LANGUAGE DEVELOPMENT

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second, progress in the mastery of the linguistic system of the model or adult language. Since the advent of linguistically oriented research, more attention necessarily has come to be given to the analysis of individual cases. Among adults of the same language community, differences in the linguistic system are slight. Among young children, who are developing an internal linguistic system, differences are much greater. Cross-individual comparisons of linguistic elements are not appropriate if there is a possibility that the elements may occupy a different structural position in the system. It is necessary, first, to develop techniques and to discover units through the study of individual systems before comparisons between individuals, or group studies, are possible. For this reason, many of the studies herein reported are analyses of the rules of individual systems.

Since these analyses are producing the most significant changes in current views of language among psychologists, this chapter will give attention primarily to the analysis of the internal system of sound and syntax. Considerations of space have led to the omission of systematic treatment of the semantic and functional aspects of language acquisition which a complete discussion would require.

**Phonology**

**Prelinguistic stage**

All human languages have certain distinctive properties: (a) they are learned; (b) they include conventional, arbitrary signs for meanings or for referents which may be displaced in time or space; (c) they include conventional units and rules for the combination of those units. It is evident that the vocalizing infant does not have a language. Though he may respond to adult language, we cannot begin to analyze the structure of his own language until he has at least two systematically contrasted meaningful words, a point usually reached by the end of the first year (69).

Spectrographic studies of sound during the first few months of infancy indicate that vocal behavior is very unstable. The speech organs are employed in breathing, eating, crying, or gurgling. The cortex is immature and the speech-like sounds which do occur show extreme fluctuations and defy analysis by the ordinary phonetic
classifications applicable to speech under more stable cortical control (68, 60).

The most striking change in the months immediately following is the acquisition of increasing control over volume, pitch, and articulatory position and type, a control manifested by continuity or repetition of these features. The best recent study of this phase of development is by Tischler (92). In a study of seventeen children in contrasted social situations, he noted that there was a gradual increase in the frequency of vocalization. It reached its peak at eight or ten months of age, then declined. Between the eighth and the twelfth month, almost all conceivable sounds occur, including some not in the adult language.

An important theory regarding changes during the prelinguistic stage has been offered by Mowrer (73). He has suggested that there is secondary reinforcement in hearing one's self speak as the rewarding parent speaks. This suggestion would account for both increasing quantity of sounds and increasing approximation to adult sounds. There are few data to test this theory. The prelinguistic sounds of deaf and hearing children are indistinguishable in the first three months, but there is a gradual decrease in the range of sounds uttered by the deaf after the age of six months (60), with each child specializing idiosyncratically. Thus, the hearing of a variety of speech sounds may increase the range of sounds used by the child, but we do not know if the hearing of a particular range of sounds influences the particular range used by the child. A study of children from two different language communities would shed some light on this problem.

Unfortunately, most studies which have been done at this stage and which have used adequate samples (43, 44, 45, 46) have two serious defects for our purposes. One is that they have seldom recorded the complete range of infant sounds, providing no record of rounded front vowels (as in French “tu”, German “lőse”), glottal trills, implosives, or clicks. The other is that they have not separated sounds uttered during babbling or cooing and those contributing variants in systematic language. Linguists have noted marked differences in vocal behavior even when babbling and language occurred at the same age.

It is usually assumed that passive control of phonological features antedates active control, that a child can hear a phonetic contrast, such as that between “s” and “sh,” before he can produce it. The reader may have had the common experience of having his imitation of the child's speech rejected; Brown and Berko (8) give an example: “That's your fis?” “No, my fis.” “That's your fish.” “Yes, my fis.” Hearing a contrast may be a necessary but not sufficient condition for producing it.

Little is known about the order of learning to hear differences in various aspects of intonation, stress, and quality in voices. The only study on this subject is reported by Shvarchkin (25), in which he taught children between 11 and 22 months Russian words differing only in one phoneme at a time. He presented his results as a series of phonemic features that distinguish groups or classes of phonemes. The phonemic features are learned in a given order. By the end of the second year the children could distinguish all the phonemes of Russian. While techniques which could be expected to yield comparable results to those of this important study have been applied in this country, the results have not been presented according to sounds or features (83, 91). Information on the actual phonetic cues used by the child could be obtained by using artificially constructed vocalic stimuli. Such studies have been conducted by psychoacousticians on adults, but not on children.

THE SYSTEM OF CONTRASTS

Just before the transition to the use of meaningful words, there is sometimes a period of complete silence or decreased babbling, but often babbling continues into the linguistic stage.

The use of meaningful words marks the onset of an active phonological system replacing unsystematic phonetic preferences. Now for the first time we are dealing with true language, and we may

3. Vowel distinctions are learned first. The order of acquisition for the remaining features is: (a) vowels vs. consonants; (b) sonorants vs. articulated obstruents; (c) plain vs. palatalized consonants; (d) nasals vs. liquids; (e) sonorants vs. unarticulated obstruents; (f) labials vs. linguals (i.e., nonlabials); (g) stops vs. fricatives; (b) front vs. back linguals; (b) voiceless vs. voiced consonants; (f) blade vs. groove sibilants; (b) liquids vs. /y/.

a
examine the systematic structure of the sound contrasts employed by the child to distinguish meaningful words. A few examples from Joan, described by Velten (93), will serve as an illustration. At 22 months, Joan had bat (bad), dat (cut), hap (lamb), and lap (cup). In these words, [b-] and [d-] can be seen to contrast, in that they signal differences of meanings in otherwise identical words. These four words also illustrate a phenomenon that applied to all of Joan’s vocabulary at this time. Four stops were found, [b], [p], [d], and [t]. The voiced stops, [b] and [d], occurred only in initial position, never final, whereas the voiceless stops, [p] and [t], occurred only in final position, never initial. The stops [b] and [p] did not contrast in the same position and therefore were allophones of the phoneme /p/; and, similarly, [d] and [t] were allophones of /t/.

