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Rules, rote, and analogy in morphological formations by Hungarian children*

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ABSTRACT

This study examines the relative contributions of rote-memorization, analogic formation and rule-operation in the production of plurals by Hungarian children. In order to maximize analogic formations, each of fifteen actual roots was matched to a rhyming nonsense root. The elicited plural responses were characterized in terms of five stages of morphological learning. The importance of rule-operation as an explanation of word formation was evidenced by the fact that children producing responses characteristic of a given stage did not produce responses for later stages. The contribution of analogic formation was seen to be minimal and the effect of rote-memorization only somewhat greater.

INTRODUCTION

Experiments conducted by Berko (1958), Anisfeld & Tucker (1967), Ervin (1964) and Bryant & Anisfeld (1969) have demonstrated that English-speaking children are capable of attaching inflections to unfamiliar roots provided by the investigator. Similar results have been reported by Bogoyavlenskiy (1957) for Russian and by Kernan & Blount (1966) for Spanish. These studies have generally been interpreted as providing evidence for the productivity of the morphological rules being investigated. The possibility that such formations are produced by analogy, rather than rules, has not yet been systematically excluded; nor has the role of rote-memorization in the formation of familiar plurals been carefully assessed. The major goal of the present study is the investigation of relative contributions of ROTE-MEMORIZATION, ANALOGY and RULE-OPERATION as strategies of morphological formation. A subsidiary goal is the determination of the sequence of rule acquisitions that would provide an account of developmental patterns in the data. The discussion that follows attempts to characterize each

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of the three major strategies in an internally consistent and theoretically meaningful way. Nonetheless, it must be admitted that the sharp distinctions drawn here may appear muted in any given set of behavioral data.

Rote-memorization

As a strategy in word formation, rote-memorization requires that the model for the child's production be present in the speech heard by the child. This necessarily precludes rote-memorization as an explanation of the inflection of unfamiliar bases (roots), if those unfamiliar bases are only heard without inflection. Thus, if the child hears the singular *wug* and memorizes it, this rote-memorization alone will not suffice to produce a plural form such as *wugs*. If rote-memorization is used to acquire an inflected form, the sound segments of the inflection should be produced as accurately as if they were components of a unitary root. Thus, the use of an incorrect allomorph of either root or suffix provides evidence against the operation of rote-memorization.

Analogy

A confusion between analogy and rule-operation as strategies in word formation can be observed even in the works of Bloomfield (1933: 275-7, 404-424) and de Saussure (1966: 61). De Saussure, for example, speaks of an analogic form as 'a form made on the model of one or more forms in accordance with a definite rule'. For example, the plural of Berko's nonsense stimulus *wug* could be formed on analogy with the plural of the actual item *rug*. Thus, the analogy would be: *wug:wugs — rug:rugs*. However, in the formulations of de Saussure and others, the pattern *rug:rugs* is not the basis of the analogy; it is merely a shorthand for the effects of the general rule of progressive assimilation of voice in English consonant clusters. Esper (1973) may be consulted for a review of the historical development of the concept of analogy in linguistics and psychology.

Within the tradition of child language research, workers such as Guillaume (1927) and Ervin (1964) have used the term ANALOGY to refer to a comparison between two items. It is their usage that will be adopted here. It is important to recognize that there is, at least in principle, a fundamental difference between the comparison of two items (analogy) and the comparison of an item to one or more items in terms of a definite rule (rule-operation). To state that *wugs* is based upon analogy with *rugs* is to state that the speaker analyses the semantic and phonological differences between *rug* and *rugs* and produces the form *wugs* which differs from *wug* in the same ways that *rugs* differs from *rug*. On the one hand, the association *rug-rugs* may be deemed to mediate the response *wugs*. On the other hand, analogy may be viewed as a process of stimulus generalization in which there is a stimulus equivalence between *rug* and *wug*. A defect inherent to analogy as an explanation of word formations is that it fails to specify the stimulus continuum along which this generalization may take place (cf. Neisser 1967: 66).

For example, analogy might be limited to rhyming words, or it might be applicable only to words that differ in only one or two distinctive features on only one segment. If no conditions are placed upon the stimulus continuum relevant to analogy, the child could form the plural *wugen* on analogy with *oxen*. In fact, no such form has ever been reported.

