XXII. LINGUISTICS*

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RESEARCH OBJECTIVES

This group sees as its central task the development of a general theory of language. The theory will attempt to integrate all that is known about language and to reveal the lawful interrelations among the structural properties of different languages as well as of the separate aspects of a given language, such as its syntax, morphology, and phonology. The search for linguistic universals and the development of a comprehensive typology of languages are primary research objectives.

Work now in progress deals with specific problems in phonology, morphology, syntax, language learning and language disturbances, linguistic change, semantics, as well as with the logical foundations of the general theory of language. The development of the theory influences the various special studies and, at the same time, is influenced by the results of these studies. Several of the studies are parts of complete linguistic descriptions of particular languages (English, Russian, Siouan) that are now in preparation.

Since many of the problems of language lie in the area in which several disciplines overlap, an adequate and exhaustive treatment of language demands close cooperation of linguistics with other sciences. The inquiry into the structural principles of human language suggests a comparison of these principles with those of other sign systems, which, in turn, leads naturally to the elaboration of a general theory of signs, semiotics. Here linguistics touches upon problems that have been studied by modern logic. Other problems of interest to logicians – and also to mathematicians – are touched upon in the studies devoted to the formal features of a general theory of language. The study of language in its poetic function brings linguistics into contact with the theory and history of literature. The social function of language cannot be properly illuminated without the help of anthropologists and sociologists. The problems that are common to linguistics and the theory of communication, the psychology of language, the acoustics and physiology of speech, and the study of language disturbances are too well known to need further comment here. The exploration of these interdisciplinary problems, a major objective of this group, will be of benefit not only to linguistics; it is certain to provide workers in the other fields with stimulating insight and new methods of attack, as well as to suggest to them new problems for investigation and fruitful reformulations of questions that have been asked for a long time.

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A. A NOTE ON THE FORMULATION OF PHONOLOGICAL RULES

This report deals with a restriction that must be imposed on phonological rules of the type

(1) $A \rightarrow B$ in env: $X \underset{Z}{\_\_\_} Y$

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where the capital letters represent distinctive-feature specifications and X, Y, Z may be null (i.e., the rule may apply in all environments).

Following Halle[1] and Chomsky,[2] we shall define segments $\{\alpha\}$ and $\{\beta\}$ to be phonemically distinct (i.e., nonrepetitions) if and only if at least one feature has a different value in $\{\alpha\}$ than in $\{\beta\}$. Thus segments $\{\alpha\}$ and $\{\beta\}$ below are phonemically distinct because $\{\alpha\}$ is specified [+feature A] whereas $\{\beta\}$ is specified [-feature A]; segment $\{\gamma\}$, however, is phonemically distinct neither from $\{\alpha\}$ nor from $\{\beta\}$ because there is not one feature in $\{\gamma\}$ that has a different value either in $\{\alpha\}$ or $\{\beta\}$:

segment:	$\{\alpha\}$	$\{\beta\}$	$\{\gamma\}$
feature A:	+	-	0
feature B:	+	+	+

We discuss possible interpretations of how rules of type (1) should be applied to segments of type $\{\gamma\}$.

In particular, we want to determine how rule (2) should be applied to segment $\{\gamma\}$:

(2) [+feature A] → [-feature B].

Let us assume first, that rule (2) applies to segment $\{\gamma\}$ and thus specifies $\{\gamma\}$ as [-feature B]. Application of (2) to $\{\beta\}$ and $\{\gamma\}$ will then produce the following distinctive-feature matrix:

segment:	$\{\beta\}$	$\{\gamma\}$
feature A:	-	0
feature B:	+	-

Since segments $\{\beta\}$ and $\{\gamma\}$ were not phonemically distinct to begin with and since they are phonemically distinct after application of rule (2), we conclude that

> No rule may be applied to any segment if a feature to the left of the arrow has not already been specified for that segment.

Now let us assume that rules of type (2) do not apply to segments of type $\{\gamma\}$. We begin with segments $\{\alpha\}$ and $\{\gamma\}$. Application of rule (2) to these segments results in the following matrix:

segment:	$\{\alpha\}$	$\{\gamma\}$
feature A:	+	0
feature B:	-	+

Once again we have succeeded in producing two phonemically distinct segments from segments that initially were not phonemically distinct. We therefore conclude that

> No rule may not be applied to any segment if a feature to the left of the arrow has not already been specified for that segment.

The application of this restriction to specifications in the environment is obvious.

