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AUTHOR Dulay, Heidi; Burt, Marina
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ABSTRACT

Previous work by the authors permitted them to hypothesize the existence of certain universal cognitive strategies that play a significant role in child second language acquisition. Forming the basis of the "creative construction process" in L2 learning, these strategies have heretofore remained unspecified. This paper offers new perspectives on the specific nature of the creative construction process: first, by an attempt to use Brown's notions of semantic and linguistic complexity to account for differences between first and second language acquisition; second, by a clarification of the notions of "learning complexity" and "learning strategy"; and finally, by presenting a new analytical procedure and framework which may be useful in research on children's strategies in acquiring L2 syntax. This new procedure involves an adaptation of Bart and Krus' "Ordering- Theoretic Method," which assumes that there is a logical relationship among items in a group, and which is designed to determine those relationships. The ultimate value of this type of analysis lies in its potential to uncover the sorts of empirical facts needed before one can begin to specify with any confidence the nature of language acquisition strategies. (Author/DB)

A NEW PERSPECTIVE ON THE CREATIVE CONSTRUCTION PROCESS IN CHILD SECOND LANGUAGE ACQUISITION

Heidi Dulay and Marina Burt
Puerto Rican Studies Dept. Bilingual Education Program
State University of New York at Albany

BACKGROUND

This paper is the fourth episode in our continuing efforts to discover how children learn the syntax of a second language. The investigation began with a treatment of the serious conflict between two accounts of how a language is acquired -- a conflict that starts with the most abstract theoretical assumptions about the nature of language learning and continues through to the level of pedagogical consequences. The habit formation account of language acquisition states that language is learned by imitation, reinforcement of the correct associations between verbal responses, immediate correction of incorrect responses. This view has been seriously questioned -- first by the logical arguments of Chomsky's transformational account of the nature of language and also by the growing findings of first language acquisition research. According to Roger Brown (1973a: 105), "A radically different possibility is that children work out rules for the speech they hear, passing from levels of lesser to greater complexity, simply because the human species is programmed at a certain period in its life to operate in this fashion on linguistic input." We have called this account the creative construction process.

In 1970, when this (still unfinished) investigation began, there was virtually no research on the process of child second language learning. Most of the published literature dealt with the problems and methods of teaching. This curious state of affairs was probably due to the widespread acceptance of the behaviorist learning principles developed by experimental psychology, namely, the principles of habit formation. However, since the first language acquisition findings of the last decade have contradicted the principles of habit formation in child language learning, it is no longer justifiable to assume the adequacy of those principles for second language learning.

An empirical test of both theories was, therefore, the first research task undertaken. The study focussed on the question: Do children tend to use the structures of their native language when trying to speak a second language and therefore make "interference errors" when the structures of the two languages differ? (as predicted by habit formation). Or do they reconstruct the new language and therefore make "developmental errors" that are similar to those made by children learning English as a first language? (as predicted by creative construction). The results of this study showed that the major portion of the error types can be explained by creative construction rather than habit formation. (Dulay and Burt 1972 and 1974a) Consequently, a second study was undertaken to further investigate the creative construction process in second language (L2) acquisition.

If it is true that certain universal cognitive mechanisms control the way in which children organize linguistic input (the assumption underlying creative construction), this should be manifested by certain regularities in children's L2 speech. We chose to explore acquisition sequences of certain grammatical structures, since Roger Brown and his colleagues had discovered an "invariant sequence" in L1 acquisition and had made important breakthroughs in research methodology in this area. Therefore, the second study in this investigation (Dulay and Burt 1973) asked: Given interaction with English-speaking peers, is there a natural sequence in Spanish-speaking children's acquisition of certain English grammatical structures? We found that for three different groups of children (Chicano children in Sacramento, California; Mexican children living in Tijuana, Mexico, but attending school in San Ysidro, California; and Puerto Rican children in New York City) the acquisition sequence of the following eight structures was approximately the same: plural (-s), progressive (-ing), copula (is), article (a, the), auxiliary (is), irregular past (ate, took, etc.), 3rd person singular (-s), and possessive (Noun-'s).