Rule operation

A third strategy in word formation is that of rule-operation. Unlike analogies, rules exhaustively specify the conditions under which changes or selections will be made. Morphological rules of the generative-transformational variety effect changes in the shape of lexical encodings on the basis of information in the morphological context. The present discussion is confined to rules of this type. Although rule-operation is more specific than analogy in its account of morphological formations, it is also more complex. The rule-based account offered below is no exception to this. On the other hand, the account which follows attempts to improve upon previous research by interpreting rule acquisition in terms of psychologically meaningful processes. This model of morphological learning is based upon processes involved in the storage and comparison of input forms. The model predicts a five-stage developmental sequence in the learning of morphophonemic patterns. Those aspects of morphological learning that are interwoven with semantic learning undergo a somewhat different development.

Stage I. Observers of child language have frequently noted that inflections appear with certain bases before they are generally and productively attached to all possible bases. The basic acquisitional process or strategy applied in forming these amalgams is none other than that of rote-memorization in which one sound unit is associated with one meaning unit.[1] Thus, the English-speaking child associates the sound unit *ships* with the meaning unit 'a collection of several objects of a given form'. Both representations may be encoded with features. This sound-meaning association is also a form-function relation in which the sound is the form and the meaning the function. This process requires that one form be associated to one function.[2] Explanation of morphological formations as rote-memorizations requires no learning beyond Stage I. Explanations of morphological formations based on analogy or rule-operation require not only Stage I associations, but also further processes. In the data on the acquisition of the Hungarian plural inflections which are to be discussed below, Stage I

[1] Although the ramifications of the proposed process-model are here discussed only in relation to morphological learning, the same model, with certain amplifications, is relevant to understanding of syntactic and semantic learning.

[2] MacWhinney (1974: 345-55) cites reports from the Hungarian data indicating that the semantics of inflections in early amalgams are often incompletely controlled. There appears to be a development during Stage I of the semantic control of inflections appearing within amalgams.

behavior involves generation of correct adult plurals for any one of the conventional nouns and no plurals for the nonsense nouns.

Stampe (1969) and Braine (1974) have suggested that the shapes of early child words may be determined by primitive tendencies toward phonetic simplification. If progressive assimilation of voice in English consonant clusters is in accord with such 'primitive tendencies', choice between the allomorphs /s/ and /z/ of the English plural in forms such as *cats* and *dogs* may be a natural result of articulatory tendencies already present at Stage I.

Stage II. Whereas the only major acquisitional process operative at Stage I was that associating one form to one function, the processes of analysis and superimposition assume importance at Stage II. The process of analysis is involved in analogical formation. In order to form *wugs* on analogy with *rugs,* the speaker must be able to analyze the lexical amalgam *rugs.* Such analysis is achieved through a comparative process that is here termed SUPERIMPOSITION. Superimposition compares lexical items on both phonological and semantic levels to determine the areas of optimal fit and residual differences. When *rugs* is compared to *rug,* it is found that the phonological difference consists of the segment /z/, while the semantic difference involves plurality. In the case of analogical formation, this residual is attached to *wug* to form *wugs.* However, in Stage II plural formation, the child is predicted to use the process of superimposition once more during the comparison of several plural allomorphs. Thus, the plural amalgams *dogs, ships* and *horses* are each compared with their bases. On the basis of this comparison, the amalgams are analyzed into their bases *(dog, ship* and *horse)* and their plural allomorphs (/s/, /z/ and /iz/). The three plural allomorphs are then subjected to superimposition and the area of optimal overlap is selected as the plural. Superimposition of the three English allomorphs results in a plural with all the features common to /s/ and /z/ but with voicing determined by the ' primitive tendency' to assimilate voice in consonant clusters. The /i/ of the /iz/ allomorph is not present in this lowest common denominator plural extracted at Stage II. Use of this Stage II plural should result in correct plurals for items such as *cat* and *dog,* but incorrect plurals for *box* and *foot.*