T. M. Lightner

References

1. M. Halle, The Sound Pattern of Russian (Mouton and Company, The Hague, 1959), p. 32.

2. N. Chomsky, Review of Jakobson and Halle, Fundamentals of Language, Int. J. Am. Ling. 23, 234-235 (1957).

B. VOWEL HARMONY IN CLASSICAL (LITERARY) MONGOLIAN

In Classical Mongolian (CM), vowels in a word must be either all grave or all acute, in agreement with the gravity of the first vowel in the word. The vowel i, however, may occur either with grave vowels or with acute vowels.

The CM vowel phones are as follows:

segment:	u	o	ü	ö	i	a	e
flat:	+	+	+	+	−	−	−
diffuse:	+	−	+	−	+	−	−
grave:	+	+	−	−	0	+	−

We would like to account for CM vowel harmony in essentially the same way that Halle accounts for Finnish vowel harmony.[1] We would require the following two ordered rules:

(1) $\begin{bmatrix}+\text{voc}\\-\text{cns}\end{bmatrix} \rightarrow [\alpha\text{grv}]$ in env: $\left(\begin{bmatrix}+\text{voc}\\-\text{cns}\\ \alpha\text{grv}\end{bmatrix} X\right)_1$ ———

where X may be any number of nonvowel segments and may contain + boundaries or juncture symbols but may not contain a pair of #'s (i.e., may not contain a word boundary).

(2) $\begin{bmatrix}+\text{voc}\\-\text{cns}\\-\text{flt}\\+\text{dif}\end{bmatrix} \rightarrow [-\text{grv}]$

In the examples below capital letters represent archiphonemes not specified for gravity; thus U represents {u, ü}, etc. We omit boundary markers, since they play no role in vowel harmony.

(a) emA →1→ eme 'woman'
(b) barsUn →1→ barsun 'tiger (gen. sg.)'
(c) barsI →1→ barsi →2→ barsi 'tiger (acc. sg.)'

The difficulty with this analysis lies in the existence of words that have i for their first vowel phoneme (nigen 'one,' e.g.). Since the first vowel of these stems is unspecified for gravity, it may be objected that one may not formulate rule (1).

At first glance this seems to be a serious objection: either one must discard the intuitively correct analysis above or else one must specify i for gravity in these words — and thus violate Halle's simplicity criterion.[2]

Closer examination reveals that an objection of this type is ill-formed.

Given a word whose first vowel is i, there is no way to tell whether the other vowels in the word should be back vowels or front vowels. In actual fact, the other vowels may be either front or back, depending on the particular morpheme in question. The i in these words must, therefore, be specified for gravity.

In short, the phonemic CM vowel system contains one more vowel than the phonetic CM vowel system[3]:

segment:	u	o	ü	ö	ï	i	a	e
flat:	+	+	+	+	−	−	−	−
diffuse:	+	−	+	−	+	+	−	−
grave:	+	+	−	−	+	−	+	−

Examples of application of rules (1)-(3) to words whose first vowel phoneme is i or ï are the following:

(d) bidAnU →1→ bidenü (→2→ bidenü) 'of us (inclusive)'
(e) ïnAdU →1→ ïnadu →2→ inadu 'on this side'

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References

1. M. Halle, Questions of linguistics, Nuovo cimento 13, 513-514 (1959).

2. M. Halle, On the role of simplicity in linguistic descriptions, Proc. Symposia in Applied Mathematics, Vol. 12 (American Mathematical Society, New York, 1961), pp. 89-94.

3. It may be of interest to note that in Proto-Mongolian there were phonetically two nonflat diffuse vowels — an i that occurred only in words with front vowels, and an ï that occurred only in words with back vowels. The two phonetic vowels i and ï subsequently merged into one phonetically front vowel i, but phonemically we must retain both i and ï. See K. Grønbech and J. Krueger, An Introduction to Classical (Literary) Mongolian (Otto Harrassowitz, Wiesbaden, 1955), p. 18, and N. Poppe, Grammar of Written Mongolian (Otto Harrassowitz, Wiesbaden, 1954), p. 11.

C. ON THE PRESENT TENSE THEME o/e IN RUSSIAN

Most North Russian (R) dialects and a few South R dialects are commonly considered to have the present tense theme o for verbs with stems in a consonant or in a back vowel

(the so-called first conjugation). The remaining North R dialects and most South R dialects are considered to have the present tense theme e. There are also a few dialects that are considered to have both e and o: e before soft consonants and o before hard consonants.[1]

Thus, for example, the 2 Sg, 3 Sg, 1 Pl, 2 Pl present tense forms of the stem pas-, may occur in any of the following phonetic forms, depending on the particular dialect in question:

A:	pas, óš	pas, ót	pas, óm	pas, ót, e
B:	pas, éš	pas, ét	pas, ém	pas, ét, e
C:	pas, óš	{ pas, ót / pas, ét, }	pas, óm	pas, ét, e

We cannot accept any analysis that postulates that the underlying present tense theme is either e or o for any R dialect (in fact, for any East Slavic language).