Encouraged by this finding, a more rigorous and comprehensive study was undertaken (Dulay and Burt 1974). It compared the acquisition order of 11 English functors[1] by Chinese- and Spanish-speaking children learning English in an environment that included English-speaking peers. Contrary to popular intuition, we found an acquisition sequence that was approximately the same for both the Spanish and Chinese children.

This series of studies provides strong support for the creative construction process in child second language acquisition -- the process

[1] The 8 functors in the previous study, plus pronoun case (nominative-accusative), regular past (-ed) and long plural (-es).

in which children gradually reconstruct rules for the speech they hear, guided by universal innate mechanisms which cause them to use certain strategies to organize that linguistic input, until the mismatch between the language system they are exposed to and what they produce is resolved. The child's construction of linguistic rules is said to be creative because no native speaker of the target language--whether peer, parent or teacher --models many of the kinds of sentences produced regularly by children who are still learning the basic syntactic structures of a language.

The unavoidable question now arises: What is the specific nature of the creative construction process in second language learning? So far, we have used empirical observations of children's second language speech solely to provide the basis for a decision about the general nature of the child L2 acquisition process. All of our work so far permits us to say only that there must be certain universal cognitive strategies that play a significant role in child second language acquisition. The specification of those strategies still remains very much a question. This paper offers some new perspectives on the creative construction process, first by an attempt to use Brown's notions of semantic and linguistic complexity to account for differences between first and second language acquisition; second, by a clarification of the notions "learning complexity" and "learning strategy"; and finally, by presenting a new analytical procedure and framework which may be useful in the search for children's strategies in the acquisition of second language syntax.

A FIRST ATTEMPT

At this point in our research we can no longer hypothesize similarities between L2 and L1 acquisition as we did at the outset of our investigations. Although both the L2 and the L1 learner reconstruct the language they are learning, it is intuitive to expect that the manner in which they do so will differ. Children learning a second language[1] are older than L1 learners; they are farther along in their cognitive development, and have experienced learning a language once before. These factors should combine to make the specific strategies of the creative construction process in L2 acquisition somewhat different from those of the creative construction process in L1 acquisition.

However, it was difficult to part with the L1 research crutch that

[1] not including children learning two languages simultaneously as their "first language", as in Swain's (1972) study of "Bilingualism as a First Language".

had been so helpful till now. And indeed, it was not yet necessary, for speculation about the differences between L1 and L2 suggested a manageable research plan to begin to approach L2 acquisition strategies.

After an exhaustive analysis of the semantic and grammatical complexity of the functors in his acquisition studies, Brown concluded that "the order of acquisition is dependent upon relative complexity, grammatical and/or semantic" (1973b: 255). In other words, the two major "determinants of acquisition" for the L1 order were, according to Brown, semantic and grammatical (or "linguistic") complexity. He defined semantic complexity as the number of major meanings of roughly equal weight expressed by a functor. The greater the number of major meanings, the more semantically complex that functor should be. He defined linguistic complexity in terms of "derivational complexity": the more transformations required in the derivation of a functor (according to the Jacobs and Rosenbaum (1968) analysis) the more linguistically complex that functor should be.

It seems intuitive that children who are acquiring their first language have to deal with both semantic and syntactic information. However, six, seven and eight year old children learning a second language need not struggle with semantic concepts they have already acquired, such as concepts of immediate past, possession, or progressive action. Thus, one would not expect the semantic complexity of functors already acquired in L1 to be a major determinant of the order of those functors in L2 acquisition. If this is correct, the functor acquisition sequences for L1 and L2 should differ significantly due at least to the absence of the semantic complexity factor in L2. The importance of such a finding would be that conceptual development, at least for those concepts expressed by the functors, could be safely discarded as a major explanatory device for L2 acquisition sequences.

