

## THEORETICAL NOTES

### ON THE ACQUISITION OF SYNTAX:

#### A CRITIQUE OF "CONTEXTUAL GENERALIZATION"<sup>1</sup>

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It has been recently suggested that the child's assimilation of the syntax of simple sentences can be attributed to a process of "contextual generalization" whereby information about the ordinal position of words and phrases is transferred from sentences the child has observed to new sentences. The theoretical and experimental bases for this claim are examined in the present paper. It is argued that such a process could not, in principle, account for what children learn about the structure of or relations between the sentences of their language. It is further argued that the experiments which purportedly demonstrate the existence of contextual generalization are, in fact, equivocal.

#### INTRODUCTION

There is a wide gap between the view of language current in linguistics (cf. Chomsky, 1957; Fodor & Katz, 1964; Lees, 1960) and the view of the language-using organism implicit in psychological theories of learning. The reason for this is clear. Neither the methods nor the results of recent work on grammar are fully compatible with the methodological and theoretical tenets prevalent in psychology.

<sup>1</sup> This work was supported in part by the United States Army, Navy, and Air Force under Contract DA 36-039-AMC-03200(E); in part by the National Science Foundation (Grant GP-2495); the National Institutes of Health (Grants MH-04737-04 and MPM-16, 760); the National Aeronautics and Space Administration (Ns G-496); the United States Air Force (ESD Contract AF 19 [628-2487]).

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William Weksel was a National Science Foundation Postdoctoral Fellow during the preparation of this manuscript.

We wish to thank Margaret Bullowa and her staff for their kindness in making available to us the data discussed in Footnote 4.

The present paper examines the work of Braine (1963). This work has been selected for analysis because Braine attempts to assimilate insights provided by current linguistic theories while retaining an approach typical of psychological inquiries into syntax. The inadequacies of Braine's position thus suggest a number of respects in which such theories resist translation into the vocabulary of learning theory. In particular, since Braine's position differs only in details from that of such other learning theorists as Jenkins and Palermo (1964), the arguments we shall present apply to their work *mutatis mutandis*.

According to Braine, "the acquisition of grammatical structure, especially those aspects of grammatical structure which have to do with word order . . . [p. 323]" is to be explained by appeal to a process of *contextual generalization*. Contextual generalization is informally defined as a process whereby an individual who learns the position of a word or a phrase in the sentence he hears "tends to place this segment in the same position in other contexts [p. 323]." Thus, "What is learned' are primarily the proper locations of words in sentences. [p. 324]."

Braine clearly recognizes that the ability to deal with novel sentences constitutes a major part of the child's linguistic competence. It is thus central among the phenomena that a theory of language learning must explain. Braine takes the ability to construct and comprehend novel sentences to be a special case of transfer of training based upon stimulus and response generalization. Specifically, contextual generalization is identified as a case of perceptual learning, "a process of auditory differentiation, or of becoming familiar with, the temporal positions of expressions in utterances [p. 326]."

#### ARGUMENTS FOR CONTEXTUAL GENERALIZATION

Braine notes the inadequacy of a theory of syntax acquisition based on associative relations between lexical items. Such a theory cannot account for the ability of speakers to recognize the grammatical structure of nonsense material. Thus, a nonsense syllable, *kivil*, is recognized as a nonce verb in:

1. People *kivil* every day.

That is, 1 is recognized as syntactically well formed despite the lack of associative connections between the words.

Such examples show that the speaker's ability to exploit syntactic relations does not depend upon forming associative bonds between lexical items. Therefore, Braine argues, the speaker's information about syntactic structure primarily concerns the grammatical properties of *locations* in sentences. Thus, the child learns such facts as: The first position in a simple English sentence is characteristically the noun position; the second position is characteristically occupied by a verb. Since the syntactic properties of a position do not, by definition, depend on the lexical item or phrase that appears in that position, novel material in a given location is perceived as having the grammatical properties characteristic of that location. Thus *kivil* is recognized as a verb in 1 because it appears in the posi-

tion assigned the verbal element in such sentences as:

2. The boys eat the rabbits.
3. The boys do eat the rabbits.

For Braine, then, the syntactic properties of a segment are determined by the locations in which it occurs. A verb is defined as a word which characteristically appears in the second position in simple sentences, a noun is a word which characteristically appears in the first position in simple sentences, etc. To learn the syntactic properties of a word is primarily to learn the positions in which it can occur. In particular, given the positions a word can occupy in one sentence, we can often predict the positions which it may occupy in new sentences. From the fact that *eat* occupies the second position in 2, we can predict that it will occupy the homologous position in 4.

4. The wolves eat the rabbits.

Syntax assimilation thus consists of generalizing information about the positions in which a word is observed to occur. The correct use of a given word in a given position in new sentences is a consequence of such processes of generalization.

Braine holds that a description of word order accounts for much of the grammar of English and, consequently, that a theory which accounts for the learning of positions will have considerable explanatory power. Braine admits, however, that learning syntactic relations cannot consist solely of learning the appropriate relative positions of words and phrases. First, Braine points out, knowledge of relative positions would contribute little to the mastery of languages in which syntactic relations are expressed by inflection rather than order. Second, the notion of a position must be construed sufficiently abstractly so that a given sentential position can be occupied either by a word or by a phrase. (Notice, for example, that the "second" position in 3, i.e., the position functionally equivalent to the one occupied by "eat" in 2, is filled by the phrase "do eat.")

Some explanation is required for the fact that phrases may exhibit positional privileges analogous to those exhibited by single words. In short, an explanation is needed of how phrases can act as syntactic units.