Jakobson has developed a very influential hypothesis about the development of child language (49). His approach is summarized and applied by Velten (93) and Leopold (62). The hypothesis is that the development of the sound system can be described in terms of successive contrasts between features that are maximally different and which permeate the whole system. Thus, the first distinction is between a vowel and a consonant, since vowels and consonants are more different than any other part of the system. Next, the child might learn to contrast a stop with a nonstop, e.g., /p/ and /m/, or /p/ and /f/. Theoretically, the child could double his stock of consonants with each pair of contrasting features. When Joan, discussed in the preceding paragraph, learned to contrast /p/ and /b/, she also learned to contrast /t/ and /d/. In short, she learned the contrasting voiced-voiceless feature and applied it to all her stop phonemes. Thus, this theory presents an economical process of learning since the number of contrasting features is much smaller than the number of phonemes. Radical changes in the system come at once rather than through the gradual approximation of the adult phonemes one by one.

Are contrasts of features acquired suddenly as Jakobson hypothe-

4. The symbols [..] are customarily used for phonetic writing, and /..../ for phonemic writing. The choice of the symbols /p/ and /t/ rather than /b/ and /d/ is arbitrary in representing Joan’s phonemes. The concept of phonemic analysis is also applicable to adult speech. A fuller discussion is given by Brown (71: 27–30) and Hockett (40: chaps. ii–xiii).

sizes? Evidence on phonology stems largely from diary reports about single children (1, 12, 20, 36, 62, 63, 93). These reports tend to support the notion of acquisition of features.

Jakobson also suggested an order in the acquisition of contrasting features. He suggested that the order reflects the prevalence of the contrasting features among the languages of the world. It is possible that the more common contrasts are both acoustically or visually distinct and easier to articulate. Evidence has been presented for acoustic confusion of /t/ and /k/ by adults (71). The contrast of /p/ vs. /t/ or /k/ is also acoustically confused, but, in normal situations, a visual cue is provided. There is probably a relation between the visual cue and the fact that children usually develop a contrast between labial (e.g., /p/) and nonlabial (e.g., /t/, /k/) consonants well before they develop a contrast between dental (e.g., /t/) and velar (e.g., /k/) consonants.

Among adults, auditory confusions are more common among phonemes similar in manner of articulation (e.g., /p/ and /t/) than phonemes similar in place of articulation (e.g., /p/ and /b/) (71). Children, however, frequently make substitutions that differ in manner of articulation. Stops replace the corresponding fricative (e.g., “thing” may become ting), and semivowels or vowels replace liquids (e.g., “rabbit” may become rabbit; “bottle” may become batte) (63, 91). Degree of difficulty in articulation is probably the crucial factor. Thus, stops (e.g., /p/, /t/) are usually acquired earlier than fricatives (e.g., /f/, /th/), probably because a more delicate adjustment of the tongue is necessary for the fricatives. Caution must be exercised in ascribing articulatory difficulty, because no simple measure of articulatory difficulty exists, and judgments are usually made post hoc from acquisition problems.

There is adequate evidence from diary reports to warrant an examination of the generalizations which have the widest support. These generalizations, which follow, appear to be the most tenable current hypotheses, but they must be viewed with extreme caution, in view of the small sample and restricted range of languages. (a) The vowel-consonant contrast is one of the earliest, if not the earliest, contrast for all the children. (b) A stop-continuant contrast is quite early for all children. The continuum is either a fricative (e.g.,
and child’s systems by rules of substitution.5 If the child has a smaller stock of phonemes than the adult, it is obvious that the child must make certain substitutions; one phoneme must serve for two or more adult phonemes. Ordinarily, these rules reveal remarkable consistency (2, 63, 93).

It is an oversimplification to state that one phoneme in the child’s system substitutes for several in the adult’s system. The reverse is also frequent. Articulatory assimilation is one of several factors that can produce this result (1, 20, 63). One can hear similar assimilations in adult speakers—e.g., nightin-gale vs. nighting-gale. Templin’s results suggest that medial unvoiced consonants tend to be voiced—especially /t/-/t/-/, also often voiced by adults—and that final voiced consonants tend to be unvoiced (91).

Complex substitution rules are often the result of anticipation. Morris Swadesh6 observed such a pattern with his son. Final and medial consonants of the adult’s words were dropped by the child. The initial consonant was replaced by a nasal if a noninitial nasal was found in the adult’s word; a labial was replaced by the labial nasal /m/, and a nonlabial was replaced by /n/: blanket /me/, green /nh/, candy /ne/. Complicated substitutions of this type are not at all uncommon, but they are ordinarily not recognized by the parent.

Adult allophones are frequently allocated to different phonemes by the child (1, 63, 93). Thus, the adult’s prevocalic /r/ is often represented in the child’s system as /w/, but in other positions it often becomes a vowel or is lost. In adult speech, /r/ is formed with rounded lips before vowels, unrounded lips elsewhere; lip-reading research suggests that /r/ and /w/ are visually very similar before vowels (104).

Not infrequently an allophonic feature of the adult’s language is reinterpreted by the child and becomes phonemic—i.e., it becomes contrastive—because the factors that condition the adult’s allophonic feature are not represented in the child’s phonological system(93). The relation between the adult’s and child’s phonological system

5. Similar techniques of language comparison are employed in the study of bilingualism and second language learning (99).

6. Personal communication.
and pattern of allophones can become extremely complex. Chao (20) presented evidence which suggests that the complex patterns found for one child were in part due to different physiological capabilities of the child and the adult—specifically, the difference in relative size of the tongue and mouth cavity.

The child's phonological system is not a static system. Today's substitution rules are not tomorrow's rules. And, yesterday's rules are still to be found with some words today. The results are archaisms, found in almost every child's vocabulary. We have observed a child who learned to distinguish /t/ from /k/. She continued, unless corrected, to use an earlier word /ta/ for car. Velten (93) and Leopold (63) observed this phenomenon and, also, hypercorrections at times of change. We have noticed that new and old forms are sometimes stylistic variants; for example, the earlier form may be used in "baby-talk" or in talking to parents, the new form with outsiders. Archaisms are probably more common among children who have a relatively larger vocabulary and more primitive phonological system. In such a case, a newly acquired contrast must apply to a larger number of vocabulary items. Some vocabulary items are missed, and archaisms result.