This task involves two steps:

1. A comparison of the L2 and L1 functor sequences

2. An examination of the predictions made by Brown's semantic and linguistic complexity factors from the viewpoint of their explanatory power for the L2 sequence obtained.

Comparison of L2 and L1 Functor Sequences

Fortunately, in a previous study on L2 acquisition order (the third episode summarized above, Dulay and Burt, 1974), 9 of Brown's 14 functors had been included. Thus, we only needed to compare the sequence we had already obtained for L2 with that of Brown, making the appropriate adjustments to include only the 9 functors found in both L1 and L2 studies. Table 1 lists the L1 rank orders obtained by Brown (1973b) and by the de Villiers' cross-sectional study (1973) along with the L2 rank orders we obtained using three different methods of analysis (these methods are described in detail in Dulay and Burt, 1974b).

Table 1 — L1 AND L2 ORDERS FOR 9 FUNCTORS

	L1 RANK ORDER			L2 RANK ORDER		
	Brown	De Villiers Method I	De Villiers Method II	Group Score	Group Means	SAI
-Ing	1	1.5	2	3	2.5	2.5
Plural	2	1.5	1	4	4	5
Past-irreg	3	3	3	7	7.5	7.5
Possessive	4	5	6	8	7.5	6.5
Article	5	4	5	1	1	2.5
Past-reg	6	7.5	4	6	6	8.5
3rd Person	7	7.5	8	9	9	8.5
Copula	8	6	7	2	2.5	1
Auxiliary	9	9	9	5	5	4

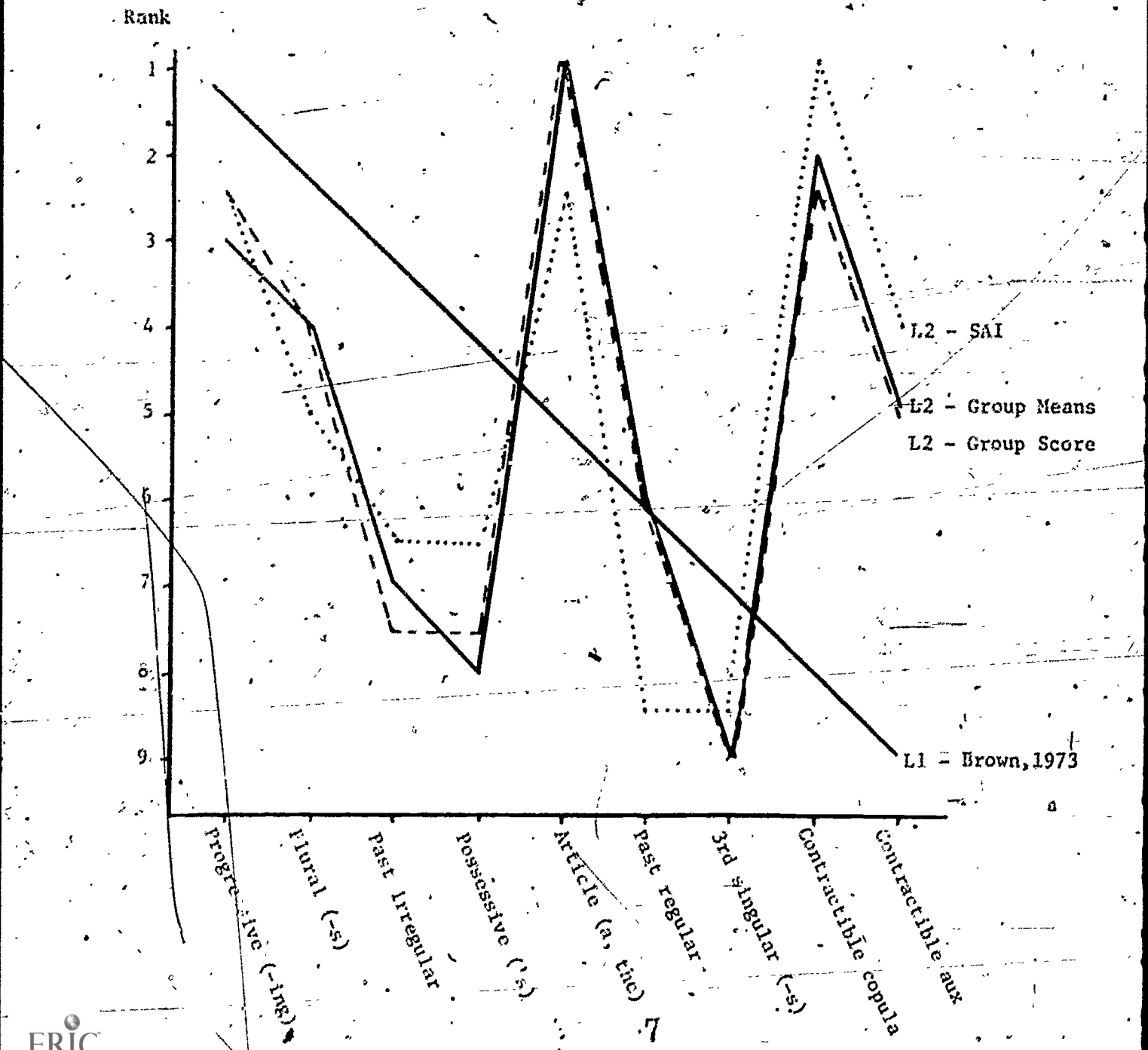
Table 2 — SPEARMAN RANK ORDER CORRELATION COEFFICIENTS