To accommodate inflection as a syntactic device and to account for the integrity of the phrase, Braine resorts to a limited associationism. He postulates associative bonds between "closed-class" morphemes (e.g., inflections) and "open-class" morphemes such as nouns and verbs. For example, Braine would presumably hold that the phoneme "s" at the end of a noun is associated with the lack of a phoneme "s" at the end of a following verb and conversely. Such associations hold for simple declarative sentences like:

5. The boy eats the rabbits.
6. The boys eat the rabbits.

Braine believes that the formation of associations, augmented by position learning, is adequate to explain how the syntax of simple declarative sentences is learned. In effect, Braine considers such sentences to be sequences of "primary phrases." Primary phrases are themselves sequences of open- and closed-class morphemes connected by associative bonds. "The location learned is that of a unit within the next-larger containing unit of a hierarchy of units. There are hierarchies at two levels: within sentences the units are primary phrases and sequences of primary phrases; within primary phrases the ultimate units are morphemes [p. 348]."

Braine is aware that the information that certain sequences of linguistic elements behave as units and that such units can appear only in specified positions in simple sentences does not exhaust the speaker's knowledge of syntax. There are many different kinds of sentences allowing nearly all possible orders of words and primary phrases. Thus, if we take into account *all* the types of sentences in which it may occur, there are indefinitely many permissible locations of a linguistic unit (see examples, sen-

tences 35-41). A list of the positions available to a linguistic unit could at best specify its behavior in only a circumscribed part of the language. Yet it is only the learning of such a list that contextual generalization could explain.

Braine meets this objection by restricting the scope of his theory to the assimilation of the grammatical properties of simple declaratives. He maintains this restriction is not arbitrary since simple declaratives have psychological and linguistic characteristics which justify postulating special processes for their assimilation. Braine thinks simple declaratives may predominate in the child's verbal environment, thus forming the primary models from which the child's knowledge of his language is extrapolated. Second, Braine claims recent work in linguistics divides grammar into two parts.

According to Harris (1957) and Chomsky (1957), the grammar of a language can be hierarchized into an elementary part, called the "kernel" of the language, and a second part which consists of a set of transformational rules for deriving complex sentences from simple ones. The kernel grammar contains the definitions of the main parts of speech and describes rules for constructing simple declarative statements . . . [p. 340].

Thus, if we can explain the acquisition of simple declarative sentences, we have accounted for the basic component of the grammar. The remaining portion—the complex sentences produced by transformation—is to be described as a set of *sublanguages*, one sublanguage for each type of sentence (passive, relative, question, etc.). Rather than attempting to study English in its full complexity, Braine concludes ". . . it seems that it would be sound strategy to aim first at finding an explanation for the learning of the kernel of the language, i.e., for the learning of the structure of the simple declarative English sentence. This constitutes enough of a problem already [p. 342]."

Finally, Braine argues that perceptual learning, of which contextual generaliza-

tion is a special case, is a primitive process which does not demand much in the way of intellectual capacity of the learner. Contextual generalization would therefore satisfy at least one requirement on any process involved in first-language learning, namely, that it "not require intellectual capacities obviously beyond the reach of the 2-year-old [p. 326]."

If the learning of syntax is the generalization of the ordinal positions in which linguistic units appear, it is evident that the initial stage must consist in the perceptual isolation of such units. Braine claims that an argument for the feasibility of contextual generalization is that the boundaries of such units can be identified with certain specifiable properties of the speech signal.

Braine proposes two sorts of cues the child could use to identify these boundaries. One is "intonation": The stress, rhythm, and pitch patterns of sentences are assumed to be acoustic features which communicate information about segmentation. The other is the position of closed-class morphemes which, Braine holds, tends to delimit phrases.

We now turn to a discussion of these arguments. We first consider the claim that simple declaratives ought to receive special treatment. Second, we investigate whether the linguistic character of simple declaratives can be selected by reference to the syntactic properties of sentential positions. Third, we ask how much of the relation between simple declaratives and other types of sentences can be expressed by such a specification. Fourth, we consider broader issues raised by Braine's treatment of inflection, intonation, and perceptual isolation of units. Finally, we discuss his experimental techniques and results.

#### THE ROLE OF DECLARATIVE SENTENCES

Because he believes that a theory of the simple declarative sentences explains the basic part of the grammar and that such sentences predominate in the child's linguistic environment, Braine holds an account of the learning of simple declara-

tives is important even if it does nothing else. We shall return to the question of the kernel grammar presently. Let us first consider the claim that the verbal environment of the child exhibits a preponderance of grammatical simple declaratives.

It is clear that normal speech among adults does not exhibit any statistical bias towards fully grammatical simple declarative sentences. On the contrary, adult speech is usually ungrammatical (cf. Maclay & Osgood, 1959), and there is little evidence that adults engage in a careful limitation of their linguistic output when conversing with children.<sup>3</sup> Moreover, the verbal environment of children includes utterances produced by adults conversing among themselves, utterances produced by siblings with little command of the language, utterances heard on radio and television, etc. These diverse sources presumably form a heterogeneous verbal environment.

Even if simplified speech predominates in the child's verbal environment, there is no reason to suppose that the environment is unusually rich in simple declaratives. Analyses we have made of the speech of mothers taped during conversations with their children fail to support that hypothesis.<sup>4</sup> On the contrary, of a

<sup>3</sup> Brown and Bellugi (1964) do find a relatively large proportion of fully grammatical utterances in their recordings of mothers' speech to children. They do *not*, however, find that simple declaratives are preponderant among such utterances. On the contrary, in the only sample of their data they present (a sample which they say is "rather representative"), only one of the six sentences produced by the mother is of the simple declarative type.

<sup>4</sup> The data were supplied by Margaret Bullowa and her staff at the Massachusetts Mental Health Center. The total represents 38 half hours of recorded conversation between three mothers and their children taped at ages ranging from 6 to 30 months. Six transcripts were selected for analysis, greater weight being given the recordings made at 20 months than those made at 6 months.