The reverse effect of archaisms is also found, but less often. Chao (20) reports a case of a Mandarin-speaking child who applied a newly learned contrast to one frequently occurring word but not to other words for which the new contrast would have been appropriate.

By the fourth year, the child's phonological system closely approximates the model, and the remaining deviations are usually corrected by the time the child enters school. Occasionally, earlier substitution patterns persist, and the child is usually described as having speech problems. Applegate (2) describes the rules of substitution for such a child.

GRAMMAR

Children display no evidence of systematic grammar when they first begin to use words at about the age of ten months, yet most observers agree that by four years the fundamentals are mastered. The acquisition of grammar is one of the most complicated intellectual achievements of children. How does the child learn the grammatical structure of the language? Before attempting to answer this question, we must understand something of the nature of grammar and specify some of the grammatical devices used by languages. Try to construct a sentence from a string of English words: house, hat, ski, John, man, drop. Out of these we can construct, among others, the sentence the man dropped his skis and hat at John's house. The most obvious addition is order. Secondly, we have added markers in the form of function words (and, the, his, at) and suffixes (-ed, -s, -s'). Together, markers and order are employed for any of several functions. They identify classes (the identifies a noun), they specify relations (and relates skis to hat; 's relates John to house; order indicates the subject-object relationship), or they signal meanings (plurality, possession, and tense are signalled by markers). A third device is prosody, or characteristic intonation and stress patterns.

The unit for grammatical analysis is the morpheme, the smallest element in speech to which meaning can be assigned. A word may be composed of one or more morphemes; cats consists of two morphemes, eat and the plural suffix. Morphemes, like phonemes, may take various forms. The plural morpheme appears as /-z/, /-z/, /-z/, /-z/, or a vowel change in cats, dogs, bridges, oxen, and men. All of these various forms of the plural morpheme are called allomorphs.

Morphemes are divided into classes, and sentences are composed of certain ordered sequences of classes. Morpheme classes are comparable to traditional parts of speech but are identified in terms of substitutions in linguistic contexts rather than in terms of meaning. Thus, the morphemes that fit in the sentence, "The _______ was good," constitute a class. Morpheme classes can be divided into two groups, lexical and function classes. Lexical classes are few in number but have many members. In English these include nouns, verbs, adjectives, and certain adverbs. Function classes constitute a larger number of small, closed classes. In English these include conjunctions, prepositions, auxiliaries, and suffixes such as the plural and past tense morphemes.

More detailed treatment of morphemic and grammatical analysis can be found elsewhere (8, 31, 40). In the remainder of this chapter the term "word" will be used in place of "morpheme," except where the distinction between them is necessary.
PASSIVE GRAMMATICAL CONTROL

The child’s first word normally appears before the first birthday, but a year may pass before the child forms his first two-word sentence. During this period the child cannot be said to have an active grammatical system, or grammatical rules for forming sentences, because words are not combined into sentences. All his utterances are one-word sentences. At this stage, however, the very young child may have a passive grammatical system, rules for decoding or understanding many adult grammatical patterns, but the appropriate experimental techniques have not yet been applied to study children so young. A few studies with older children have been made that bear on the problem of passive grammatical patterns.

In Russian, as in English, the subject and predicate constitute the largest units of the sentence; these in turn can be subdivided into smaller units. Karpova (53) has reported an ingenious study on sentence analysis by Soviet preschool children. They were trained with pictures, then with isolated words, to list, count, and then report which was first, second, and so on. Then sentences were presented. The majority of children five to seven tended to hear two parts, a subject and a predicate. When they heard more, they more often segregated concrete nouns; less often verbs and adjectives; and least often, function words.

Porter (78) observed that in identifying verbs in written sentences, children seven to thirteen and adults relied primarily on structure, relatively little on meaning. He asked them to find a word like “jumped” in “the cow jumped the fence.” He used both meaningful and nonsense sentences, varying the cues available—meaning, markers, and order. Prosodic cues were not available since the sentences were written. Children tended to select on the basis of position, adults more often on the basis of markers. Thus, in the nonsense sentence, “docib hegof gufed rupan tesor,” children more often thought “hegof” was the verb, and adults chose “gufed.”

The two forementioned studies were concerned with the identification of units belonging to lexical classes. The understanding of markers or function words can be studied both from a syntactic and semantic standpoint. Sokhin (87) studied the understanding of a Russian locative preposition by children 23 to 41 months of age.

He asked the children, for example, to “put the ring on the block” or to “put the block on the block.” The youngest children seemed to depend so heavily on situational probabilities that they could not understand these instructions. Eighteen of the children, between 26 and 36 months of age, who understood the difference between “on” and “under,” still were unable to put the block on the block; and when told to put the ring on the block did the reverse half the time. Thus, they could discriminate the semantic contrast between different prepositions but could not distinguish the syntactic difference between the object of the verb and the object of the preposition, and the semantic contrast thereby signalled. Fourteen children 26-41 months of age were relatively successful in this task.

Derivational suffixes were studied by Bogoyavlenski (26). He contrasted four Russian derivational suffixes, a diminutive, an augmentative, and two suffixes -(nik, -ishchik) that formed agentive nouns from nouns and verbs. The agentive suffixes are like the English suffix -er in farmer and worker. It was found that the children had much more difficulty in understanding words using the agentive suffixes, evidently because there is a more radical semantic change involved.

THE UNMARKED GRAMMATICAL SYSTEM

Our knowledge is relatively well developed regarding children’s sound systems and includes elegant and detailed descriptions of particular children’s systems, which can be a prelude to generalizations when more children have been studied. The same is not true of children’s grammatical systems. For this reason, the treatment in this section must rely largely on a few studies of individual cases now in progress.

Observers have agreed that when true sentences appear, sentences composed of two or more words, they seem to be abbreviated or “telegraphic” versions of adult sentences (10, 57). That’s the ball becomes that ball; where’s the ball becomes where ball. Function words are almost completely lacking at this stage. Recent studies of individual children show that even in these early sentences there are systematic regularities of order (5, 10, 11, 72). How seriously are we to take these regularities? There are grave difficulties in defining children’s classes and establishing grammatical rules on internal evi-
language in which only equiprobable lexical items existed, classes would be very hard to learn. Jenkins and Palermo have suggested that operators are necessary for the development of word classes. There is no proof that this is the case, but the evidence so far available supports this contention.