L2		L1	
Group Score with Group Means	+.98	Brown with de Villiers I	+.84
Group Score with SAI	+.89	Brown with de Villiers II	+.78
Group Means with SAI	+.91	de Villiers I with II	+.87

L2/L1	
Group Score with Brown	+.43
Group Means with Brown	+.42
SAI with Brown	+.39

It is obvious from Table 1 that the three-L1 rank orders are very similar, as are the L2 orders, but that the former differ significantly from the latter. This difference is clearly illustrated in Figure 1, and the supporting Spearman rank order correlations appear in Table 2. (As the L1 orders are approximately the same, as shown by the Spearman coefficients in Table 2, those obtained by the de Villiers are excluded from the L2-L1 correlations.)

Figure 1
COMPARISON OF L1 AND L2 ACQUISITION SEQUENCES



As Table 1 indicates, Past irregular, Article, Copula and Auxiliary show the greatest amount of difference: approximately 4 ranks between L2 and L1. Except for Past-irregular, which is acquired later in L2, these functors are acquired earlier in L2 than in L1. The other functor ranks also differ consistently, but the difference is not as great, i.e., there is a difference of approximately 1-2 ranks between L2 and L1 for -Ing, Plural, Possessive, Past-regular, and 3rd Person. Notice also that this group of functors is acquired later in L2 than in L1.

The Explanatory Power of Brown's Semantic and Linguistic Complexity Factors for L2

In an effort to account for the L1 acquisition sequence, Brown (1973b) carried out a detailed analysis of the semantics and the transformational derivation of each functor in the sequence. This analysis enabled Brown to order the functors according to their semantic complexity (number of "major meanings" of roughly equal weight) and according to linguistic complexity (number of transformations in the derivation of a given functor based on Jacobs and Rosenbaum, 1968). Our task was simply to see to what extent the L2 sequence could be predicted by Brown's semantic and linguistic complexity ordering.

The ordering predictions based on semantic complexity appear in the lefthand column of Table 3. The column on the right indicates whether or not each prediction is borne out by the L2 acquisition sequence. That is, say -ing is less semantically complex than Copula (-Ing < Copula). If -Ing was acquired before Copula in the L2 sequence, then the semantic ordering prediction (-Ing < Copula) is borne out by the L2 sequence. However, if -Ing was not acquired before Copula, then the semantic prediction is not borne out by the L2 sequence. Table 3 summarizes the extent to which Brown's semantic complexity ordering could account for the L2 sequence.

