing.	ualg + e + au [+strong]	(1,3,4,5,6,8,9)	válgiau
2.	sing.	ualg + e + ei [+strong]	(1,3,4,6,8,9)	válgei
3.	pers.	ualg + ee + V	(1,3,6,8,9,15)	válgė
1.	plur.	ualg + ee + mee	(1,3,6,8,9,15)	válgėme
2.	plur.	ualg + ee + tee	(1,3,6,8,9,15)	válgėte

The future is formed by affixation of si to the stem of the verb that appears in the infinitive. Note two peculiarities of the future: 1.) The assimilation rule (2) does not operate before the future marker si, as already mentioned above; and 2.) in the third person the si always attracts the accent, except when it is preceded by a [-post stem]-stem plus derivational suffix (e.g., máák + ii + si → finally mõkys, but rãš + íi + si → finally rašỹs). This peculiarity of the third person provides an explanation for what in traditional grammars is referred to as Metatonie.

Example: lauk[-post stem, -Rule (4), -strong susceptible]

1.	sing.	lauk + si + au	(1,3,4,6,8,9,13)	láuksiu
2.	sing.	lauk + si + ei	(1,3,4,6,8,9,13)	láuksi
3.	pers.	lauk + si → láuk + si	(1,8,9)	laũks
1.	plur.	lauk + si + mee	(1,6,8,9)	láuksime
2.	plur.	lauk + si + tee	(1,6,8,9)	láuksite

Note that the personal endings au and ei are not [+strong] in the future.

C. Heeschen

C. INWARD AND UPWARD – DIRECTIONALS IN ENGLISH

We have in present-day English several small wordlike elements; in, out, up, down, and others, which we may call "directionals."[1] Any one of these formatives may alternatively be called a preposition, as in (1); a part of a compound preposition, as in (2); part of an adverb of direction, as in (3); and in (4), various analyses call it a "dangling" preposition (in analogy with (1)), an adverb (in analogy with (3)), or even a verbal particle (in analogy with "he blew up (became angry)" or "the teacher bawled him out").

(1a) at this point the smoke travels up the chimney.
  b) this piece of paper just blew in the window.

(2a) but first, the smoke must travel up to the ceiling.
  b) so he pushed it into the center.

(3a) after being released, the balloon floated upward.
(3b) in a hurricane, the surface wind blows inward.

(4a) the air travels up for a few minutes before taking on a rotational motion.
  b) after traveling in, it starts moving up the eye of the storm.

Thus we have 4 uses of each of several directionals (Di's). In discussing them, let us use up for examples, since it is a typical one.

The semantic contribution offered to the sentence by any Di (e.g., up) is at least roughly the same, regardless of which construction it is used in. For this reason, it would be desirable to relate them in the syntax, thereby allowing a single lexical reading to be applied in these different cases. But it is not only desirable to do so but also necessary, because of the following considerations. First, a Di in any of these usages is found only after a verb of motion.[2] Second, after a Di, there may be only one of 4 possibilities; either a nominal phrase as in (1), or the formative-ward(s) as in (3) (Is this a nominal of sorts?), or a prepositional phrase as in (2), or else nothing, by which I mean that it can be followed by any and everything that can follow any of the other 3 possibilities. These 4 constructions are syntactically equivalent; they play the same role in the syntactic structure of the sentence, as is seen by the fact that whatever can follow (precede) one such usage can follow (precede) the other, and whatever cannot follow (precede) one cannot follow (precede) another. But the most binding consideration is that if a sentence contains an occurrence of a particular directional in any usage, it cannot contain a second occurrence of the same directional, as seen in the impossibility of the constructions in (5).

(5) *he climbed { up up the flagpole
                  up upward
                  upward up the flagpole
                  up up to the top
                  upward up to the top
                  etc.