The child's first two-word sentences are frequently something like *that truck, that baby, and where dolly, where truck.* If the child has used *that* and *where* as operators for identifying a class, he can generate a new sentence—*where baby.* An operator occurs in a fixed position; i.e., in either first or second position. The remainder of the vocabulary forms a single, undifferentiated class and can occur with any operator (5). Very soon, the remainder is divided into classes; certain operators occur exclusively or almost exclusively with certain words. The classes tend to reflect class distinctions of the model language, e.g., some children use *it* as an operator only after words that are transitive verbs in the model language.

The evidence from three studies conducted by Miller and Ervin (72), Brown and Fraser (10) and Braine (5) reveals a high degree of similarity in the existence of such sequences of high-frequency and low-frequency items. Braine observed that children had periods of concentrated use of certain operators with particularly high frequency, using the favorite with a variety of other words, as new vocabulary was acquired.

A second feature in the evolution of classes may be the common semantic properties of referents. Thus, nouns often refer to things and verbs to actions. Brown has observed that children's classes are more semantically consistent than adults'. He has also demonstrated that preschool children select a picture of action when asked to find "sibling," a picture of a container or simple object when asked to find "a sib," and a picture of confetti-like material when asked to find "some sib." The word "sib" is, of course, nonsense to the children, but they can select the most probable semantic properties of "sib" by the marker which identifies the word class: "-ing" (verb), "a -" (count noun), and "some -" (mass noun) (6).

If grammatical rules simply stated allowable sequences of words, it would be necessary to have one set of rules for two-word sentences, a different set of rules for three-word sentences, and so on. In sentences of more than two words, certain words are nested so
that it is necessary to deal with only two units at a time. Thus in the sentence *many birds fly*, the first two words are nested and occupy the same structural position as the first word in the sentence *birds fly*. One rule will account for the subject-predicate sequence in both sentences, and another rule will account for the two-word sequence that composes the subject of the first sentence. The principle of nesting (or immediate constituent analysis, as it is termed in linguistics) is described in detail by Hockett (40: chap. xvii). Preliminary evidence suggests that nesting is learned early, but the child sometimes develops his own system before learning the system of the adult language (5, 72). It is difficult to assess the evidence, however, because nested constructions are usually delineated by markers which are largely lacking in the early grammatical systems.

**THE MARKED GRAMMATICAL SYSTEM**

Word classes in the early grammatical system are identified primarily in terms of order. As the child starts using more and more function words and suffixes, the classes are also identified by markers. Nouns are words that can occur after *the* and before the plural suffix; verbs are words that can occur after *can* and before *-ing*. At this time it is convenient to describe the child's grammatical system as a simplified version of the model, along with additional grammatical rules to account for features that have no counterpart in the model.

Rapid progress is commonly observed when the child enters this phase of development. Velten (93) reported in his daughter’s speech from 27 to 30 months a swift development of prepositions, demonstratives, auxiliaries, articles, conjunctions, possessive and personal pronouns, the past-tense suffix, the plural suffix, and the possessive suffix. At first, the use of markers is usually optional and often inconsistent, and only gradually does the child’s usage approach that of the adults, with increasing subdivision of classes (16).

Most observers have noted that before a contrast occurs consistently, one of the alternate forms is preferred. Gvozdev has added that, in the case of the Russian child, there is free variation observable just prior to mastery (36). Comparisons of different studies are difficult because the criteria of mastery are different. The fact that a given child says *toys* and *eyes* does not necessarily indicate that he has mastered the plural suffix. We must know if the use was spontaneous or imitated, if the singular forms *toy* and *eye* are used, if there is a contrast in meaning between the singular and plural forms, and if the formation is productive, i.e., if the plural suffix can be added to new nouns. Berko (4) developed a technique which involved asking children to make new formations using nonsense words. The child was told: “This is a wug. Now there are two of them. There are two ____.” The appropriate response is, of course, “wugs.” Using this technique, Berko found that four- to seven-year-old children knew the rules for forming the plural and possessive for nouns and the past tense and third person singular for verbs. Their greatest difficulties were partly phonological in nature; e.g., they had difficulty in adding the plural suffix “-*s*” to items that ended in a sibilant, such as “tass,” perhaps because such forms were interpreted as already including a plural suffix. Miller and Ervin (72) used this technique with younger children in studying the acquisition of the plural. The tests were repeated at monthly intervals, and both meaningful and nonsense items were used. They found that the plural was usually learned before the child was three years old, but there were large individual differences. Learning of the plural for meaningful words almost always preceded that of the plural for nonsense words that had a similar phonological shape, but the interval between the two was surprisingly short.

Mastery of familiar forms precedes their generalization. The patterns are then extended to irregular forms, so that along with the regular pairs like *dog-dogs* or *walk-walked*, regularized pairs are found: *man-mans, foot-feet* (or *feet-feet*), *go-good, break-broke*. Guillaume (35) also was struck with his children’s tendency to regularize verbs; *battre* became *batter*, *rire* became *rier*. Even very common verbs such as *prendre* and *tenir* were affected. He reported the only statistics suggesting why such regularization occurs; he found that though the French verbs employing a regular pattern were used only 36.2 per cent of the time, they constituted 75 per cent of the different verbs used.

Syntactic contrasts are often added to the less obvious required markers when the contrast is semantically important. In *I talked to him yesterday*, time is marked by both *-ed* and *yesterday*; in *two books*, plurality is marked by both *two* and *-s*. The child will some-
times use the more specific syntactic indicator (*yesterday and two*) in place of the less specific suffix (-ed and -s). A child is probably more apt to use a syntactic device if his phonological system does not allow him to use the suffix. Miller and Ervin (72) reported one case in which the child lacked final sibilants and used *one-two* in place of the standard plural: *one-two shoe* meant more than one shoe. Such a child, though she would fail a standardized test of the plural, would fail for phonological, not grammatical, reasons. Grammatically, she did have a plural signal. We do not know if such syntactic indicators are commonly acquired before suffix contrasts for phonological or other reasons. Gvozdev has reported that in the observations he has made in Russia these indicators are acquired at the same time (36).