In Hungarian the plural allomorphs serving as the input to suffix superimposition are *-k, -ök, -ek, -ok* and *-ak.* The common denominator extracted by superimposition is simple /k/. For roots such as *hajó '* ship', which add *-k* to form the plural, the use of the /k/ without a preceding vowel causes no error. However, simple attachment of *-k* to *pipa, pingvin* and *ló* results in the forms *pipak, pingvink* and *lok,* rather than the correct *pipák, pingvinek* and *lovak.* A particularly clear example of Stage II learning is the Spanish plural which is realized by the allomorphs /s/ and /es/. Use of the lowest common denominator here results in extraction of /s/ as the plural suffix. Thus, the Stage II child would form *tios* as the plural of *tio,* but *papels* as the plural of *papel,* rather than the correct form *papeles.* (See Kernan & Blount 1966.)

Stage III. Learning at Stage III goes beyond that required for analogy and establishes morphological rules. The rules isolated at this stage are free rules applying to a particular concatenation of segments across the morphological boundary (#) without any further considerations. If progressive assimilation of voicing is achieved through a 'primitive tendency' in early English plurals, then English inflectional morphology contains no good illustration of a rule requiring Stage III learning. Hungarian, however, makes use of one rule of this type in plural formation. This rule may be formulated as the rule of FINAL VOWEL LENGTHENING:

$$\begin{bmatrix} -\text{long} \\ -\text{tense} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{long} \\ +\text{tense} \end{bmatrix} / \begin{bmatrix} \text{———} \\ +\text{low} \end{bmatrix} \# \; [+\text{consonant}]$$

This rule lengthens and tenses a short vowel before a suffix beginning with a consonant. Thus, *pipa* 'pipe' + -k 'plural' becomes *pipák* 'pipes'. Note that this lengthening and tensing also occurs before suffixes like *-ban, -ben* that are never preceded by linking vowels. The processes operative at this stage are those of the previous stage together with the process of rule-formation. First, analysis and superimposition proceed as in Stage II to isolate *pipá* and *-k* as the two morphemes forming *pipák.* As in Stage II, a second pass of superimposition compares *pipá* with the nominative base *pipa.* The lack of proper fit in length of the final segment is noted and, instead of settling for use of the lowest common denominator, the child searches his lexicon for similar base pairs. Finding pairs like *liba-libák '* goose-geese', *labda-labdák '* ball—balls', and front low vowel pairs like *csésze-csészék '*cup-cups', the child establishes the free rule of final vowel lengthening. Establishment of this rule requires a third round of superimposition that isolates the context of the transformation by comparing a number of input amalgams all illustrating a similar alteration. Although the rules of INTERNAL VOWEL DELETION and VOWEL SHORTENING are not free rules, and although they are only acquired in their bound form at Stage V, some children attempt to use over-generalized versions of these rules at Stage III.

Stage IV. The additional acquisitional process operative at Stage IV is unification, which is an extension of the basic strategy of associating one form to one function. Beginning with the level of plural analysis that characterized Stage II, the child goes beyond the selection of the lowest common denominator of an inflection and attempts to compress all the allomorphic variants into a single lexical item. Such a compressed lexical item will contain one or two archi-segments of the type discussed by Anisfeld & Gordon (1968). Superimposition of the three English plural allomorphs yields a lexical item with two segments. The first segment is /i/ with the additional feature [±delete]. This ambiguous feature encodes the fact that the /i/ is not always present in the input allomorphs. The plus sign in any given ambiguous feature symbol encodes the fact that, under certain circumstances, rules may function to assign a positive value to the feature.

Similarly, the minus sign in the ambiguous feature represents the fact that, when these circumstances do not prevail, the feature will be realized by a negative value. The second segment has all the common features of /s/ and /z/ with the feature [± voice]. In order to disambiguate the features [± delete] and [± voice], the child must establish two phonological rules each contingent upon or bound to the occurrence of one of these ambiguous features. The rule for the first segment may be written as:

$$[\pm \text{delete}] \rightarrow [+\text{delete}]/[-\text{sibilant}]\ \#\ \text{——}.$$

As at Stage III, rule-formation requires a third round of superimposition for the isolation of the context of the rule. The rule disambiguating the feature [+ voice] is formed in a similar way. Note that the isolation of this rule established progressive assimilation of voice as a phonological rule, rather than a ' primitive tendency'. Once the two bound-rules are established, the child is ready to unify the plural allomorphs into a single lexical item. Unification can only occur when rule-formation is complete; otherwise, free variation of allomorphs would result.