(The same usage of a Di may apparently be repeated, however, for emphasis, as is typical of simple adverbs "? he flew up up and away," like "have you ever ever done that?") The only reasonable way to disallow multiple occurrences of each Di is to derive the different usages from a common underlying structure, which can become one or another of its realizations but not several. And the reduplicated cases (if they occur) can be handled by a low-level rule, which works only on single words.

We may note that many of the so-called "2-word verbs" or "verb particle combinations" are formed from a verb of motion and an accompanying directional, e.g., "blow up" (explode), "put up" (preserve), and as is expected from directionals, they cannot co-occur with another occurrence of the same directional. There is nothing further to be said here, except that these must be essentially verb-directional idions.

Thus we see that any satisfactory grammar of English must have these underlying directionals which are realized in the various ways (1) to (4). This fact will serve to explain the other properties of directionals noted above. Accepting, then, that a unified analysis of all of these usages is necessary, let us examine an example of such an analysis.

First, it seems clear that the bare Di of (4) is derived by deleting the -ward(s) of (3). Semantic and syntactic constance,[3] along with a designated element for deletion, makes this a clear case of a simple deletion transformation. The conditions to be met for deletion to occur are perhaps more interesting, but to a rough approximation they merely require that there be something to the right of the -ward in the same clause. While (6) and (8) are permitted, (7) is not.

(6a) the electrons are moving upward.
b) he was climbing upward.
c) helium balloons go upward.

(7a) *the electrons are moving up.
b) *he was climbing up.
c) *helium balloons go up.

(8a) the electrons are moving up in order to avoid the negative charge here.
b) he was climbing up when it happened.
c) a helium balloon goes up if you release it.

Next, we note that in the compound preposition cases, the Di may have -ward attached without any semantic change, except perhaps a loss of the concept of completion (necessarily submerged if the preposition carried this meaning also), as in (9). The same explanation as that above given will suffice here.

(9) he walked up(ward) to the top.
she looked up(ward) through the conduit.
the wires pass up(ward) along this joist.
he climbed up(ward) from the bottom.

Finally, turning to the prepositional[4] cases of (1), if we distinguish between 'goal' prepositions (from, to) and 'path' prepositions (along, through), we may observe that whenever a Di is used as a preposition, there is a path preposition (but never an end preposition) which can be inserted without changing the meaning of the sentence (10), and which makes these constructions parallel to the ones just examined. Because the prepositional

(10a) he climbed up (along) the path.
b) it fell down (through) the tube.
c) it rolled down (along) the crack.

cases must be related to the other directionals, we are, at present, forced to accept the analysis that these putative prepositional Di's are really Di's followed by deleted path prepositions.[5]

Thus we have a clean, tight analysis.[6] There is a -ward (or something similar) deletion transformation, and there is a preposition deletion transformation applying to its output which depends in an interesting way upon the object of that preposition. If prepositions are analyzed as a spelling-out of features from a nominal phrase, then the effect of the second transformation can presumably be obtained by inhibiting that spelling-out process.

There is, however, a joker left in the deck. If the directionals really are adverbial in nature, as they must be from the arguments above, they must also be prepositions, at least they must be so considered by some transformations. Besides (11) we have the word questions (12), and also the alternate word question (13), which is possible only for prepositional phrases. The same problem appears in relative clauses (14).

(11a) Lincoln climbed up the flagpole.
b) he pushed it up the tube.

(12a) what did Lincoln climb up?
b) what did he push it up?

(13a) up what did Lincoln climb?
b) up what did he push it?

(14a) the flagpole up which Lincoln climbed fell down last year.
b) the tube up which he pushed the wire ended on the second floor.

Thus we are faced with a contradiction. We must either give up this analysis of directionals and consequently try to explain the distributional facts noted above in diverse ways or give up the restriction of the question-word fronting transformation(s) to prepositions only (it does not work on ordinary adverbs, e.g., *accidentally whom did he hit?), or, as I am inclined to believe, we must have a process by which directional is attached to a prepositional phrase in such a way that is is indistinguishable from a true preposition.[7] For the last alternative, other hints of support may be found in examining the relationship of prepositions to verbal prefixes in

German, Greek, and Russian (especially zu in German).