Table 3 shows that almost half (9 out of 20) of the semantic predictions were not borne out in the L2 sequence. The L1 sequence, on the other hand, agreed with all 20 semantic predictions.

Since it appears that semantic complexity is not a major determinant of our L2 order, as it seems to be for L1, it might be reasonable to expect that linguistic (derivational) complexity--the second major determinant of acquisition proposed by Brown, should predict much of the L2 order. Specifically, one might expect that linguistic complexity orderings should predict the L2 sequence precisely where semantic pre-

Table 3
SEMANTIC COMPLEXITY IN THE L2 SEQUENCE

Semantic Complexity Ordering Predictions ("<" is less complex than)			Borne Out (+)/Not Borne Out (-) in L2 Sequence
ing	<	3rd person	+
		copula	-
		auxiliary	+
plural	<	3rd person	+
		copula	-
		auxiliary	+
past irreg	<	3rd person	+
		copula	-
		auxiliary	-
past reg	<	3rd person	+
		copula	-
		auxiliary	-
poss	<	3rd person	+
		copula	-
		auxiliary	-
article	<	3rd person	+
		copula	+
		auxiliary	+
3rd person < auxiliary			-
copula < auxiliary			+
		Totals: + =	11
		- =	9
			20

dictions had failed. Brown's linguistic complexity predictions appear in the lefthand column of Table 4. The column on the right indicates whether or not each prediction is borne out by the L2 sequence.

Table 4
LINGUISTIC COMPLEXITY IN THE L2 SEQUENCE

Linguistic Complexity Ordering Predictions ("<" is less complex than")		Borne Out (+) /Not Borne Out (-) in L2 Sequence
ing <	past reg	+
	plural	+
	3rd person	+
	copula	-
	auxiliary	+
Article <	past reg	+
	plural	+
	3rd person	+
	copula	+
	auxiliary	+
Past Irreg <	past reg	-
	plural	-
	3rd person	+
	copula	-
	auxiliary	-
Past Reg <	3rd person	-
	copula	-
	auxiliary	-
Plural <	3rd person	+
	copula	-
	auxiliary	+
3rd person < auxiliary		-
copula < auxiliary		+
	Totals: + =	13
	- =	10
		23

As we can see from Table 4, the linguistic complexity predictions fared little better than those on semantic complexity. Again, nearly half of the linguistic predictions were not borne out by the L2 sequence. Nevertheless, one might still hope that the linguistic predictions that

were borne out by the L2 order would be precisely those involving Copula, Auxiliary, Article, and Past Irregular, as their places in the L2 sequence were not predicted by semantic complexity, and at the same time, their ranks were the most different in L2 and L1.

Unfortunately, this is not the case. Both the semantic and linguistic complexity predictions are almost exactly the same for the 4 functors whose rank orders were the most different in the L1 and L2 sequences. Table 5 displays this predicament.

Table 5
DIFFERENCES IN L1 AND L2 PREDICTED BY BROWN'S SEMANTIC AND DERIVATIONAL COMPLEXITY

		Borne out (+)/Not borne out (-) by L1	L2
Predictions that are the same in both the semantic and linguistic complexity orderings:			
Ing	Copula	+	-
Plural	Copula	+	-
Past-irreg	Copula	+	-
	Auxiliary	+	-
Past-reg	Copula	+	-
	Auxiliary	+	-
3rd person	Auxiliary	+	-
Predictions made by semantic complexity alone			
NONE			
Predictions made by derivational complexity alone:			
Article	Plural	-	+
Past-irreg	Past-reg	+	-
Past-reg	3rd person	+	-

Table 5 includes only those predictions where L2 and L1 differ.[1] It first lists those predictions which are the same in both the semantic and linguistic complexity orderings. The few remaining predictions are unique to linguistic complexity. As we see from the table, all of the semantic predictions are also made by linguistic complexity. These predictions are all borne out by the L1 sequence, but not by the L2 sequence. Of the three predictions made by linguistic complexity alone, two are not borne out by the L2 sequence.