Let us first look at type A (the contemporary standard literary dialect is of this type). If the present tense theme is postulated as o, then the rules of the transformational cycle will read, in part (we omit rules that are irrelevant here), as follows[2]:

C-1: Transitive softening occurs in env: $\_\_\_\_\_ + \begin{bmatrix}+\text{voc}\\-\text{cns}\\-\text{flt}\end{bmatrix} + \begin{bmatrix}+\text{voc}\\-\text{cns}\\+\text{flt}\end{bmatrix}$

C-2: $\begin{bmatrix}+\text{voc}\\-\text{cns}\end{bmatrix} \rightarrow \emptyset$ in env: $\_\_\_\_\_ (+) \begin{bmatrix}+\text{voc}\\-\text{cns}\end{bmatrix}$

C-3: [+cns] → [+sharp] in env: $\_\_\_\_\_ + \left\{\begin{matrix}\underline{i}\\\underline{e}\\\underline{o}\end{matrix}\right\} +$ X where X may not be null.

C-4: Erase parentheses and return to C-1.

We note that the specification of the environment in C-3 will be rather complex because i, e, and o do not form a natural class of vowels.

Our suggestion is to postulate a front, rounded vowel, ö, as the present tense theme. Rule C-3 will then read:

C-3': [+cns] → [+sharp] in env: $\_\_\_\_\_ + \begin{bmatrix}+\text{voc}\\-\text{cns}\\-\text{grv}\end{bmatrix} +$ X

After all of the rules of the transformational cycle have been applied, the forms of pas- listed above will be as follows:

A':	pas, öš	pas, öt	pas, öm	pas, öt, e

We require now only the following phonetic rule:

P-A: [+flat] → [+grave]

Application of rule P-A to the forms above will give the correct final phonetic forms.

A": pas, ǒš pas, ót pas, óm pas, ót, e

We must prefer this analysis to an analysis that uses the present tense theme o because our analysis requires fewer distinctive feature specifications.

Now let us examine type B. The postulation of a present tense theme e for this type would involve a considerable increase in the complexity of the grammar because rule C-1 would have to be changed drastically. We would have to find some environment that causes transitive softening in forms like ((p, is+a + e) + t), ((xod+i + i) + u) – ultimately p, íšet and xózu – and prevents transitive softening in forms like ((xod+i + i) + at), ((smotr+e + i) + at), ((pas + e) + u) – ultimately xód, at, smótr, at, pasú. Such an environment cannot be of the simple form shown in rule C-1.

If, however, we were to postulate that the present tense theme for type B were ö, then we could use rule C-1 as it stands. We would now need only to have the following phonetic rule in place of P-A:

P-B: [-grave] → [-flat]

This rule will ensure that ö → e and the final phonetic form of the examples given above will have the (correct) vowel e.

At this point it should be clear that we want to postulate ö as the present tense theme for type C also. For these dialects we will require, not one, but two phonetic rules:

P-C1: [+flat] → [+grave] in env: _____ $\begin{bmatrix}+\text{cons}\\-\text{shrp}\end{bmatrix}$

P-C2: [-grave] → [-flat]

We must point out that the present analysis clearly brings forth the underlying unity of R conjugation; the particular dialectal variations find their explication in low-level phonetic rules, i.e., at a late stage of phonetic specification rather than at an earlier stage.

Although we leave Ukrainian (U) and Byelorussian (BR) conjugation for later studies, we would like to mention the inherent plausibility that the present theme in these languages is also ö.

In U the late phonetic rule will be P-B; rule C-3 does not apply in U. Thus the present rules will generate the following U forms:

stem	2 Sg	3 Sg	1 Pl	2 Pl
pas-	paséš	pasé(t,)	pasemó	paseté
pis+a-	píšeš	píše(t,)	píšemo	písete

In BR the late phonetic rules will be P-C1 and P-C2. Thus the present rules will generate the following BR forms[3]:

n, os- n, as, éš n, as, é(c,) n, as, óm n, as, ac, ó

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References

1. See N. Durnovo, Očerk Istorii Russkogo Jazyka (Gosudarstvennoe izdatel'stvo, Moscow-Leningrad, 1924), Sec. 512, p. 333.