Unification of the Hungarian plural at Stage IV requires the formation of three ambiguous features and three rules to disambiguate these features. The first segment of the Hungarian plural is a vowel with the features [± delete], [± back] and [± round]. Disambiguation of the feature [± delete] is achieved by the rule of SUFFIX-INITIAL VOWEL DELETION:

$$[\pm \text{delete}] \rightarrow [+\text{delete}]/[-\text{consonant}]\ \#\ \text{——}.$$

FRONTING HARMONY resolves the ambiguous feature for backness to agree with the backness of the last vowel of the base. ROUNDING HARMONY resolves the ambiguous feature for rounding to agree with the roundness of the last vowel of the root, but always makes it round if the root is back. Examples of the action of these rules are: *virág* + *-Vk* 'plural' = *virágok* 'flowers', *bör* 'leather' + *-Vk* = *börök* 'leathers', *hely* 'place' + *-Vk* = helyek 'places', and *ház* 'house' + *-Vk* = *házak* ' houses'.

In order to eliminate free variation between the allomorphs *-ak* and *-ok,* the child must learn to code /a/ as a part of the preceding root. However, this leads to the creation of two allomorphs for the noun root. In the case of the item with the meaning ' fish', the nominative base *hal* and the secondary base *hala* differ in only one segment and are therefore susceptible to unification. The resulting lexical item *hal(a)* has a final archisegment with the feature [± delete]. This feature is resolved by the rule of BASE-FINAL VOWEL INSERTION that inserts the vowel before a suffix beginning with a deletable vowel. Correct use of base allomorphs such as *hal* and *hala,* as well as correct use of *-k, -ok, -ek* and *-ök,* is predicted to occur at Stage IV.

Stage V. Learning at Stage V differs from learning at Stage IV only in terms of its

complexity. At Stage V the child is predicted to unify encodings for allomorphs requiring new rules for more than one segment. English inflectional morphology presents no examples of this type, since the rule of progressive assimilation of voicing is present as a 'primitive tendency', even before it is established as a phonological rule.

Hungarian, on the other hand, possesses a large number of bases with allomorphs differing in two or three segments, e.g. *majom-majm ′* monkey', *ló-lova* 'horse', *daru-darva* 'crane', and *kosár-kosara* 'basket'. Unification of these allomorphs requires not only coordination with the existing rule of base-final vowel insertion, but also with new rules for VOWEL-SHORTENING, INTERNAL VOWEL DELETION and V-INSERTION. A further factor retarding the development of Stage IV learning to Stage V is the small number of nouns involved in such patterns as INTERNAL VOWEL DELETION. Without the availability of sufficient input forms, superimposition may not move to completion.

METHOD

Subjects

The 25 children participating in the experiment were enrolled in a state nursery school in Budapest. The 15 older subjects, ranging in age from 2;8 to 3;8, constituted the older playgroup at the nursery. Three children from the younger playgroup with ages 2;1, 2;5, and 2;8 proved capable of producing plural responses in the experimental situation. Seven other children in this younger group showed no evidence of ability to provide plurals upon request. None of the children suffered from any major physical, emotional or cognitive disability. Children came from families of all socio-economic levels, but all spoke only Hungarian at home. Fifteen adult Hungarians were also tested.

Stimuli

Fifteen common Hungarian nouns were each paired to a rhyming nonsense word which differed from the original only in terms of one or two distinctive features on one segment, i.e. *tehén* 'cow' and *pehén* 'nonsense'. The 30 stimulus words were each represented by an object ranging from 2 to 4 inches in height. For example, *tehén ′*cow' was represented by a small ceramic cow, and *pehén* (nonce) was represented by a small yellow plastic object resembling some creature from outer space. The stimuli and the nature of their representations can be found in Table I. Initial validation of the stimuli conducted with six children of the age group under investigation indicated that all the actual words were within the vocabulary limits of this group. Although children attempted to provide names for the unfamiliar objects, there was no agreement regarding the names assigned. Therefore, the stimuli to which nonsense words were associated were assumed to be unfamiliar.