Neither our judgments of grammaticality nor sentential type were checked for inter-

total of 432 utterances, 258 were fully grammatical. Of these, only 46 were simple declaratives.

Of course the character of the verbal environment plays a major role in language acquisition. It determines which language, vocabulary, style, and accent the child learns. *What is unknown, however, is which features of the verbal environment are critical for such learning.* There is, at present, no reason to believe that the learning of English is facilitated by a preponderance of simple declaratives in the child's sample of his language. Nor is there any reason to suppose that such a bias normally obtains.

We turn now to the question of whether the simple declarative has any formal or linguistic peculiarities to which its claim for special psycholinguistic status might be referred.

Braine makes a mistake that has unfortunately been common in psychological investigations concerned with generative grammar.<sup>5</sup> He supposes there exists a base or kernel grammar producing all and only simple declaratives and that the transformational operations producing complex sentences are defined over the declaratives generated by this base component. If this *were* the case, one

judge reliability. While some degree of latitude may be involved in judgments of the former kind, the criteria for the latter are reasonably objective. It is clear that there is need for an extensive survey of the verbal environment of the child; the data we have cited are intended only as preliminary.

<sup>5</sup> For examples of discussions in which this mistake appears to have been made, see Miller (1962); Miller, Galanter, and Pribram (1960); Osgood (1963); and Mehler (1963). All these assume that linguistics assigns a privileged status to the simple declarative. For example, Miller's (1962) discovery that it takes less time to find the passive corresponding to an active than to find the passive corresponding to a question is *not* explained by appeal to the linguistic fact that the active is the underlying form in the production of the passive and the question. There is no such linguistic fact.

might plausibly maintain that the status of the simple declarative as the underlying *linguistic* form justifies a parallel psycholinguistic precedence.

Braine is correct in asserting that there is a base form from which all syntactically related sentences are directly or indirectly derived. It is also true that base form is produced by a set of rules whose formal properties distinguish them from other rules in a generative grammar. *But it is not true that the base form is the simple declarative sentence.* The kernel grammar does *not* produce simple declarative sentences; it does not produce *any* sentences. Rather, the kernel grammar produces abstract structures that are transformed into a variety of different sentence types of which the simple declarative is one. In particular, the kernel sentence discussed by Chomsky (1957) should not be confused with these abstract structures. Kernel sentences differ from sentences of other types solely in that they are the consequence of applying only obligatory transformations to the kernel structure. Kernel sentences are thus in no sense the source for, or underlying form of, sentences of other syntactic types.<sup>6</sup>

Since the misunderstanding of the kernel notion has been widespread, it is worth indicating some of the linguistic considerations that militate against supposing the simple declarative to be the underlying form from which other sorts of sentences are derived. Consider the passive construction. We might attempt to derive 7b from 7a by a rule like that given in 8.

7a. The boy chases the dog.

7b. The dog is chased by the boy.

<sup>6</sup> That this has always been Chomsky's view is clear from a reading of *Syntactic Structures*. That Harris does not hold the simple declarative to be the base form follows from the fact that the notion of a derivation plays no role in Harris' theory. The mappings Harris (1957) employs in transformational analysis are characteristically symmetrical, hence there can be no questions of identifying an underlying syntactic form.

8. If  $NP_1$  Verb  $NP_2$  is a declarative sentence, and if  $NP_2$  is the object of the verb, then  $NP_2$  is Verbed by  $NP_1$  is the corresponding passive.<sup>7</sup>

But now, consider 10, the result of applying 8 to 9:

9. The boy chases the dogs.

10. \*The dogs is chased by the boy.

a string which is not grammatical for many dialects since the number of the verb should be determined by the subject. To avoid 10, Rule 8 must be split into two rules:

8a.  $NP_1$  V  $NP_2$  + sg  $\rightarrow$   $NP_2$  is V + ed by  $NP_1$ .

8b.  $NP_1$  V  $NP_2$  + pl  $\rightarrow$   $NP_2$  + s are V + ed by  $NP_1$ .

However, consider 12 and 14, the result of the application of 8a to 11 and 13 respectively.<sup>8</sup>

11. The boy is chasing the dog.

12. \*The dog is is chasing ed by the boy.

<sup>7</sup>We shall adhere to the notational conventions employed by linguists. In particular, ungrammatical strings will be preceded by \*.  $\emptyset$  stands for the zero number of a linguistic class (the plural of the English word "sheep" is thus "sheep +  $\emptyset$ "). The following abbreviations will also be employed: NP for Noun Phrase, T for Article, VP for Verb Phrase, S for Sentence, N for Noun, V for Verb, sg for the singular morpheme, pres for the present-tense morpheme, pl for the plural morpheme, Det for determiner. Be will be used to designate any inflection of the verb "to be."

<sup>8</sup>If 8a can be allowed to interpret *is chasing* as a V at all, then it produces the incorrect form \*12; if it cannot, then another new rule is required to produce 19 from 11. In all the examples in this paper, we do not claim to present the unique solutions and rules, either for those formulations which we show to be essentially incorrect or for those that are essentially correct. All the rules are considered out of the context of a presumed full grammar. In that context they might appear somewhat differently—but the distinctions and characteristics with which we are concerned will remain unchanged.

13. The boy chased the dog.

14. \*The dog is chased ed by the boy.

Just as the difference in the number of the object required us to adopt different passive rules for 7a and 9, so two more rules, 8c and d, will be required to passivize 11 and 15:

15. The boy is chasing the dogs.

8c.  $NP_1$  is V ing  $NP_2$  + sg  $\rightarrow$   $NP_2$  + sg is being V ed by  $NP_1$ .

8d.  $NP_1$  is V ing  $NP_2$  + pl  $\rightarrow$   $NP_2$  + pl are being V ed by  $NP_1$ .

and similarly for 13 and 16.