2. For more information on the transformational cycle in Russian, see M. Halle, Note on cyclically ordered rules in the Russian conjugation, Quarterly Progress Report No. 63, Research Laboratory of Electronics, M.I.T., October 15, 1961, pp. 149-155, and T. M. Lightner, On pon,át, and obrazovát, type verbs in Russian, Quarterly Progress Report No. 67, Research Laboratory of Electronics, M.I.T., October 15, 1962, pp. 177-180.

3. In BR there will be a late phonetic rule š, → š. Furthermore, pretonic e in BR is pronounced [a]. See any elementary BR grammar, for example, R. G. A. deBray, Guide to the Slavonic Languages (E. P. Dutton Company, Inc., New York, 1951), p. 139.

D. DISCONTINUOUS ONE-WAY GRAMMARS

Chomsky[1] defines a class of grammars each of which contains a finite number of rules of the form $\chi_1 A \chi_2 \rightarrow \chi_1 \omega \chi_2$, where A is a single symbol, and $\omega \neq I$. Such grammars are called context-sensitive phrase structure (CS) grammars. Context-free phrase structure (CF) grammars are a subclass of CS grammars for which all of the rules are of the form $A \rightarrow \omega$, i.e., χ_1 and χ_2 are always null. A sequence of strings $(\phi_1, \phi_2, \ldots, \phi_n)$ is called a ϕ-derivation of a grammar G if $\phi = \phi_1$, and for each i $(1 \leq i < n)$ there are strings $A, \chi_1, \chi_2, \psi_1, \psi_2$ which are such that $\phi_i = \psi_1 \chi_1 A \chi_2 \psi_2$, $\phi_{i+1} = \psi_1 \chi_1 \omega \chi_2 \psi_2$, and $\chi_1 A \chi_2 \rightarrow \chi_1 \omega \chi_2$ is a rule of G. The language L_G is the set of strings that do not contain nonterminal symbols and conclude S-derivations of the grammar G. Such a string is called a sentence of L_G.

CONVENTION 1: By $\omega^{(n)}$ is meant a string ω that is n symbols in length, or that is initial and/or final in a string, i.e., follows and/or precedes #, and not greater than n symbols in length.

DEFINITION 1: (a) A left-to-right (L-R) ϕ-derivation is a ϕ-derivation in which ψ_1 and χ_1 given above are always strings of terminal symbols, i.e., $\phi_i = yxA\chi\psi$, $\phi_{i+1} = yx\omega\chi\psi$, and $xA\chi \rightarrow x\omega\chi$ is a rule of the grammar.

(b) A right-to-left (R-L) ϕ-derivation is a ϕ-derivation in which χ_2 and ψ_2 given above are always strings of terminal symbols, i.e., $\phi_i = \psi\chi Axy$, $\phi_{i+1} = \psi\chi\omega xy$, and $\chi Ax \rightarrow \chi\omega x$ is a rule.

DEFINITION 2: (a) An L-R grammar is one whose rule applications are restricted

so that all of its derivations are L-R derivations.

(b) An R-L grammar is one whose rule applications are restricted so that all of its derivations are R-L derivations.

(c) A one-way grammar is either an L-R grammar or an R-L grammar.

DEFINITION 3: (a) A right discontinuous (RD) rule is one of the form $\chi_1 A \chi_2 \rightarrow \chi_1 \underline{a}_1^{n_1} \underline{a}_2^{n_2} \cdots \underline{a}_{m-1}^{n_m} a_m \chi_2$, where $m \geq 1$ and $n_i \geq 0$ $(1 \leq i \leq m)$. A rule of this type rewrites a string of the form $\psi_1 \chi_1 A \omega \chi_2$ as $\psi_1 \chi_1 \omega_1 a_1 \omega_2 a_2 \cdots a_{m-1} \omega_m a_m \psi_2$, where $\omega_i^{(n_i)}$ $(1 \leq i \leq m)$, and for some τ, $\omega \psi_2 = \omega_1 \omega_2 \cdots \omega_m \psi_2 = \chi_2 \tau$.

(b) A left discontinuous (LD) rule is one of the form $\chi_1 A \chi_2 \rightarrow \chi_1 a_m^{n_m} a_{m-1}^{n_{m-1}} \cdots \underline{a}_2^{n_2} \underline{a}_1^{n_1} \chi_2$, where $m \geq 1$ and $n_i \geq 0$ $(1 \leq i \leq m)$. An LD rule rewrites a string of the form $\psi_1 \omega A \chi_2 \psi_2$ as $\psi_1 a_m \omega_m a_{m-1} \omega_{m-1} \cdots \omega_2 a_2 \omega_1 \chi_2 \psi_2$, where $\omega_i^{(n_i)}$ $(1 \leq i \leq m)$, and for some τ, $\psi_1 \omega = \psi_1 \omega_m \omega_{m-1} \cdots \omega_1 = \tau \chi_1$.