Procedure

After a warm-up period using stimuli not involved in the testing, a test object was presented to the child. A native-speaker in the nursery told the child the name assigned to the object, and the child was then allowed to play with the object for some seconds. If, for example, the object was a mirror, the child was then given another mirror of identical form and told that this was another mirror. After again allowing for some object manipulation, the teacher asked the child to

TABLE I. *Stimulus items and their meaning or representation*

Conventional word	Meaning	Nonsense word	Representation
(1) hajó	boat	(2) fajó	space-man
(3) pipa	pipe	(4) piga	totem pole
(5) csésze	teacup	(6) szésze	rattle
(7) virág	flower	(8) firág	furry creature
(9) könyv	book	(10) önyv	buckle
(11) bőr	leather	(12) vör	skeleton
(13) pingvin	penguin	(14) gvin	plastic arrow
(15) hal	fish	(16) gal	spider/octopus
(17) kenyér	bread	(18) kepér	ear-plug
(19) kosár	basket	(20) mosár	conical shape
(21) tehén	cow	(22) pehén	yellow creature
(23) tükör	mirror	(24) fükör	concentric circles
(25) majom	monkey	(26) kajom	space-man/spaceship
(27) daru	crane	(28) taru	rocket/shuttlecock
(29) ló	horse	(30) gó	bow (archery)

give back both objects. The objects were held up in front of the child and the teacher asked, *What are these?* The child's response was recorded by means of a transmitting microphone placed in a pocket of his school uniform. Although the order of presentation of actual items was randomly varied from subject to subject, the rhyming nonsense item followed its actual pair. A plural response was judged to be either the use of a final /k/ or the addition of some vowel to the root. When no plural response was evoked, the testing moved on to the next item. By returning to earlier items not evoking responses, the child was given up to three chances to respond to a given stimulus. Testing of the three youngest subjects required the use of games and large quantities of dialogue over the course of hours. Although the youngest male subject provided answers on nearly every item, the protocols from the two youngest females remained incomplete even after repeated testing.

Testing was also conducted with 15 adult Hungarians to determine their preferences for plurals of the nonsense items. There was unanimous agreement on these plurals: *fajók, pigák, taruk, galok, szeszék, firágok, önyvek, vörök* and *gvinek.* These are the plurals that would be formed by application of free rules. Agreement was nearly unanimous on the plurals *gók* (66 %), *kajomok* (94 %) and

mosárok (80%). Only for *keperek* (73 %), *pehenek* (73 %) *and fükrök* (53 %) was the majority in favor of application of vowel shortening or vowel deletion as free Stage III rules.

RESULTS AND DISCUSSION

Table 2, which summarizes the types and percentage of responses elicited from the children, allows us to evaluate the contributions of rote, analogy and rules.

The contribution of rote-memorization

It was noted above that rote-memorization cannot account for the plurals of unfamiliar words or incorrectly formed plurals of familiar words. Although the children produce a large number of correct plurals, the percentage of correct plural responses decreases markedly with higher stages of rule acquisition. For the Stage II conventional item ((1) in Table 2), 100 % of the children provide the adult plural. For the Stage III items (3) and (5), 78 % of the children provide the adult plural. For the Stage IV items (7), (9), (n11), (13) and (15), 75 % of the children provide the adult plurals. For the Stage V items (17), (19), (21), (23), (25) and (29), only 13% of the children provide the adult plurals. Assigning a value of 1 to a correct plural response, an average score was obtained for stimuli at each of the four stages. Comparing these scores across subjects and stages with the Cochran Q test, a significant difference (x^2 = 16.29, d.f. = 3, $P < 0.001$) between items from the different stages was observed.