16. The boy chased the dogs.

8e.  $NP_1$  V + ed  $NP_2$  + sg  $\rightarrow$   $NP_2$  + sg was V + ed by  $NP_1$ .

8f.  $NP_1$  V + ed  $NP_2$  + pl  $\rightarrow$   $NP_2$  + pl were V + ed by  $NP_2$ .

In general, if we derive passives from their corresponding actives, a different passive rule is required for each choice of object number and verb tense. For five tenses and two numbers there are at least 10 rules required to derive the simple passive from declarative sentences. Furthermore, even these 10 rules will not serve to derive the passive of more complicated sentences. For example, we will need special rules for:

16a. Does the boy chase the dog?

16b. Is the boy being chased by the dog?

17a. Why does the boy chase the dog?

17b. Why is the dog chased by the boy?

and so on.

In each of the cases we have discussed, the problem clearly arises from the attempt to derive the passive from its corresponding declarative. This difficulty would be avoided were it possible to define the transformation which rearranges the subject and object phrases so that it applies prior to the attachment of tense and number to the verb. In this way we specify the operations on the noun and verb relevant to passivization *without reference to the particular*

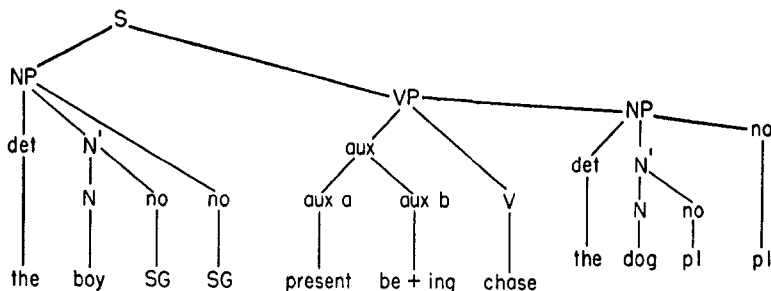


FIG. 1. Tree diagram of the underlying (untransformed) structure of the sentence: "The boy is chasing the dog."

*choice of tense and number they exhibit in a given sentence.* This rule is easily formulated:

18.  $NP_1 \text{ aux } V \text{ NP}_2$  is rewritten as  $NP_2 \text{ aux be} + \text{Past part. } V \text{ by } NP_1$ .

However, it can be applied to generate all passives only if suitable abstract representations of sentences are provided as its domain. For example, the passive sentence, 19:

19. The dogs are being chased by the boy.

has, as its corresponding active, Sentence 15. Yet, if 19 is to be generated by an application of Rule 18, 15 cannot be its source, since 15 does not possess the formal properties required of strings in the domain of 18. No definite sense can therefore be given to the notion of applying 18 to 15. Rather, the source for 19 is the abstract illustrated in Figure 1.<sup>9</sup>

<sup>9</sup> Of course, the result of 18's application to the structure in Figure 1 is *not* an actual sentence. The full derivation of Sentence 19 from the structure represented in Figure 1 is accomplished in at least three steps: (a) Rule 18 converts it into the string (constituent structure is not marked here) *the dog pl pres be+ing be+Past part. chase by the boy sg sg*; (b) an affix-attachment rule (affix,  $V \rightarrow V + \text{affix}$ ) then applies to produce the string *the dog pl be+pl+pres be+ing chase+Past part. by the boy sg sg*; (c) morphophonemic "spelling" rules convert this into Sentence 19 (see the paragraph following 33 in this paper and Chomsky, 1957, for other examples of affix movement and sentence derivations). The concept of the

It can be demonstrated that derivations employing Rule 18 can account for the examples we have investigated so far. This means, in effect, that we have eliminated the proliferation of passive rules by insuring that inflections of number and tense are not specified by the passive rule. To do this, however, we have had to assume that the underlying form from which the passive derives is not a corresponding active but rather an abstract structure never realized in speech. Since analogous considerations show that the active itself is merely one of the deformations of this underlying structure, there would appear to be nothing in the linguistic theory of the derivation of English sentences which would justify assigning a special status to active declarative sentences.

abstract and concrete level in sentences is a formal representation of many intuitions: for example, the difference between "logical" and "apparent" grammatical relations, the description of relations among sentences, and so on (see Fodor & Katz, 1964, for various discussions). Notice that by having the affix-attachment rule follow the passivization rule, 18, we avoid formally the multiplication of passive rules. Thus, this analysis is a formal account of the intuition that "passive" sentence is a unitary notion, and the intuition that it is the number of the apparent subject of the verb which determines verb number in English, not the number of the underlying or "logical" subject (see the section on inflection and Footnote 10 in this paper).

# CONTEXTUAL GENERALIZATION AND THE LEARNING OF POSITION

Suppose, however, that we grant Braine's assumption that there is some point to a special theory of the psychological processes underlying the learning of the syntax of declaratives. We must ask how much of the character of such sentences emerges from an analysis of the order relations among their constituents. We shall see that very little of the speaker's knowledge of the syntactic structure of simple declaratives can be attributed to having learned such relations.

To see how little of the syntax of a simple declarative is expressed by order, it is only necessary to consider sentences whose grammatical structure is not so expressed. Thus a speaker who knows that 20 and 21 are sentences also knows that while 22 is perfectly good English, there is something wrong with the syntax of 23.

20. The kangaroo cost 10 dollars.

21. The child blew the kazoo.

22. The kazoo was blown by the child.

23. \*Ten dollars was cost by the kangaroo.

This example is particularly embarrassing for Braine, since 20 and 23 exhibit precisely the sort of positional relations on the basis of which contextual generalization is supposed to operate. That is, since both "10 dollars" and "the kazoo" appear postverbally, and since "The kazoo" appears preverbally in 22, the operation of contextual generalization ought to permit the preverbal appearance of "Ten dollars" in 23. The ungrammaticality of 23 suggests that there must be a difference between "blow" and "cost." Though this difference is not revealed by their positional privileges in simple declaratives, it is decisive for determining how passivization operates in sentences in which they occur.