Note that the rules defined by Chomsky[1] are special cases, both of RD rules and of LD rules, i.e., those in which $n_i = 0$ $(1 \leq i \leq m)$.

DEFINITION 4: (a) An RD grammar is a phrase structure grammar that contains just RD rules.

(b) An LD grammar is one that contains just LD rules.

(c) A discontinuous grammar is either an RD grammar or an LD grammar.

DEFINITION 5: A discontinuous one-way grammar is either an L-R RD grammar or an R-L LD grammar.

The following theorems and corollaries have been proved.

THEOREM 1: For each discontinuous one-way grammar there is an equivalent CF grammar.

Proof is by reduction to a push-down storage automaton (PDS).[2]

COROLLARY 1: For each CF grammar – and thus for each PDS – there is an equivalent nondeterministic PDS containing just three types of instructions in addition to a single initial and a single final instruction. For each terminal symbol $\underline{a}$ of the grammar the PDS has the instruction $(a, S_1, a) \rightarrow (S_1, \sigma)$; for each nonterminal symbol A the PDS has the instruction $(e, S_1, A) \rightarrow (S^A, \sigma)$, and for each rule of the grammar $A \rightarrow \omega$ the PDS has the instruction $(e, S^A, e) \rightarrow (S_1, \omega)$. The initial and final instructions are $(e, S_0, \sigma) \rightarrow (S_1, S)$ and $(e, S_1, \sigma) \rightarrow (S_0, \sigma)$, respectively.

COROLLARY 2: Given any discontinuous one-way grammar, there is an algorithm for constructing an equivalent CF grammar.

THEOREM 2: For each discontinuous grammar there is an equivalent CS grammar.

G. H. Matthews

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2. N. Chomsky, Formal properties of grammars, Handbook of Mathematical Psychology, Vol. 2, edited by R. R. Bush, E. H. Galanter, and R. D. Luce (John Wiley and Sons, Inc., New York, in press).

E. CHILDREN'S GRAMMAR

In describing children's grammar there are three objectives that seem most important. The first of these is to be able to examine language at particular times in its development as a self-contained system. The second is to be able to describe the changing processes of this system as the child matures. The third and most important is to gain some insight into the basic capacities of the child to understand and produce language.

Most studies of children's grammar have measured the percentage and proporation of what has been termed 'adult usage' in the child's language.[1] Such aspects as completeness of sentence structure and sentence length were the focus of these studies. I felt that such an approach would not contribute to reaching the objectives stated above. For these reasons, in this research program a transformational model of grammar was used to describe a children's grammar.[2] This technique allows us to describe the rules or categories from which the child may generate the sentences in his language. This grammar is analogous to a categorization theory of learning. The rules formulated for generating possible sentences in a language are the categories of grammatical structure in the language (the negative sentence, the imperative sentence, etc.). It is hypothesized that the attributes of a given category are memorized and the child can then produce new instances of the category.

1. Method

The language of 159 children ranging in age from 2 years, 10 months to 7 years, 1 month was elicited and recorded in various stimulous situations: (a) responses to a projective test, (b) conversation with an adult, and (c) conversation with peers. The last two situations took place both in controlled and in free (classroom) environments. The language sample produced by each child was analyzed by using the transformational model. A grammar was written which contained rules to produce all of the sentences in the total language sample.[3]

2. Results

It was found that all of the basic structures that generated all of the sentences obtained could be described within the framework of the transformational grammar.

Almost all of the structures used by adults to generate their sentences were found in the grammar of the youngest children (youngest 4-month age range). Structures that are nonconsistent with adult use of rules occurred infrequently. These were termed structures restricted to a children's grammar. There were few significant differences in the usage of all structures by males and females or by children whose I.Q. is above or below the mean I.Q. of the sample population.

It was also found that most of the structures were used at an early age and used consistently. Most of the structures that were still in the process of being acquired by the youngest group were also still in the process of being acquired by the oldest group (first-grade children).[4] There was a steady increase in the percentage of children using the various structures as they matured.

A subsample of the population was presented with sentence examples of the various syntactic structures taken from their own language sample and asked to repeat these sentences after the experimenter.