There has been little systematic study of the order of acquisition of contrasts indicated by markers for English-speaking children. Russian linguists have done some work along these lines. Gvozdev (36) contends that the order of evolution depends on meaning. Russian gender contrasts appear relatively late because of their lack of strong semantic support, and the conditional mood, which is grammatically quite simple, occurs a year after the past-tense contrast for reasons of semantic difficulty.

An important aspect of language has been raised by Chomsky's transformational analysis (21). Transformations are complex derivations from a simple or kernel sentence. Compare the following sets of sentences, each of which contains a kernel sentence and a question, a negative, an emphatic, an elliptical, and a progressive transformation of the kernel:

<table>
<thead>
<tr>
<th>HE GOES.</th>
<th>HE WENT.</th>
<th>HE'LL GO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does he go?</td>
<td>Did he go?</td>
<td>Will he go?</td>
</tr>
<tr>
<td>He doesn't go.</td>
<td>He didn't go.</td>
<td>He won't go.</td>
</tr>
<tr>
<td>He does go.</td>
<td>He <em>did</em> go.</td>
<td>He will go.</td>
</tr>
<tr>
<td>He does.</td>
<td>He did.</td>
<td>He will.</td>
</tr>
<tr>
<td>He's going.</td>
<td>He was going.</td>
<td>He will be going.</td>
</tr>
</tbody>
</table>

A number of rules can be formulated which apply to more than one transformation. In the first four transformations, the auxiliary *do* is added if there is no auxiliary. A past tense or third-person-singular suffix is shifted from the main verb to the auxiliary. Additional, nontransformational rules must be applied to account for contractions and irregular forms; e.g., *go* plus -ed becomes *went*. The great advantage of a transformational account is that a small number of rules compared to a large number of possible sentences results in an economy of description and a potential economy in learning as well. The transformation theory remains controversial in linguistics; in the field of language acquisition it is an ingenious hypothesis, which deserves testing.

Whether transformations are imitated or productive requires testing with novel sentences. Then one can discover if the sentences represent simply independent, unrelated patterns without effect upon each other. We would expect that, if transformations are acquired as operations, they should appear suddenly and influence much of the language at once, just as morphological regularities do. Miller and Ervin (72) present evidence from one child supporting this expectation.

**Grammatical Development After Four Years of Age**

There have been very few structural analyses of language in older children. What material is available (4, 16, 38) suggests that by the age of four most children have learned the fundamental structural features of their language and many of the details. There is then a long period of consolidation, a period of overlearning so that grammatical habits become automatic. Some irregular patterns are learned. Other irregular patterns, already learned, still must become firmly established. A six-year-old often uses forms such as *bayed* and *bought*, or *brang* and *brought* interchangeably. When he corrects himself, changes *bayed* to *bought*, he indicates that he knows the adult norm but has not yet developed a firmly established habit. Less frequent patterns, such as the use of *too* with positive sentences and *either* with negative sentences, are yet to be learned. The child must still acquire certain grammatical patterns that are associated with difficult semantic patterns, such as passive transformations and causal patterns with *why* and *because*.

We have pointed out that sentences can be produced by memorizing sequences. The evolution into classes based on substitution in the same contexts is gradual. The process continues over many years and affects many verbal habits, even when children's sentences
seem to conform to adult grammar. Thus, during the primary school years, there is a marked increase in the tendency to give free associations that are grammatically similar to the stimulus word. This tendency is earliest and strongest with nouns and adjectives and weakest with function words (9, 27). Experimentally, it has been found that such associations derive from occurrence in identical linguistic contexts (27, 70), that is, in the same conditions that we have suggested lead to the learning of grammatical classes. In pursuing the link between grammar and association, Brown and Berko (9) found that when children were asked to use nonsense words after they had heard them in sentences, they had difficulty. They were most successful with count nouns and adjectives. Their progress in mastery of classes showed the same sequential development found in mastery of word associations.

For diagnostic purposes, it would be useful to have standardized tests for various aspects of grammatical development. While there have been many separate studies of individual features (69), no standardization norms are available. The most common quantitative measures employed to assess development in standardization studies, such as Templin’s (91), have been sentence length—as judged by adult words—and frequency of structural features, such as phrases and subordination. Brown and Fraser (10) compared sentence length in two-year-olds with certain other factors, such as presence of specific auxiliary verbs, and found a high correlation. When age is allowed to vary, all of these features tend to be correlated, since all change with age. One important precaution should be observed in finding appropriate measures of grammatical development. Adult usage differs in the various subcultures of any community. A good developmental measure for general use should include only those features common to all adult speech in the presence of children.

LANGUAGE DIFFERENCES

Comparison of acquisition of different languages may provide some clues to the bases of the particular sequences observed. For example, it has been commonly observed in English that the child who does not yet make a contrast in plurality simply uses no marker at all. The plural suffix in adult speech has a double function; it is both a semantic signal and a noun marker. Usually children say dog for both adult dog and dogs. Why this choice? Frequency and ease of articulation may dictate which of the alternative forms is preferred. As for frequency, toys, eyes, shoes may occur so often in the plural that this form is preferred by the child. On the other hand, the development of final consonant contrasts and consonant clusters is usually late, so that the singular of words with consonant finals may be preferred. Languages which use prefixes rather than suffixes might show a different pattern, but no evidence is available.

Most contrasts in English consist of a marker vs. no marker. By preferring the unmarked form, the child not only fails to signal a semantic contrast but also lacks a class marker. In some languages, on the other hand, the noun must occur with an inflectional suffix. Before they have inflectional contrasts, children have preferences in the form they use. Thus, these forms would be available as class markers to distinguish nouns from verbs when the child begins to form sentences, even before he uses them contrastively.