A similar case is the following:

24. John phoned Jane up.

25. John phoned up Jane.

26. John phoned her up.

27. \*John phoned up her.

Since "up" appears in the fourth and third positions respectively in 24 and 25, and since it appears in the fourth position in 26, Braine's theory predicts that place generalization requires its occurrence in 27. This prediction is incorrect. On the contrary, it is a necessary condition upon the grammaticality of sentences of the form:

28. John phoned up X.

that X not be a pronoun. Hence, if we are able to formulate the rule which permits 25 but precludes 27, we must take account not only of the ordinal positions of the words in those strings, *but also of the syntactic classes to which the words belong.*

These examples are a consequence of a quite general fact: *the types of expression that can appear at a given ordinal position in a simple declarative sentence are extremely heterogeneous.* This fact is of the utmost importance for an evaluation of Braine's theory. For it entails that contextual generalization is an inadequate mechanism for extrapolating the grammatical regularities the child observes in his language. Many types of expression can appear at a given sentential position. Hence sentences exhibiting precisely the same ordinal relations among their segments may nevertheless be of different syntactic types. Since the operation of contextual generalization requires only that features of order be common to conditioned stimulus and generalized stimulus, it follows that we cannot infer that String S is a sentence whenever there exists a sentence, S', related to S in a way that satisfies the conditions for contextual generalization.

To put it slightly differently, the examples just discussed demonstrate that some of our information about the syntactic character of simple declaratives cannot be expressed in terms of location information; rules which determine the interrelations among simple declaratives and the relations between simple declaratives and other sorts of sentences



distinguish between expressions that can appear in a given location.

The similarity between Braine's view and that of Jenkins and Palermo (1964) is most evident at this point. Jenkins and Palermo apparently hold that the syntactic structure of a sentence can be expressed by a sequence of markers representing the classes of which the words comprising the sentence are members. Thus, they remark that "... the ideas we want to present here are of two sorts: *sequence* and *class* [p. 164]" and that

"Colorless green ideas sleep furiously" is a sentence in English not because it is true, or sensible, or interpretable by the listener, but because it is a "correct" assembly of classes appropriately modulated (*i.e.*, they are the right general classes of entries properly modified to take their places in the particular sequence). . . . The critical question, then, is seen to be that of the organization of the elements into classes [p. 164].

It is thus evident that Jenkins and Palermo's view of syntax is simply a weaker version of Braine's. For while Jenkins and Palermo acknowledge only sequences of class markers (and inflection), Braine has noticed the necessity of providing some psychological mechanism to account for the phrase structure of such sequences.

In short, there is no basis for Jenkins and Palermo's belief that the employment of mediational paradigms affords a breakthrough in the study of syntax assimilation. Though the formation of word classes can perhaps be accounted for by such paradigms, they throw no light whatever upon the assimilation of even such relatively superficial syntactic features as phrase structures. It goes without saying that appeals to them are utterly unilluminating on the question of how the child learns the deep syntactic structures with which this paper is primarily concerned.

#### THE DERIVATION OF ORDER

Thus far we have noted one sense in which order is a relatively unimportant

feature of syntactic structure even in English where inflection is not widely used: Identity of order relations is compatible with considerable differences in syntactic form. There is a more important point which also stems from Braine's failure to distinguish between underlying and surface structure. Often a correct formulation of the rules determining syntactic structure requires distinguishing between the order of lexical items in the sentence and in the underlying representation from which the sentence is derived. While contextual generalization might conceivably account for learning the former, it is patent that it could not account for the learning of the latter.

For example, in our discussion of the passive we treated *be + ing* as a unit in the underlying representation of sentences like 15. There are intuitive and formal advantages to this treatment. It permits us to account for the intuition that *be + ing* functions as a semantic unit indicating a particular mode of the main verb. Moreover, treating these morphemes as a single item permits us to account for the fact that such strings as:

29a. \*The man is chase the dog.

29b. \*The man chasing the dog.

are not sentences: If *be + ing* is represented as a lexical unit, one of the morphemes comprising that unit cannot be selected without also selecting the other.

Cases in which simplicity of representation and linguistic intuition require an underlying order differing from the order of elements in the manifest sentence are found throughout English. Thus in sentences 24-27, the underlying form of the verb must be *phone + up*, since English restricts the particles that can accompany certain verbs. Thus we have no

30a. \*John phoned down the girl.

30b. \*John phoned the girl down.

Similarly, 31a, but not 31b, is grammatical.

31a. They looked the house over.

31b. \*They looked the house in.

To account for such examples and for the fact that the verb-particle sequence forms a semantic unit, such sequences are recorded in the underlying form as *verb + particle*. But notice that, though the particle precedes the object in the *underlying* representation of 27, a mandatory transformation of that underlying structure permutes the particle and the object whenever the latter is a pronoun. Hence the underlying form of 27 has a different order from its manifest form. Moreover, this underlying order is *never* directly reflected in an actual sentence.

Finally, even the very simplest sentences derive from an underlying form in which the order of the elements differs from the manifest order. Consider:

32. The child runs.

The terminal portion of the tree representing the underlying structure of this sentence is:

33. Det N sg pres V.  
Øə/čaild/run.

The tense marking (present) precedes the verb phrase in the underlying structure in order to permit a uniform treatment with more complicated sentences. In the manifest sentence, the tense marker is always attached to the first verbal element in the verb phrase whether that element is an auxiliary, modal, or compound verb. This is accomplished for complicated expansions of the auxiliary by a rule which permutes the tense marker with the adjacent verbal element to the right. If the tense and verb order for 32 were not as represented in 33, 32 would constitute an exception to this rule and would thus require a complication of the grammar (cf. Chomsky, 1957, and Footnote 9).