These examples consisted of a set of sentences exemplifying transformations found in both children's and adults' grammar and a set of sentences exemplifying structures restricted to a children's grammar. This study was undertaken to determine the differences, if any, between the production of language and innate capacity. It was found that success in repetition was not correlated with sentence length at all but, rather, with the specific structure of the sentence. Also, it was found that although these children produced the restricted structures in their spontaneous language, they corrected these forms when asked to repeat. Significantly more of the youngest children corrected these structures.

3. Additional Data

One developmental trend observed in this analysis of children's grammar was the use of alternate rules by the same child. That is, the children generate their sentence from rules that conform with adult use of rules, and, simultaneously, from rules that are restricted to a children's grammar. For example, some children under 3 years of age use the rule:

> pronoun + singular + first person in the context subject or object becomes me.
> ("Me have this one.")

Simultaneously, they use the rule:

> pronoun + singular + first person in the context subject becomes I.
> ("I like that.")

It was found that the use of alternate rules, on the whole, gradually declines from the beginning age range of the sample population to its end. However, the specific rules

that are alternated change through this age period as the children mature. For example, contraction deletion ("I going to the movies.") accounts for a significant number of the restricted forms at the youngest age level but not at the oldest. On the other hand, tense restriction in conjunction ("They get mad and then they pushed him.") accounts for a significant number of the restricted forms at the oldest age level but not at the youngest. These data may give us further insight into the notions of simplicity or complexity of children's grammar and the concepts of differentiation and integration in language learning.

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F. THEORETICAL IMPLICATIONS OF BLOOMFIELD'S "MENOMINI MORPHOPHONEMICS"

At least two publications written during the final decade of Leonard Bloomfield's career contain extensive use of ordered descriptive rules: "Menomini Morphophonemics"[1] and the first four chapters of "Eastern Ojibwa."[2]

"Menomini Morphophonemics" (MM) is a well-known example of experimentation with synchronic morphophonemic rules. Bloomfield emphasizes that the rules occur in a purely descriptive order, but the form of the rules and their application demonstrate a limited notion of the concept "rule," and unavoidably reflect his comprehensive understanding of historical Algonquian.[3]

1. The Form of the Rules and the Order

The morphemes are written in morphophonemes and constitute the "basic forms" of the language, the input to the morphophonemic system. These basic forms are combined and then transformed to phonemes by the morphophonemic rules.

The rules are of the form:

(1) $A \rightarrow B$ in the environment C

and are generally classed according to the environment C, not according to the process

A → B or to the units that interact in that process, A, B. In other words, rule (1) can be combined only with a rule

(2) P → Q in the environment C

Thus a numbered rule consists of many processes or subrules that all occur in the same environment:

(3) Rule N:

a) A → B
b) P → Q
. . .
. . .
. . .
n) X → Y

in environment C

It can be shown that the subrules of N, (a...n) often must apply simultaneously, i.e., if applied in any order, the output is incorrect. In the only case in which different processes must be ordered, even though they occur in the same environment, they are written as two separate numbered rules.

The general conclusion drawn from these characteristics of the rules is that Bloomfield was working with a series of ordered environments. For instance, the same process is written in two separate rules only because the rules have different environments. Rules (4) and (5) are presented as disjoint because the environments are disjoint, although it is just that characteristic that should allow them to be combined:

(4) R → S in env. X

(5) R → S in env. Y

A rule of the form (4+5) was not an alternative for Bloomfield.

(4+5) R → S in env. $\left\{\begin{matrix} X \\ Y \end{matrix}\right\}$

The constraint that does not allow rules of the type (4+5) limits the power of any simplicity criterion. Since rules are combined by common environments only, the goal of descriptive simplicity in MM would have the effect of minimizing the number of environmental statements, but the number and ordering of the processes within the ordered environments would be immaterial to the grammar. The resulting system is redundant because environments often cannot be ordered when the processes occurring within those environments might be ordered to great advantage.

In spite of these limitations, Bloomfield presented ordering depths of at least five rules, apparently operating with the goal of minimizing the total of numbered rules, that is, the number of environments. Efforts to reduce this number by reordering the MM rules have very little effect.

2. Simplification of the MM System

The Menomini morphophonemic system as presented in MM can be significantly simplified if different environments with processes in common may be combined. For example, if rules of the type (4+5), as well as of the type (3), are allowed, the original MM vowel assimilation subsystem can be reduced from 33 process statements to 24 without the invention of any new statements. Reordering and combinations make the existing system redundant so that 9 statements may be deleted, and no new ones need be added. If new rules of the same type are devised (still by using phonemic notation) the assimilation system can be further reduced to 13 statements.