The linguistic complexity analysis shows with disconcerting clarity that what we might have inferred from the semantic complexity analysis is invalid, at least in this framework. That is, since both linguistic and semantic complexity yield the same predictions with regard to the differences between the L2 and L1 sequences, we cannot say that this analysis supports the absence-of-semantic complexity hypothesis mentioned earlier. Nor can either "determinant of acquisition" proposed by Brown explain the L2 sequence obtained. It appears then, that we are still at the beginning of the search for factors that explain the L2 acquisition sequence.

A NEW PERSPECTIVE

This first unsuccessful attempt to deal with factors that might explain, at least in part, the observed progression in child L2 syntax acquisition inspired a rethinking of the notion "complexity", as well as a search for new research procedures.

"Complexity" and "Strategy"

The notion of complexity in its strictest sense refers to characteristics of what is to be learned. That is, if X and Y are items to be learned, X is more complex than Y if it involves more learning matter than Y. For example, perfect tenses require more morphemes than the simple tenses, and thus are considered more complex. Or, in reading, blends and diphthongs are considered more complex than simple vowels and consonants. Since more complex items involve more incre-

[1] Table 5 excludes the 3 predictions involving Possessive which Brown excluded in his linguistic predictions, because Jacobs and Rosenbaum did not provide a derivation for the Possessive.

ments of learning matter, it is generally assumed that they will be learned later. In other words, the more there is to learn, the longer it must take. Not surprisingly, an inspection of oral language or reading curricula reveals that the more complex items are presented later than the "simpler" ones. Apparently, then, complexity has become synonymous with lateness of learning. Specifically, if the complexity of X and Y is known, so is their learning sequence. Empirical verification of the learning sequence is, in this view, superfluous.

Research on child language acquisition, on the other hand, has given primary importance to the empirical determination of learning sequences and consequently, careful studies of learning sequence were undertaken. As acquisition orders began to emerge from these investigations, so did attempts to explain them. It is in these explanations that the reliance on complexity again appears. As we have seen, Brown used the notion of linguistic (and semantic) complexity to explain his functor acquisition order. Linguistic complexity was defined in Brown's study as the number of optional transformations in a derivation. To correct some of the difficulties of this metric (such as assuming equal increments of complexity for all transformations), Brown offered a more refined notion of linguistic complexity as a recommendation to future researchers, namely, "cumulative derivational complexity":

> We do not... simply count the number of optional transformations in a derivation, since this procedure involves the generally unwarranted assumption that any one transformation, or some other feature, involves the same increment to complexity of knowledge as any other. In our cumulative sense of complexity a construction x + y may be regarded as more complex than either x or y because it involves everything in either of the constructions alone plus something more. (pp. 406-407)

Although this cumulative notion is certainly an improvement on simple derivational complexity, it still consists entirely of a description of what is to be learned to explain the learning sequence. As Brown stated:

> If x + y involves all the knowledge of x and y, each taken alone, how could it fail to be the case that x + y will be acquired later than its components? (p. 407)

This complete dependence on a description of the target language

to explain acquisition order is made quite clear by the reasons Brown gives for any possible failure of his cumulative complexity notion to predict learning sequences:

> ...the prediction can fail if the analysis of requisite knowledge, grammatical and semantic, is faulty, or if the evidence used to indicate constructional acquisition is insufficient. (p. 407)

It is clear that Brown's definition of "knowledge" refers explicitly to the analytical description of what is being learned, e.g., a linguist's description of the syntactic and semantic components of the target language. However, one cannot assume that what is more "complex" (more transformations, features, etc.) in a linguistic description of a language system also prescribes the sequence in which a child acquires a language. It seems reasonable to ask whether a child organizes linguistic data in a different fashion. In other words, the criteria that might be perfectly adequate for a description of a language may not be the criteria the child uses to learn that language. Bever (1970) makes a similar point:

> ...we cannot use preconceived notions about the form of grammar underlying a child's utterances...because this would prejudge the sort of fact that we are trying to ascertain by collecting his utterances in the first place. (p. 349)

The reliance of psycholinguists on linguistic descriptions partially explains their great interest in transformational derivations, as well as their impatience with the changes that linguists inevitably make in their descriptions. Chomsky's transformational grammar has been partially susceptible to such reactions from psycholinguists, as the ultimate goal of transformational grammar does involve the description of mental structure. However, Chomsky and Halle (1968) have been very careful to state that before any claim can be made about human cognitive structure or learning strategies, a comprehensive description of language structure must be available. Therefore, they have undertaken the task of providing an empirically adequate description of language. They also emphasize that their choice of this "first step" has no bearing on the psychological reality of their linguistic descriptions. Rather, it is a decision about which research program they believe might be most fruitful in the search for knowledge about human cognitive structure. We include their own comments on this issue as it has so often been seriously misconstrued.

A further word of caution is perhaps necessary in connection with this formulation of the general problems that guide our study of language. Apart from the idealization mentioned in the preceding paragraph, there is another, much more crucial, idealization implicit in this account. We have been describing acquisition of language as if it were an instantaneous process. Obviously, this is not true. A more realistic model of language acquisition would consider the order in which primary linguistic data are used by the child and the effects of preliminary "hypotheses" developed in the earlier stages of learning on the interpretation of new, often more complex, data. To us it appears that this more realistic study is much too complex to be undertaken in any meaningful way today and that it will be far more fruitful to investigate in detail, as a first approximation, the idealized model outlined earlier, leaving the refinements to a time when this idealization is better understood. The correctness of this guess, of course, will have to be judged by the long-range effectiveness of a research program of this sort, as compared with alternatives that might be imagined. In the meantime, this idealization must be kept in mind when we think about the problem of the "psychological reality" of the postulated mental structures.

To take a concrete example, consider the matter of the synchronic residue of the English Vowel Shift, discussed in Chapter Six. We have argued that the underlying lexical forms in English contain vowels in pre-Vowel-Shift representation, and that these forms are what would have psychological reality given the other assumption in our model--in particular, the assumption of instantaneous language acquisition. To the extent that these assumptions are false to fact, the conclusions that follow them may also be false to fact. In particular, it is no doubt the case that the linguistic forms that justify our postulation of the Vowel Shift Rule in contemporary English are, in general, available to the child only at a fairly late stage in his language acquisition, since in large measure these belong to a more learned stratum of vocabulary. Since the order of presentation of linguistic data is, for the moment, an extrinsic factor that has no place in our theory, we cannot take account of this fact, and we can therefore state our conclusion about psychological reality only in hypothetical form: if it were the case that language acquisition were instantaneous, then the under-

> lying lexical forms with pre-Vowel-Shift representations would be psychologically real. This, we propose, is a true statement about language--ultimately, about mental processes and the particular way in which they function. But an empirical conclusion of this sort will, naturally, be more difficult to verify, will require more indirect and subtle means of verification, than a simple categorical assertion. To us it seems that for the foreseeable future, the study of language and mental processes will have to be carried out at such a level of abstraction if it is to make significant progress. (p. 331-332)

The "more realistic study" which Chomsky and Halle feel is "much too complex to undertake in any meaningful way today" is what we are venturing to undertake. Although an adequate description of the structure of language is still in the process of being formulated, we feel that its absence does not preclude a meaningful attempt to specify language learning strategies. An adequate description of the developing syntactic structures children produce while learning a language should be an equally fruitful route to the discovery of cognitive structure. We must, however, caution the reader not to forget the distinction between a "first step" and our ultimate goal, i.e., between a description of the speech children produce (product level) and the learning strategies underlying that speech (process level). In sum, while Chomsky and Halle focus on a description of the target language (s) to arrive at universal cognitive structure, we focus on a description of the developing syntactic structures children produce while learning a language, to make similar types of inferences.