To what extent do different language structures condition different learning patterns? This is a question that has not yet received study. Kluckhohn suggested that Navaho children, who must learn an extremely complicated language, are more retarded in their language development than English-speaking children (19). Leopold (62) has stated that syntax (grammatical rules that apply to arrangements between words) comes before morphology (grammatical rules that apply to arrangements of morphemes within words) in the child’s grammatical development. Leopold did his work with an English- and German-speaking child, and these are languages in which syntax plays a more important role than morphology. Burling (12) describes the development of a child learning Garo, a language in which morphology plays a more important role. He found that morphology and syntax appeared simultaneously and were of equal importance for the child.

Derivational suffixes (as distinct from inflectional suffixes) such as -ly in wiggly, -y in fuzzy, -er in gunner, play a less important role in English than in some other languages, such as Russian. Berko (4) found that American children, ages four to seven, avoided such suffixes, preferring compounds or syntactic constructions. When they were asked, for example, what they would call a very tiny
“wug,” most children responded with phrases like baby wug, teeny wug, or little wug. A large number of adults responded with wuglet, wuggie, wuggette, or wugling. Russian children studied by Bogoyavlenski (26) readily formed derivatives using suffixes such as the diminutive.

**Language Socialization**

Cultures differ markedly in their practices in and attitudes toward language teaching. Baby talk furnishes an example. At one extreme is Comanche with a uniform and formalized baby talk (19). Baby talk has also been reported for Arabic, Gilyak, and Nootka cultures (3, 29, 82). At the other extreme are the Hidatsa, who claim to use no baby talk at all. They state, “We don’t like baby talk... When they talk, we want them to talk just like us, right from the start” (96). The Mohave claim newborn children can understand speech (24). It is not known whether these differences are related to any differences in the rate of language acquisition. But we can expect that language instruction will be more casual among the Mohave, for example, than among the Hidatsa.

Baby languages in various societies cast some light on adult views of children’s language systems. Baby vocabularies frequently bear a systematic relation to adult vocabularies and have three common features: employment of articulatory simplifications, tending to the use of stops and nasals and the elimination of consonant clusters; use of reduplications, such as byebye and mana; and the use of special suffixes which may be peculiar to baby talk or may also be used as endearments or diminutives, such as the English suffix -y in doggy, horsey, Billy, sweety. Grammatical simplification is probably also a feature of the baby talk used in speaking to children, though this feature has not often been thus described.

Steward (90) compared two cultures that differ radically in their tolerance of the peculiarities of child language. He found stuttering

7. Whether the articulatory changes are actually simplifications is arguable, since the criteria of simplicity are unclear. Pharyngeal fricatives are common in Arabic baby words (29), and glottalized consonants are found in Acoma baby words (authors’ notes). Both of these sounds are difficult for second-language learners. It may be significant that a number of words in the formalized baby vocabulary of both languages are not systematically related to adult words.

more common in the society that made more rigid demands on the young speaker. This study is novel in its analysis of a variety of socialization practices related to language learning.

Societies may differ greatly in the amount and type of verbal stimulation given children. Irwin (46) has shown that speech development may be affected by reading to children. Children of multiple births are known to be retarded in language development (69), implying the importance of siblings in the kind of language the child learns. Hockett (39) has suggested that older children are the most important environmental force in shaping the younger child’s speech habits. If this is the case, we can expect to find differences across cultures that correlate with differences in the amount and kind of contact found among children.

The development of good miniature tape-recorders makes possible the study of the evolving relation between speech forms and social functions, a study neglected even in the analysis of adult language (42, 88). There have been occasional comparisons of children’s speech in different social conditions (37, 41, 97). The study of the nonlinguistic factors that condition the choice of differing linguistic forms offers another point of departure. A nice example is provided by Fischer (30), who studied the stylistic alternation of the participial suffix -ing vs. -in among children in a New England town. He found the alternation was related to personality (the “good boy” said -ing), to situational formality, and to the type of word used (swimmin, chewin, bittin, vs. correcting, reading, visiting). There was a slight tendency for girls to use -ing more than boys. Social class, in this relatively unstratified group, was not a significant factor.

Studies of the functional development of language are dependent on adequate descriptions of the behavior under study, the linguistic system of the child. As knowledge of the significant properties of children’s language increases, it seems probable that more attention will be focused on the evolving differentiated usage of children, which results in the complex functional argots of adults, and on the features of the environment, which alter the rate of change in various aspects of the system.
Language and Cognition

There has been a great interest in the past decade in the effects of language or label learning on nonverbal behavior. Soviet research, with a slightly different focus, has been concerned with the relation between the “first and second signal systems.” Since the early 1950’s, there has been a resurgence of research in this field in the Soviet Union. English summaries are found in Luria (66) and the collection edited by Ivanov-Smolenkii (48). Because Soviet research is less familiar to us, we will give it somewhat disproportionate attention.

In this country, many of the studies have been done on adults, since the questions have been framed in terms of general behavior theory rather than developmental changes. There appear to be three explanatory frameworks employed in American studies:

(a) **Acquired distinctiveness.** Verbal training during the acquisition of labels alters the similarity of stimulus material, even on a single stimulus dimension, affecting discriminability.

(b) **Verbal mediation.** Though discriminability might be unaffected, verbal responses permit chaining, bringing to bear any prior reactions learned to the verbal responses themselves. Delay or stimulus complexity increases the effect.

(c) **Dimensional salience.** Verbal training may lead to selective attention to certain dimensions of the environment, as revealed in tasks requiring sorting of complex materials.

**ACQUIRED DISTINCTIVENESS**

It has not been shown that psychophysical discrimination is altered by the acquisition of labels. In a study of speakers from different language communities, with different categories for color names, Lenneberg found that the capacity to discriminate hues was the same, even though the labels were differently distributed on the hue continuum (59). The only form of discrimination known to be affected by language is that of speech sounds themselves. Liberman showed the ability of adults to hear differences between sounds which are discreet in articulation but on the same acoustic continuum is clearly improved at phoneme boundaries (65). An example is the contrast between do and to, differing only in one feature on an acoustic continuum. The studies have shown that there is im-

proved discrimination at phoneme boundaries, but no acquired similarity, or decrease in discrimination, within the phoneme. Why is there such a difference between the effects of acquiring labels for colors and sounds? One explanation may be that we make hue discriminations daily, without the use of color names, in our transactions with the physical world—judging contours, distances, and so on. We only discriminate speech sounds when we are listening to speech.