This indirect relation between the order of elements in the underlying form and their order in the manifest sentence poses serious problems for *any* theory of syntax learning. It is clear that the child never encounters manifest models

of the underlying sentence order. Adults do not utter such sequences as:

34. Øə čaild s run.

We have seen, however, that in a formalization of English grammar 34 represents a step in the derivation of 32. Hence, if the child who learns English learns the rules governing the syntax, it follows that he *must learn to manipulate underlying structures, for which his verbal environment provides him with no explicit models*. It is evident that contextual generalization, simply because it is a variety of generalization, cannot account for such learning.

### "SUBLANGUAGES"

We have seen that relatively little of the syntactic character of simple declarative sentences can be expressed in terms of the manifest order of their constituents. We now ask how much of the syntactic relations between simple declarative and other types of sentences can be expressed in those terms. We maintain that the behavior of a linguistic unit in complex sentences cannot be captured by a theory which represents its syntactic properties by a list of the positions it is capable of occupying. There are two reasons for this, one of which Braine acknowledges; the other has escaped him.

It is clearly possible to construct complicated sentences exhibiting almost any order of syntactic constituents. Thus in Sentence 15, Braine would presumably distinguish three major positions occupied, respectively, by *the boy*, *is chasing*, and *the dogs*. The relations between these three positions are, however, very flexible. Consider:

35. The dogs are being chased by the boy.

36. It is the dogs the boy is chasing.

37. What is being chased by the boy are the dogs.

38. What the boy is chasing are the dogs.

39. It is the dogs that are being chased by the boy.

40. Chasing them is what the boy is doing to the dogs.

41. Chasing the dogs is what the boy is doing.

Far from it being the case, as Braine suggests, that transformation tends to produce relatively minor variations in order, examples 35–41 show that order is the syntactic property transformation is least likely to preserve.

Braine is aware that relative order is preserved only within sentences of the same syntactic type. This leads him to suggest that natural languages should be thought of as systems of "sublanguages," distinguished by a characteristic constituent order. This suggestion is defective in a number of ways. First, if sublanguages are specified solely by the ordinal relations of their constituents, there must be an infinity of sublanguages since sentences in a natural language may be arbitrarily long, and every pair of sentences which differ in length will ipso facto differ in constituent order at some level. It is thus logically impossible that the child should master his language by learning one sublanguage after another.

The preceding demonstrates what was shown above on purely syntactic grounds: The differences between types of sentences cannot, in general, be specified in terms of differences in constituent orders since sublanguages cannot be defined in those terms.

This can be seen most strikingly in the ambiguity of such sentences as:

42. The office of the president is vacant.

where the lexical items and order of constituents *at all levels* are the same on both readings despite the fact that any reasonable analysis of English into sublanguages must assign 42 to two sublanguages, because it can be questioned in two quite different ways (cf. 43 and 44):

43. Where is the office of the president?

44. Who held the office of the president?

There are other examples which illustrate the impossibility of exploiting constituent order to capture relations between syntactically different types of sentences: 45 is related to 46 rather than to 47 while the reverse holds for 48.

45. John is easy to please.

46. They please John.

47. John pleases them.

48. John is eager to please.

Since, however, the constituents of 45 and 47 are ordered in precisely the same way, we cannot appeal to order to explain the relations between the sublanguages these sentences belong to.

These examples reflect a fact that must be evident to anyone who has seriously considered the problem of describing the syntactic structure of a language like English: Very few of the interrelations between types of sentences are expressed by similarities and differences of manifest order. Rather, a theory which marks such interrelations must do so in terms of highly abstract constructs such as the phrase analyses and transformational histories underlying sentences. Linguistic evidence shows that no simpler apparatus explains intersentential relations that are intuitively evident to native speakers. It follows that Braine's attempt to specify sublanguages and their interrelations in terms of constituent order can be of no serious explanatory value.

#### INFLECTION

We now turn to some of the broader issues raised by Braine's theory. The first arises from difficulties implicit in Braine's assumption that the processes employed in learning order languages are different in kind from those employed in learning inflected languages.

The search for the mechanism of syntax acquisition is, presumably, a search for species-specific capacities common to all children. An adequate theory of syntax acquisition must explain the ability of a child to learn any language to which he happens to be exposed. It follows that a theory of language learning which makes essential reference to

linguistic features specific to a particular language or group of languages is necessarily suspect. However, one of Braine's arguments for contextual generalization rests on the fact that constituent order is a major device for expressing syntactic structure in English. It is thus notable that, whatever the relevance of word order to English, there exists a host of languages in which surface order is far less constrained (Russian and German, for example). The notion that contextual generalization is essential for the learning of syntax is thus incompatible with the assumption that the language-learning mechanisms are independent of the peculiarities of particular languages. Rather, Braine's position requires either that the child has different mechanisms with which to learn different languages (contextual generalization for English but not for Russian) or that he has a universal mechanism which, however, is biased to learning certain languages. The first of these suggestions is unparsimonious and not easily reconciled with the fact that languages *do* exhibit a number of important universal properties, suggesting a corresponding pretuning of the language-learning mechanisms (cf. Lenneberg, 1964). The second assumption is tantamount to the naïve view that some languages are "harder" than others. It can be maintained only in face of the fact that there exists no evidence that children find languages in which position is constrained easier to learn than languages in which it is not. Indeed, there exists no evidence that children find *any* natural language harder to learn than any other. (Compare the well-known differences in the assimilability of formally different types of writing systems.) In short, it is presumably the commonalities, not the differences, between natural languages that provide us with insight into the mechanisms underlying their assimilation.