If rote-memorization operates in producing a Stage II plural like *hajók,* it should also be operative in producing a Stage V plural like *darvak.* The only factors limiting a child's ability to rote-memorize a plural should be phonetic and semantic complexity and the frequency of occurrence of the plural in the speech heard by the child. Morphological complexity should not be a factor. In fact, rote memorization should be even more important in producing the Stage V plurals than the Stage II plurals, since the latter can be generated by the application of simple rules. Since the proportion of correct responses to Stage V items is so low, whether they be common plurals like *lovak* 'horses' or rarer plurals like *darvak* 'cranes', and since rote-memorization would produce correct responses, the overall effect of rote-memorization as a strategy in word formation must be estimated to be small, perhaps less than the 13 % figure for the Stage V plurals. If the contribution of rote-memorization in the formation of the Stage II plural *hajók* were also 13 %, then 87 % of the responses would still be attributable to either analogies or rules.

The contribution of analogic formation

The experimental situation was structured to maximize analogies in that the unfamiliar word was presented after the familiar rhyming word with the assump-

TABLE 2. *Type and percentages of responses by acquisitional stage required for the formation of the adult plural by rule*

Stage	Item	Adult plural	%	Error 1	%	Error 2	%	Error 3	%	% NR
II	(1) hajó	hajók	100	—	—	—	—	—	—	—
II	(2) fajó	fajók	84	—	—	—	—	—	—	16
III	(3) pipa	pipák	89	pipak	11	—	—	—	—	—
III	(4) piga	pigák	94	pigak	6	—	—	—	—	—
III	(5) csésze	csészék	67	csészek	22	csésze	6	—	—	5
III	(6) szésze	szészék	50	szészek	39	szésze	6	—	—	5
IV	(7) virág	virágok	94	—	—	—	—	—	—	6
IV	(8) firág	firágok	73	—	—	—	—	—	—	27
IV	(9) könyv	könyvek	83	könyvök	17	—	—	—	—	—
IV	(10) önyv	önyvek	55	önyvök	17	önyve	17	—	—	11
IV	(11) bör	börök	67	börek	5	börö	6	—	—	22
IV	(12) vör	vörök	73	vörek	5	vörö	5	—	—	17
IV	(13) pingvin	pingvinek	61	pingvink	28	pingvingek	6	—	—	5
IV	(14) gvin	gvinek	50	gvink	17	gvinok	6	gik, gvinkgik	10	17
IV	(15) hal	halak	72	halok	22	hala	6	—	—	—
IV	(16) gal	galok	67	galak	17	galo	5	—	—	11
V	(17) kenyér	kenyerek	22	kenyérek	67	kenyérk	6	—	—	5
IV	(18) kepér	kepérek	56	kepérk	17	keperek*	11	kepére	5	11
V	(19) kosár	kosarak	11	kosárok	56	kosárak	28	kosárk	5	—
IV	(20) mosár	mosárok	66	mosárk	11	mosárak	11	mosáro, mosára	12	—
V	(21) tehén	tehenek	33	tehének	56	—	—	—	—	11
IV	(22) pehén	pehének	72	pehenek*	5	pehene	6	—	—	17
V	(23) tükör	tükrök	6	tükörök	83	tükörek	6	tükörk	5	—
IV	(24) fükör	fükörök	62	fükörek	6	fükörk	11	fükörö	11	—
V	(25) majom	majmok	—	majomok	89	majok	6	—	—	5
IV	(26) kajom	kajomok	67	kajok	11	kajomo	5	—	—	17
V	(27) daru	darvak	—	daruk	89	—	—	—	—	11
IV	(28) taru	taruk	83	—	—	—	—	—	—	17
V	(29) ló	lovak	17	lók	83	—	—	—	—	—
IV	(30) gó	gók	94	—	—	—	—	—	—	6

* Twelve of the fifteen adults examined generalized the bound rule of vowel shortening to these roots. Generalizations of other bound rules, such as V-INSERTION in *lovak* to produce *govak*, were obtained in only two or three subjects per item.

tion being made that the plural of the latter would still be available. It is the production of the low vowel /a/ as a linking vowel in the plurals of the nonsense words *(galak, mosárak, mosára)* and the shortening of base vowels in the plurals of nonsense words *(keperek, pehenek)* which are least well explained as the results of either rote-memorization or rule-operation. Use of /a/ as a linking vowel requires encoding of a deletable final /a/ on the root, as in *hal(a)*. (See the discussion of Stage IV above.) However, the child hears only the nominative form *gal* in the test situation and should have no reason to make such an encoding. The situation for *kepér* and *pehén* is similar, with the difference that the alternation *kepér-kepere* and the alternation *pehén-pehene* both require Stage V learning.