**VERBAL MEDIATION**

Many investigations which have been called studies of acquired distinctiveness actually seem to involve the occurrence of verbal mediation. In fact, the speech-sound studies, such as Liberman’s, may involve comparison not of two heard speech sounds but of two utterances reinterpreted by the listener in terms of his own phonemic system—i.e., response mediation. Verbal mediation involves a response by the subject, and we may group the studies into two categories: those which are concerned with the distinctiveness of the response-produced cues, and those which are concerned with their chaining.

Spiker and his associates are among those who have studied the first of these two problems with children as subjects (89). An example is a study by Hayne Reese (80), in which children were taught in two stages. First they learned labels for colored lights; then they learned a motor response to the lights. Reese contrasted four different pairs of labels, differing in the distinctiveness of the labels. The most similar was wug-zog with phonetically similar vowels, then zim-zam with less similar vowels, and the most different were lev-mib and wug-zam. Reese found that there were differences in both the time it took to learn the labels and the time it took to learn the motor responses for the different groups. The more distinct the labels, the more quickly they were learned, and the more easily the motor response was learned. Evidently the ease in learning the motor response did not reflect merely the distinctiveness of the labels, but rather the mastery of the labeling response which took longer with the similar labels. Whether an alternative type of distinctive response which was nonverbal might have been equally
effective is not known. A theoretical discussion of related studies has been presented by Goss (33).

Studies on delayed response suggest that verbal mediation is important in a variety of ways. Brown and Lenneberg (7) showed that if there were a delay after a color chip was shown, subjects tended to recognize the color, to choose it from among many, not so much in terms of its hue as in terms of its label. Thus, if a pale lavender blue was called “blue” by a subject, he tended to identify it later as bluer than it actually had been. This study has not been repeated with children, but the phenomenon is very striking and predictable in adults.

Spiker has pretrained children with labels for stimuli in a delayed-reaction experiment and thereby improved their performance (89). He designed the labels to fit the performance categories. The children remembered the correct response later because they had verbal labels which corresponded.

Oller (76) has noted that deaf children were inferior to hearing children in their ability to solve double alternation problems of the type “left twice—right twice.” He later found that the children did not know how to count and assumed that counting might help solve such problems. A study by Carrier with deaf children also suggests the importance of verbal mediation (15). He noted that hearing children judged black or dark objects to be heavier than similar light or white objects. Before adolescence, deaf children did not make such judgments. He had to teach these children the terms “heavy” and “light” for concepts they already had. Clearly the deaf children were unlikely to know the double meaning of “light.”

Michèle Vincent (95) has found differences between deaf and hearing children, less than eight years of age, in sorting tasks. Verbal mediation was assumed to be the critical factor. Two blocks, alike with respect to one dimension, were displayed, and the children were asked to choose the third. Wrong choices were corrected. The deaf were more than a year retarded. In a similar study meaningful categories, such as animals, were employed (94). Deaf children of eight behaved like hearing children of six years. When the hearing children were asked to justify their choices, subsequent performance improved. Presumably, this procedure increased the probability of verbal mediation. Studies comparing deaf and hearing children have the hazard that many features of experience are likely to differ and that some organic defects besides deafness may be present.

It has been common to compare children before and after they can verbalize a contrast and to assume that verbalization reflects the availability of verbal mediation. Of course, where the verbal skill has not been taught by the experimenter, the verbalization and the performance may both reflect a third factor. The Kendler’s recent work with reversal shifts seems to solve this difficulty (55, 56). Subjects are trained to criterion on a task requiring response to one of two available cues—such as size or color—and then a new rule is made. The new rule may simply be a reversal—if white was correct, now black is correct—or it may involve a shift to the other cue. Children between five and seven years found the two equally difficult, but, if young children were taught to mention the relevant cue, reversal was easier. For the older children, who presumably verbalized spontaneously anyway, the teaching had no effect, except that teaching them to mention the irrelevant cue impaired performance.

These studies assume the occurrence of a covert or implicit response. One way to test the occurrence of such covert responses is to condition a reaction to them. Volokova found that a response conditioned to the word “right” occurred if children were given arithmetic problems that were correctly solved and that a response conditioned to the word “ten” occurred when the stimulus was “five plus five” (79).

**DIMENSIONAL SALIENCE**

The sorting studies of Vincent, mentioned above, suggest the presence of verbal mediation, but it is possible that sorting or grouping tasks might be affected simply by the relative salience of different dimensions. Such salience varies with experience, and dimensions commonly codified by vocabulary or grammar would tend to be noticed more often. Casagrande (18), in a study connected with the Southwestern Project in Comparative Psycholinguistics, compared Navaho- and English-dominant Navaho children who lived on the Navaho reservation. The Navaho language includes a set of verbs referring to handling of objects, with a different verb for long rigid objects, mushy objects, flat flexible objects, and so forth. The
classification of objects into these categories is similar to the classification of objects into the gender categories of European languages, except that the Navaho categories display marked semantic consistency. Since verbs of handling are prominent in the vocabulary of children, Casagrande believed the children might attend to the pertinent properties of objects earlier if they spoke primarily Navaho. He asked them to choose from two others a block to match a model, allowing matching on either of two dimensions. Between the ages of three and eight, there were marked differences, the Navahodominant children choosing the block similar in form, the English-dominant that similar in color.

This study has been concerned with the impact of the learning of language on nonverbal processes. While positive results have been found, in many studies the total effect is relatively slight and only barely statistically significant. It is possible to exaggerate the importance of verbal processes in simple tasks involving objects and motor responses. In studies involving aiming, mechanical puzzles, or various kinds of visuo-motor co-ordination such as that reported by Ervin (28), verbal training can interfere with performance. It may distract by supplying an additional task or by drawing disproportionate attention to part of the relevant stimulus complex. In the experiment by Ervin, a verbally trained group was generally inferior but was better on one difficult item where the usual strategies discovered by visuo-motor experience were inappropriate. In the Casagrande study, a control group of Massachusetts city nursery-school children chose the form match as often as the Navaho-dominant Indian children. Perhaps their training with form-boards and other nursery toys had led them to focus on form as more relevant than color. This kind of experience may have had the same effects as the training supplied by speaking Navaho. And even verbal mediation does not, perhaps, have to be verbal. The complex problem-solving of primates on multiple-sign problems, and the level of play involving planning which can be sustained by deaf children before they receive speech training, suggests that alternative representational processes are available.