In fact, the distinction between underlying and manifest sentence structure resolves the difficulty posed by the existence of inflection and order as alternative means for expression of syntactic rela-

tions. The difference between an "ordering" language and an "inflected" language is *one which concerns the manifest sentence only*: The structure of the underlying forms is similar in both types of languages as are the kinds of transformations which apply to the underlying representations.

In general the rules which determine inflection are formulated with reference to the order and function of elements in an underlying representation of a sentence. This underlying order may, of course, be deformed by the operation of later rules. For example, in Latin, the manifest sentences:

49a. *Puer amat eam.*

49b. *Eam amat puer.*

49c. *Amat puer eam.*

49d. *Puer eam amat.*

49e. *Eam puer amat.*

49f. *Amat eam puer.*

all share the same underlying form:

50. *puer + sg pres + am ea + sg.*

*ea* has the accusative attached because it is in the object position in the underlying form, while *eo*, because it is in subject position, remains nominative. Subsequent transformations in Latin allow freedom of order in the manifest sentence, while preserving inflections of case and number attachment acquired in the underlying string.

The inflection of words in manifest sentences thus depends on the order of elements in their underlying representations. Inflection is *a direct reflection of the structural relations in the underlying form*. We have already seen that languages which constrain manifest order do so as a way of exhibiting underlying structural relations. Thus, the difference between inflecting and order language is a matter of how the underlying relations are reflected in the speech signal.<sup>10</sup>

<sup>10</sup> In fact, the most important difference between "ordering" and "inflecting" languages concerns the order in which syntactic rules are applied in generating sentences. Thus, derivations in "inflecting" languages tend to apply the rules which determine in-

In both cases, however, the same types of rules apply to abstract representations which underlie the manifest sentences. In both cases, it is primarily the assimilation of the rules for generating these underlying structures and for deforming them into manifest sentences that a theory of language learning must explain. A theory which affords such an explanation would ipso facto provide a *uniform* treatment of the learning of inflected and uninflected languages.

#### PERCEPTUAL SEGMENTATION AND INTONATION

We have argued that the generalization of position does not account for the learning of syntax. We now consider Braine's claim that the discrimination of acoustic properties of speech signals accounts for the learning of segmentation.

According to Braine, normal speech indicates its segmentation by stress, pitch, juncture, intonation pattern, etc. Braine reports brief experiments in which a nonsense utterance was spoken with differing stress patterns. Subjects were asked to respond with sentences which seemed grammatically similar. The major syntactic division in the response corresponded to the boundary following the stressed nonsense word. Braine concludes that stress and intonation are capable of transmitting structure.

Beyond doubt, extra stresses or artificially introduced pauses can induce structure in a random sequence. In natural speech, however, it is extremely difficult to determine the physical parameters which signal structural units. They cannot be simple pauses, for often large constituent breaks are not marked by pauses while relatively minor ones are

coincident with large acoustic gaps. Physical intensity is directly related to "stress" only in the case of special emphasis, and "intonation" often does not correspond to the actual pitch of the voice fundamental. Indeed, it is the rule that the acoustic analogue of linguistic percepts is either found to be extremely complex or is not found at all. Though pauses, stress, sound units, intonations, etc. are *heard* as objective features of the flow of speech, it appears that these percepts are, in fact, the result of some elaborate manipulation of the acoustic data. In the case of stress and pauses in English it is clear that they are usually a function of the syntactic structures underlying the speech signal as well as its acoustics.<sup>11</sup>

If, however, such perceptual correlates of structure as stress, pause, and intonation have no simple acoustic analogues, it is pointless to argue that the child's learning of segmentation consists of the discrimination of stress, pause, and intonation. For the problem then arises of how the child *learns to hear* stress, pause, and intonation correctly. Insofar as perception of the correlates of segmentation is the result of complicated integrations of the acoustic signal with the syntax, the child cannot be capable of perceiving them before he has learned to analyze syntactic structure.

This difficulty raises doubts about the description of language learning according to which the child first isolates individual speech sounds and then groups them successively into words, phrases, and simple sentences. For example, it is widely accepted in the literature that the child effectively masters the intonation pattern of his language *before he has learned any words at all*.<sup>12</sup> Since

flexion (e.g., affix movement in Footnote 9) before the rules that rearrange constituents (e.g., passivization in Rule 18). In "order" languages the reverse is typically the case. "Order" languages express underlying relations in the order of elements in the manifest sentence.

We are indebted to M. D. S. Braine for pointing out an error in our original example from Latin.

<sup>11</sup> For a theoretical analysis of the relation between syntactic structure and stress see Chomsky and Miller (1963). Lieberman (in press) has shown experimentally that the perception of intonation and stress is dependent on a knowledge of the syntactic structure.

<sup>12</sup> See Jakobson (1941), Grégoire (1937), and McCarthy (1954). Jakobson has described this period of intonation imitation

intonation is intimately related to syntactic structure, this indicates that the order of assimilation of syntactic structures is unlikely to be the one mentioned above. Instead, it suggests that derived constituent structure may be among the earliest syntactic information assimilated.

In short, the correct interpretation may be not that the perceived location of pause, stress, and intonation are the child's clue to the analysis of structure, but rather that the prior analysis of structure is what determines where the child learns to hear pause, stress, and intonation. Nor is the possibility of some intermediate position excluded.

#### EXPERIMENTATION ON CONTEXTUAL GENERALIZATION

We have considered some inadequacies of explanations of syntax assimilation that appeal to contextual generalization. However, Braine has shown that subjects *can* learn miniature artificial languages whose constituents are nonsense words by position generalization. This may appear to provide a foundation for theories of language learning in which contextual generalization plays an important role. However, Braine's results are equivocal. A brief discussion of his experimental techniques is therefore in order.