If analogy is to be a viable explanation of these forms, it is to be expected that the child producing *galak* would also produce *halak* as the conventional plural. It is quite surprising to find that, in 4 of the 9 plurals that seem most attributable to analogy, the conventional plural is formed differently from the nonsense plural. Thus the child produced *halok and galak,* rather than *halak and galak,* as required by analogy. Rule-operation provides an alternative explanation of the production of *halok* and *galak* in that children at Stage IV are predicted to use both *-ak* and *-ok* as allomorphs produced from the unified plural morpheme. As has been noted, alternation between these plurals cannot be controlled by rule and should vary freely until the child learns to restrict *-ak* by coding /a/ as the final segment of the base. This explanation better accounts for the presence of the /a/ in *mosárak* and *mosára,* since analogy with *kosarak* would require a shortening of the second vowel of the root, i.e. *mosarak.*

The remaining two plausible analogical plurals are *keperek* and *pehenek.* It is possible that these forms are produced through the action of the rule of VOWEL SHORTENING that has been formulated as an over-generalized free rule for all bases of CVCVC structure with long second vowels. As was noted above, the majority of the adults queried also formed *keperek and pehenek* as over-generalized plurals.

Analogy could conceivably play a role in the formation of plurals such as *firágok* by analogy with *virágok,* but other responses such as *pipak* and *kosárk* cannot be attributed to either analogy or rote, since no adult plural takes their form. One figure indicating the relative importance of analogy is percentage of generalized idiosyncratic formations among total responses. For items (15) and (16) in Table 2, only two children were found to produce both *halak* and *galak,* and for items (19) and (20) no child produced *kosarak* and *mosarak.* The percentages are thus 12.5 % and 0.0%, respectively, and the role of analogy is seen to be minimal even here.

The contribution of rule-operation

Of the 3 strategies in word formation, rule-operation is the only one capable of accounting for the full array of responses. According to the model discussed

earlier, children are predicted to progress through 5 stages in morphological learning. Setting the criterion for stage-attainment at 50% correct responses, Guttman scalogram analysis yields a coefficient of scalability of 1.00. Thus, no child attained criterion for a stage without also having attained control of earlier stages.

Seven children in the youngest playgroup were capable of using plurals in spontaneous speech, but showed no ability to use plurals in the experimental situation. These children had attained Stage I and had not advanced further. Of the 18 children providing plural responses, only the two youngest girls showed no evidence of learning beyond Stage II. These subjects formed plurals by simply attaching *-k* to the stimulus root, as in *pingvink* (instead of *pingvinek)* and *pigak* (instead *of pigák).* One of these subjects did produce the forms *virágok* and *kosarak* with correct linking vowels, but these may have been rote-memorized amalgams. All subjects who attained Stage III also attained Stage IV, if the criterion for stage-attainment is set at 50 % correct responses. There is only one error *(gvinok* for *gvinek)* in the Stage IV rule of FRONTING HARMONY; this error occurs with a base containing a vowel outside the vowel-harmony system. Acquisition of ROUNDING HARMONY is less complete. In the erroneous forms *börek, vörek, fükörek* and *tükörek* the final vowel should be */ö/.* The context of ROUNDING HARMONY is more complex than that of FRONTING HARMONY, and these sporadic errors appear to reflect problems in the superimposition of the required context. Only two subjects had attained criterion at Stage V.

CONCLUSION

Three major strategies in children's morphological formations were examined in the light of data on the development of the Hungarian plural. Each of the three strategies was described in terms of psychological processes implicit in their operation. Although rule-operation provided an inherently complex explanation it was the only account capable of explaining the presence of distinct stages in the data. Furthermore, rote-memorization could not account for the plurals of nonsense items; and, although the experiment was structured to maximize analogies, a comparison of the responses for rhyming bases indicated that there was no clear-cut evidence for the operation of analogy in any of the formations.

It was not possible to distinguish-between Stage III and Stage IV learning in the present data. Further study of a larger array of inflections in Hungarian or in other languages with complex morphological systems should provide information to aid in refining the rule-based model presented and in extending its generality.

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