The general application of these synchronic methods to the entire MM morphophonemic system halves the number of process statements, decreases the number of morphophonemes from 26 to 18, and leaves the total number of different environment statements unchanged. These simplifications of the MM system are based entirely on considerations that are internal to the synchronic description of the Menomini language.

Certain problems with general implications for the construction of morphophonemic systems are raised by Menomini. A general high-vowel assimilation system is described:

(6)

I		II	
y + $\bar{e}$	→ $\bar{e}$	y + e	→ i
w + $\bar{e}$	→ $\bar{o}$	w + e	→ i
y + æ	→ e	y + $\bar{æ}$	→ $\bar{i}$
w + æ	→ o	w + $\bar{æ}$	→ $\bar{i}$

all in environment C ———

Here, column I shows progressive assimilation with respect to gravity, column II progressive assimilation with respect to diffuseness. These facts would be easily describable were it not for the fact that the affected vowels in column I are /æ, $\bar{e}$/ and in column II /$\bar{æ}$, e/. Short /æ/ acts with long /$\bar{e}$/ and long /$\bar{æ}$/ with short /e/. This grouping can be described in features (the Menomini vowel system is a quadrangle):

(7) $\begin{bmatrix} \alpha\text{long} \\ \beta\text{compact} \\ -\text{grave} \end{bmatrix}$

column I: $\alpha = \sim \beta$
column II: $\alpha = \beta$

But there is no way to differentially describe the processes in columns I and II, except by writing two separate rules, one for the case $\alpha = \sim \beta$ and the other for the case $\alpha = \beta$. At best, this would introduce a new technique into the system. If /e/ and /æ/ are first exchanged in this environment, the system would become

(8)

I'		II'	
y + $\bar{e}$	→ $\bar{e}$	y + $\bar{æ}$	→ $\bar{i}$
w + $\bar{e}$	→ $\bar{o}$	w + $\bar{æ}$	→ $\bar{i}$
y + e	→ e	y + æ	→ i
w + o	→ o	w + æ	→ i

The descriptive rules would be

$$(9)\quad \left.\begin{array}{lll} \text{I'} & [-\text{ compact}] & \rightarrow\ [\alpha\ \text{grave}] \\ \text{II'} & [+\text{ compact}] & \rightarrow\ [+\text{ diffuse}] \end{array}\right\} \quad \text{in env.} \quad \begin{bmatrix} -\text{voc} \\ -\text{cons} \\ \alpha\text{grave} \end{bmatrix} \quad [-\overline{\text{grave}}]$$

(a later general rule deletes the semivowels).

To exchange /e/ and /æ/ in phonemic notation would be extremely cumbersome, although possible if it were required that all subrules of a numbered rule apply simultaneously. Since Bloomfield's system must have that requirement, he could have written a rule:

$$(10)\quad \begin{array}{lll} \text{a) e} & \rightarrow & \text{æ} \\ \text{b) æ} & \rightarrow & \text{e} \end{array} \quad \text{in env.} \quad C\begin{Bmatrix} y \\ w \end{Bmatrix}$$

As long as (10a) and (10b) apply simultaneously, there will be an exchange between /e/ and /æ/. But if the rules are ordered, then both /e/ and /æ/ will end up either as /e/ (order: a, b) or as /æ/ (order: b, a). A third element B that is discrete from all of the elements at this point in the system must be introduced.

$$(11)\quad \begin{array}{lll} \text{a) e} & \rightarrow & \text{B} \\ \text{b) æ} & \rightarrow & \text{e} \\ \text{c) B} & \rightarrow & \text{æ} \end{array} \quad \text{in env.} \quad C\begin{Bmatrix} y \\ w \end{Bmatrix}$$

In distinctive features (10a) and (10b) would be

$$(12)\quad \begin{array}{lll} \text{a)} & [-\text{ compact}] & \rightarrow\ [+\text{ compact}] \\ \text{b)} & [+\text{ compact}] & \rightarrow\ [-\text{ compact}] \end{array} \quad \text{in env.} \quad [+\text{cons}] \begin{bmatrix} -\text{voc} \\ -\text{cons} \end{bmatrix} \begin{bmatrix} +\overline{\text{voc}} \\ -\text{grave} \end{bmatrix}$$

This would produce the same problem as (10), but, by using the variable β, rules (12a) and (12b) may be combined so that effectively they occur simultaneously.

$$(13)\quad [\beta\ \text{compact}] \rightarrow [\sim\beta\ \text{compact}] \quad \text{in env. (12)}$$