T. R. Hofmann

Footnotes

1. I am indebted to G. H. Matthews and J. S. Gruber, who have discussed the issues raised here.

2. Either a verb of physical motion, e.g., fly, move, travel or go, or a verb of metaphonical motion, e.g., look, shout; see J. Gruber, "Look and See" (to appear in Language).

3. We might want to delete some other element that expresses completion and contrasts with -ward (which expresses noncompletion). This contrast of completeness is emphasized by the perfect auxiliary as in:

   he has climbed upward.
   he has climbed up.

   This explanation may also figure in the explanation of the completive interpretation of many verb-Di idioms (2-word verbs) such as "burn up," "wrap up," etc.

4. We notice that the putative preposition can often be deleted, sometimes leaving the nominal phrase looking like an object of the verb, but sometimes not.

   he climbed (up) the flagpole
   he walked (down) the road
   he crawled (down) the length of the hallway.

5. The real situation is somewhat more involved than the one described here; we have been looking only at nonvolumetric nominal phrases figuratively denoting planes, lines, and points). If we look at volumetric nominal phrases (denoting 3-dimensional objects, e.g., room, box, etc.), to is deletable and path prepositions are not. Generally speaking, what can be deleted after a directional depends on the following nominal phrase.

6. We may note that, besides the common directionals discussed herein, there are proper directionals ('proper' in the sense found in 'proper noun'). The names of the cardinal directions, north, south, east, west, behave just as common directionals, except that preposition deletion is forbidden.

   he walked north.
   he walked northward.
   *he walked north the road.
   he walked north along the road.
   ?north along what road did he walk?

7. There are phonologically identical and semantically similar locative prepositions which any complete analysis would presumably relate to these directionals. We shall not attempt to do so here.

D. ON PROBLEMS IMPLIED BY THE CONCEPT 'PERFORMANCE'

In Susumo Kuno's[1] works we find a tendency to construct a system, by means of an algorithm on the basis of a particular transformational grammar without applying inverse transformations, to directly determine the deep structure of a given sentence. Let us call this position A. Kuno intends this approach to be a hypothetical approximation to 'performance'.[2,3]

The possible generalizations of this approach are clear. The problem, of course, is to prove that each generalization can be constructed. First, there could be construction of a system that goes immediately from the deep structure to the sentence (a kernel or derived sentence in the terminology of Chomsky[4]). A condition is proposed, however, that this system be formed by an algorithm on the basis of transformational grammar (position B, which is the inverse of A).

The second generalization (position C) is a system that immediately determines the meaning(s) of a received sentence. This system also has to be constructed by an algorithm on the basis of the syntax and the semantics of a transformational grammar.

The third generalization (position D) is the inverse of C.

In this report we shall not take into account possible generalizations on a phonological level.

The last generalization that we make (position E) differs qualitatively from the previous ones. It is the construction of a system on the basis of linguistic data to directly determine the meaning(s) of a given sentence, and vice versa. The qualitative difference between this generalization and the previous ones is the following: The previous generalizations are all dependent on a competence (a transformational grammar); this generalization is not.

Let us now ask to what extent approaches A-E (if they can be constructed) are approaches to 'performance.' In these theories an attempt is made to achieve recognition or production procedures for each grammatical sentence and only for this kind.

Therefore, it seems possible to argue that these systems are approaches to a 'competence' model for speech production and speech recognition. The limitations and individual differences in speech production and speech recognition are the result of (a) psychophysical realizations of this kind of competence (performance-competence, which itself is dependent on 'competence' in approaches A-D); and (b) use of this realization (a and b can be called performance-performance).[5]

There is room for discussion about the use of the concepts 'performance-competence' and 'performance-performance.' We shall not discuss the pros and cons here. We shall only try to indicate a few problems that are implied by accepting this kind of distinction in the performance.