SOVIET RESEARCH

A central interest of Soviet research has been in the changing relation between verbal and nonverbal processes as children’s mastery of language increases and on the evolution of the self-directive role of language. While there is overlap, for example, with American studies of verbal mediation, the experimental questions have been quite different. The focus has been much more developmental, and the labels studied have been labels acquired in natural language learning. Age is usually the variable of chief interest.

At the earliest ages, children do not distinguish vocal from other auditory stimuli. This was found to be the case at seven to eight months of age, but three months later conditioning to words occurs four times faster than to other sound stimuli (26). There is considerable evidence from American research that children at first respond to the sound properties of words and only later to meaning. The classic experiment of Riess (81) found that, even at the age of eight, children generalized most to homophones, or words that sound like the training word, and that it was only in adolescence that synonyms became predominant. Also, it is known that children give rhyming or alliterative responses on word-association tests much more often than adults, with a sharp decrease in the early school years (27).

There have been many studies of stimulus generalization between words and referents. Korbavtov (58), using a bell or the word “ring” and various verbal and auditory stimuli, tested generalization at various ages and degrees of training. The youngest and least-trained most often responded to all the stimuli. Then there was a stage of reacting only to the bell and “ring” and not to other stimuli, and finally narrowing to the identical stimulus. When the training stimulus was the bell, the reactions tended to be more primitive in these terms than when the training stimulus was the word. Thus, at the lowest level of training, 70 per cent of the 4- to 6-year-olds and 10 per cent of the 15- to 16-year-olds showed diffuse stimulus generalization after training with the bell. At the same stage, 40 per cent of the youngest and none of the oldest gave such reactions when trained to the word. Specific training with a particular stimulus has effects similar to an increase in age. Studies in the generalization of inhibition of responses have given somewhat similar results, but the interpretation of the results is complicated by the tendency of young children to be very reactive, and thus to show little generalization of inhibition (84).

In a study on mediated generalization, Naroditskaia (74) condi-
tioned a response to a green light and nonresponse to a blue light. It was found that the discrimination generalized not only to green and blue but to leaf, grass, sky, and sea. Some of the children actually said the word green when given these secondary verbal stimuli rather than giving a motor response. Since the effect was strongly related to age, the experimenter tried to induce mediation by giving word-association training to the 5-year-old children but failed to increase the amount of mediated generalization.

Another type of mediation training was attempted by Gerasimchuk (32). Children sorted and discussed drawings, for instance, of red chicks and yellow buckets. Then they were conditioned discriminatively to a red and a yellow light. Among the 11- to 12-year-olds, there were 13 out of 20 children who reacted to the word chick, for example, although with a long latency.

All of these studies display experimentally the increasingly differentiated linkage of word and referent as the child grows older. A somewhat different frame of reference has been used by the psychologists influenced by Vigotsky and Luria. Luria was an associate of Vigotsky in the early thirties at the time of Vigotsky's vigorous and original work on the functions of language in the adaptive behavior of the child (97, 98). The recent resurgence of interest in this approach has resulted in the publication of a series of studies, many summarized by Luria in English (66). In the most ambitious of these projects, Luria and Yudovich (67) separated two speech-retarded twins and gave intensive verbal training to one. They describe vividly the great changes in behavior which accompanied training, particularly changes in the complexity and integration of play.

A series of single experimental studies was concerned with the evolution of self-control in the child through the use, first, of overt and, then, of covert verbal responses. These studies are reported by Luria (66). If a child under sixteen months was engaged in on-going activity, or saw a salient stimulus, he was unresponsive to instructions. A child, told several times to put rings on a peg, would begin to do it; but, once the task was under way, instructions to stop merely increased his activity.

A child, trained to press a bulb whenever a light went on, would press it continuously, once he began. He would stop if the light went out or a bell rang; but, in the absence of these stimuli, children under age three would return to continuous pressure. After age three, a self-produced cue would work, consisting either of a second movement after pressure, and now or boo said when the light appeared. Thus, language helped to demarcate the short time duration when pressure was to be made. When they were silent, children under age four, trained to use the verbal cue, continued pressing too long.

If a child under age four was told to say press twice, Tikhomirov (66) has shown that he pressed continuously. But if he said one-two or boo-boo he responded by pressing only twice. Here we see an overt form of the verbal control that Oléron (76) found deaf children lacked in double alternation problems.

A similar difficulty developed in efforts to train children to differentiate between a red and a blue light. At age three and a half a child could only discriminate with accompanying verbal instructions; otherwise he generalized his response to both. If the children were taught to say now or press to the red and don't to the blue, an even higher percentage pressed for the blue stimulus than before. Silence for the blue light was the only effective support for discrimination. After the age of four, such supports were not necessary. In general, Luria concludes that after four and a half years words cease merely to generate impulsive responses and become differentiated signals. This point is supported by the evidence of increasing importance of semantic rather than phonetic properties of words.

Although Vigotsky warned against identifying thought with subvocal speech (9: 44-45), these studies imply that verbal control of behavior developmentally undergoes two changes: it comes to be semantically distinctive rather than merely a trigger; and it progresses from the utterance of another to overt utterances by the subject to covert responses. The American studies, conducted largely at ages after this development is well under way, have shown the role of language in certain operations involving visible and tangible stimuli. As yet, little is known about the effects of language on cognition of a more complex type, such as the problems in natural science and mathematics investigated by Piaget. Nor has evidence been sought on an even more difficult implication, namely, the suggestion of G. H. Mead that the learning of language is crucial
to the ability to categorize one's self and one's acts and hence crucial to social and moral behavior.

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