This has made use of the existing convention that $\sim + = -$ and $\sim - = +$, also used for some cases of assimilation.[4]

For correct syllable syncope in the lengthening of vowels and for correct vowel raising, in certain positions glottal stop must be interpreted as V?V. After the vowel length and height rules are applied, the introduced vowels surrounding the glottal stop are deleted. Thus there are two rules

$$(14)\quad \begin{array}{lll} \text{m)} & ? & \rightarrow\ \text{V?V} \\ \text{n)} & \text{V?V} & \rightarrow\ ? \end{array}$$

which dramatically simplify the length and height systems intervening between (14m) and

(14n). Unless a more thorough examination of Menomini shows this to be unnecessary, it will remain an example of the addition and exact deletion of segments within the morphophonemic grammar.

3. Evaluation of the Simplifications

Is it possible to motivate the simplifications discussed above other than by the criterion of orthographic efficiency? The simplifications are in accord with the principle of descriptive simplicity but this is, at best, only an indication of the efficacy of the simplifications. It is important to show that the new simplified system satisfies criteria other than that of simplicity itself.

Although no criterion is formally proposed, there are certain comments by Bloomfield which imply (perhaps unintentionally) an indicator of the accuracy and usefulness of any descriptive system of ordered rules. This indicator is the similarity of the morphophonemes and early rules of the synchronic description of a language to the corresponding forms in the reconstructed proto-language.[5]

Bloomfield divides the morphophonemic system into two parts, (a) the morphophonemes and the first 18 rules, and (b) the last 17 rules. He points out that the rules of the latter subsystem "approximate the historical development from Proto-Algonquian to present-day Menomini." Expanded as a general statement, this suggests that the mechanism of diachronic linguistic change is simply the orderly addition of new rules to the grammar. Bloomfield confirms this implication by noting that the early subsystem of MM resembles the early subsystem of the ancestor language, reconstructed Proto-Algonquian. The rules added to describe diachronic change must be affixed to the end of the grammar, and the morphophonemes and the rules at the beginning of the morphophonemic system should remain unaffected over long periods of time. Thus the correct description of a language, based only on synchronic data, according to this view, should incidentally display morphophonemes and early rules identical with those of the parent language.

4. Comparison of MM and the Simplified System with Proto-Algonquian

The morphophonemes and early rules presented in MM "bear some resemblance" to the corresponding systems of Proto-Algonquian, and indicate that this early subsystem has remained fairly constant. If the synchronic simplifications of MM are correct improvements, then the early subsystem of the simplified description should show an improved resemblance to the corresponding Proto-Algonquian forms and rules. Consider the following comparisons of the forms and rules of Proto-Algonquian and the Menomini system, as presented in MM and also as simplified by synchronic descriptive techniques.

The short vowel and semivowel system of Proto-Algonquian analyzed by Bloomfield from four Algonquian languages has four vowels:

(15) i o
e a

This system in MM is much more complicated:

(16) e o, u w, y
ə æ a

A measure of the complication is that the transformation of (15) to (16) would require extremely intricate correspondence rules. But the simplifications of (16) based only on synchronic considerations reduce it to a new four-vowel system:

(17) e o
æ a

This system is essentially the same as the Proto-Algonquian system. System (16) can be transformed to system (17) by the addition of one simple rule:

(18) $\begin{bmatrix} -\text{ grave} \\ \alpha\text{ diffuse} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{ diffuse} \\ \sim \alpha\text{ compact} \end{bmatrix}$

which demonstrates that the morphophonemes of the improved system are much more similar to the Proto-Algonquian forms than are those presented in MM.

Now observe the correspondences among some early rules. Proto-Algonquian has the rule:

(19) a) t → ć
b) θ → ś in environment __ i

The reflex of this rule in MM is

(20) a) t → ć
b) n → ś in environment __ $\begin{Bmatrix} e \\ \bar{e} \\ y \end{Bmatrix}$

where (19a) and (20a) correspond, but (19b) and (20b) and the environment are dissimilar. A correspondence rule would have to change /θ/ to /n/ and /i/ to /e, ē, y/. In the simplified Menomini system the rule is interpreted as

(21) a) t → ć
b) θ → ś in environment __ e

If rule (18) is applied to the Proto-Algonquian system (19), it becomes identical with (21).

The morphophonemes and early rules of the simplified synchronic description of MM resemble the corresponding forms of Proto-Algonquian more closely than do those of the unsimplified system in MM. Thus the application of the synchronic methods

resulted in a description of Menomini which is implied but not fully realized by Bloomfield.

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