The first problem is the origin of the 'performance-competence.' Is it innate or is it

learned? If it is made by an algorithm from a particular competence grammar, is this algorithm learned or innate?

The second problem, "Is it possible to construct a 'performance competence' independently of a competence?" (generalization E^6). If it can be proved that it is not possible, or possible only under conditions that cannot be met by a human being, then, I think, there would be strong confirmation of the 'competence' hypothesis and the transformational grammar, which is a competence grammar. If, however, it could be proved that such a construction is possible, then the problem arises, "How can we confirm the evidence for the competence hypothesis?" (competence grammar as a psychological and biological reality and necessity[7]).

A psychological proof or another proof of the dichotomy between competence and performance, independently of a proof of the possibility or impossibility of generalization E, would be very decisive. As long as no such proof is available, however, a proof of the possibility (or impossibility) of generalization E seems to be important.[8]

We feel that it is useful for future developments to make explicit certain problems to which contemporary approaches to 'performance' lead.

We wish to thank Professor H. Putnam, Professor S. Kuno, Dr. Rubenstein, M. De May, and Dr. W. Vereecke for discussing various topics that gave rise to some of these problems. Of course, only the author is responsible for the point of view taken here.

F. J. Vandamme

Footnotes and References

1. S. Kuno, "The Predictive Analyzer," in Readings in Automatic Language Processing, edited by D. G. Hays, p. 83.

2. The term 'performance' is used to denote the actual speech-production and speech-recognition systems of mankind. It is generally assumed to be based on a 'competence.' The difference between the two is mainly a difference in function (a theory of competence is not a theory for speech recognition or speech production; see N. Chomsky, "Current Issues in Linguistic Theory," in The Structure of Language, edited by J. A. Fodor and J. J. Katz (Prentice-Hall, Inc., Englewood Cliffs, N. J., 1966), p. 52; N. Chomsky, Aspects of the Theory of Syntax (The M. I. T. Press, Cambridge, Mass., 1965), p. 9). Possibly there is a difference in formal qualities. For a more intensive discussion about the concepts 'competence and performance' in linguistics, see N. Chomsky, Aspects of the Theory of Syntax, op. cit.

3. Another proposal for approximation to 'performance' has been made by R. S. Petrick, "Recognition Procedure for Transformational Grammars," Ph. D. Thesis, Department of Modern Languages and Linguistics, M. I. T., June 1965.

4. N. Chomsky, "A Transformational Approach to Syntax," in The Structure of Language, edited by J. A. Fodor and J. J. Katz, op. cit., p. 223.

5. This 'performance-performance' corresponds closely, we think, to F. de Saussure's 'parole' in, "Course in General Linguistics," translated by M. Baskin (McGraw-Hill Book Company, New York, 1966). We read: "Speaking ... is an individual act .... Within the act, we should distinguish between: (1) the combinations by which the

speaker uses the language code for expressing his own thought; and (2) psychophysical mechanism that allows him to exteriorize those combinations." (p. 14). Does de Saussure's "langue" correspond (with a few reservations) more to the concept 'competence' than to the concept 'performance-competence'?

6. Even if the distinction 'performance-competence' and 'performance-performance' is not accepted, the generalization E can be stated, "Is a performance system possible without a preconstruction of a competence grammar?". Two interpretations seem possible: (a) a competence grammar is not explicitly used, but is not implicitly required for the construction of a performance system; (b) a competence grammar is not at all needed. The discussion that follows seems to us to be valid in this case, too.

7. N. Chomsky, Aspects of the Theory of Syntax, op. cit., p. 8. "Obviously, every speaker of a language has mastered and internalized a generative grammar that expresses his knowledge of language." (=competence).

8. More about that can be found in "A Discussion about a Possible Approach to a Model for Speech Recognition and Speech Production," (preprint, December 1966) by F. Vandamme. There we give arguments that seem to indicate very strongly that position E is possible. The value of the proposed system for 'analyse by analyse' and 'synthese by analyse' is crucial.