There is some danger in applying results garnered in the study of the learning of artificial languages by latency-aged children to the learning of first languages by preschoolers. First, it is possible that the psychological processes mediating the learning of first languages are pretuned for the assimilation of systems having quite specific formal properties. If this is correct, very little will be revealed about these processes by studying the assimilation of artificial languages whose structure is arbitrarily different from that of natural languages.

Second, as Thorpe (1961) has suggested, the learning of language may be one of the capacities for which

there . . . exist specific brain mechanisms ready to be activated during and only during a particular period of the life span of the child and . . . if they are not properly activated at the right time subsequent activation is difficult or impossible, resulting in permanent disabilities in later life [p. 200; cf. also Penfield & Roberts, 1959].

This speculation supports the widely held view that adults learn second languages in a manner essentially different from the way children learn first languages.

Braine has attempted to control for this source of error by replicating the simpler of his experiments with a population of 4-year-olds. The point is not, however, that very young children may be incapable of contextual generalization. It is rather that there may be language-learning processes operative in younger children which do not occur in older ones. Braine controls for the former but not the latter of these possibilities.

We now consider the details of Braine's experiments. It is essential to Braine's argument to demonstrate the existence of contextual generalization among phrases as well as words. We have seen that Braine defines the notion of a position in such a way that it may be occupied by a word in one sentence and by a phrase in another.

Braine's experiments are thus divided into two groups. The first demonstrates contextual generalization in a language whose sentences are all of the type shown

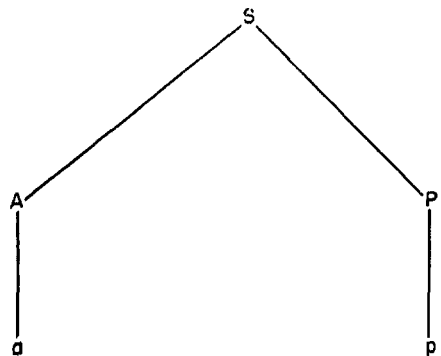


FIG. 2. Tree diagram of the alleged structure of nonsense sentences in Braine's *a + p* language.

(around 1-1½ years) as the period when the child "speaks without words."

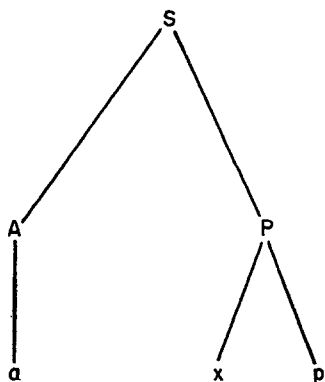


FIG. 3. Tree diagram of the alleged structure of the nonsense sentences in Braine's  $a + xp$  language.

in Figure 2, where A and P are classes of single (nonsense) words, and a and p are items drawn from those classes.

Braine's second experiment purports to show that contextual generalization can also function when the constituents are phrases. Here Braine uses language in which sentences are said to be either of the type shown in Figures 3 or 4.

But Braine provides no support for the analyses of the String  $axp$  in Figures 3 and 4 beyond the remark that, in the situations where  $ax$  was intended to have phrase status, a and x were presented together, while in the situation where  $xp$  was intended to have phrase status, x and p were presented together.

In short, Braine's experimentation is at least compatible with the interpretation that what his subjects *learned* were strings with the structure exhibited in Figure 5. So long as this interpreta-

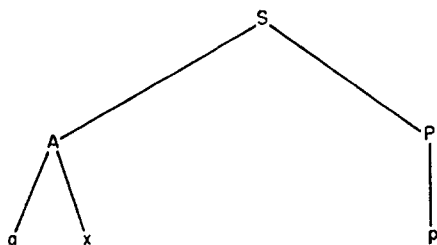


FIG. 4. Tree diagram of the alleged structure of the nonsense sentences in Braine's  $ax + p$  language.

tion remains open, Braine can hardly claim that his experiments demonstrate contextual generalization among phrase-length constituents.

In experiments with artificial languages consisting of a finite set of strings, it is extremely difficult to support claims about the psychological reality of abstract structures like phrases. In natural languages, appeals to the intuitions of speakers concerning the appropriate segmentation of sentences constrain phrase analyses to some extent. More important, formulation of the rules for transformation and stress imposes certain requirements upon the phrase-structure analysis since the phrase structure articulates the domain to which these rules apply. In the case of the artificial languages Braine studies, neither of these considerations holds. Speakers do not have structural intuitions

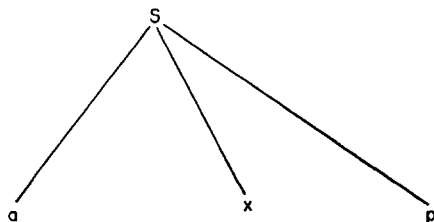


FIG. 5. A possible alternative structure for sentences allegedly belonging either to  $a + xp$  or to  $ax + p$  languages.

about artificial language, and no language which consists of a finite set of strings requires phrase-structure rules in its grammar, for any such language can be enumerated by a simple list. If, therefore, it is suggested that Braine's subjects may not have analyzed the stimulus material in the way Braine wanted them to, it is difficult to see what reply he could make.

The difficulty may have stemmed from Braine's belief that the process responsible for the perceptual integrity of the phrase is association. On that view, co-presentation of pairs of nonsense syllables would perhaps tend to establish such pairs as phrases. The fact that the pairs of items intended to be perceived

as phrases were presented together would thus help to justify the analysis provided in Figures 3 and 4.

The claim that the integrity of the phrase is mediated by processes of association is, however, totally untenable. Phrases in natural language can exhibit grammatical dependencies across strings of arbitrary length. It is thus inconceivable that the psychological unity of phrases could be attributed to associative bonds between the elements. Conversely, the suggestion that the basis of phrase integrity is associationistic in short phrases but that some different and unknown psychological mechanism operates in longer phrases is too evidently ad hoc to merit considerations.

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(Received August 31, 1964)