The notion of learning strategy as an explanation of acquisition cannot rely on a description of what is to be learned. Rather, it assumes that the cognitive mechanisms a child innately possesses makes an independent contribution to the learning process. These mechanisms have certain definable characteristics that cause the child to use a limited set of hypotheses to deal with the knowledge he is acquiring. No matter how accurately that knowledge may be described or analyzed into its elements by language scholars, the child will organize and learn it in the manner and order in which his cognitive apparatus specifies. The specification of these principles of mental organization is our long-range goal.

The "learning strategy" approach is not new. It has been used, for example, by Bever and Slobin in their first language acquisition research. Bever (1970) has discussed "perceptual strategies" in the

concept of their role in determining the universal structure of language:

> ...linguistic structure is itself partially determined by the learning and behavioral processes that are involved in acquiring and implementing that structure... Thus, some formally possible linguistic structures will never appear in any language because no child can use them. In this way the child's system for talking and listening partially determines the form of linguistic structure... (p. 280-281)

For example, such findings as children's interpretations of reversible passives as active sentences yields "strategy D: Any Noun-Verb-Noun (NVN) sequence within a potential unit in the surface structure corresponds to "actor-action-object". (Bever 1970: 298). Bever uses this information together with results of sentence processing experiments on adults to account for the pervasive NVN word order of English syntax. This strategy, however, cannot account for the structure of languages with other word orders, such as Japanese which is an SOV language. In fact, L1 acquisition studies have shown that children in the very earliest stages of learning use the word order of the language they are learning (Kernan 1969, and Blount 1969), whatever it may be. This indicates that Strategy D is only a description of the product of the interaction between a child's perceptual mechanisms and primary linguistic data, not a specification of a universal cognitive strategy. (Bever's general thesis, however, is one of the most provocative advanced recently.)

Slobin (1971) also proposes strategies, referred to as "operating principles" which he suggests children use to process adult speech. For example:

> Operating Principle A--Pay attention to the ends of words (p. 335)
>
> Operating Principle C--Pay attention to the order of words and morphemes (p. 348)

He arrives at these operating principles by looking at how "communicative intent" is expressed by children learning different first languages, and drawing generalizations about children's developing syntax from these data. Slobin calls these generalizations "universals" from which he then infers "operating principles". For example, he finds that "post-verbal and post-nominal markers are acquired earlier than pre-nominal markers" (Universal A, p. 334), hence, he infers Operating Principle A (Pay attention to the ends of words). In our framework

Slobin's "universals" are generalizations about the product level, and his "operating principles" are statements that presumably refer to the process level.

Two rather serious drawbacks become apparent in Slobin's approach. First, an accurate specification of "communicative intent" does not exist. Slobin recognizes this when he states that "what is needed is a taxonomy and coding scheme for pre-linguistic intention" (p. 324). Second, his operating principles and universals are presented as a list, in which the relation of the principles to each other, if there is one, is left unspecified. There is no attempt to provide criteria which would predict when certain principles apply and when they don't. This is especially significant when two apparently conflicting principles are applicable in the production of a certain structure. For example, in English L1 acquisition, children regularly produce utterances such as "No Daddy go", or "Wear mitten no". In these constructions they seem to be using Operating Principle D:

"Avoid interruptions or rearrangements of linguistic units."

as they do not interrupt the NVN sequence. However, the above constructions violate Operating Principle C:

"Pay attention to the order of words and morphemes."

as they have obviously not paid attention to the proper placement of the negative morpheme.

A similar problem emerges when we encounter cases that appear to disconfirm a certain operating principle. For example, Operating Principle A (Pay attention to the ends of words) seems to be violated in English L1 acquisition, where functors attached to the ends of words are regularly omitted by L1 learners (e.g. past -ed, 3rd person singular -s, etc.) even after several prepositions have been acquired. However, such disconfirming cases need not necessarily constitute disconfirmation of the existence of a particular operating principle. Rather, if operating principles were placed in their proper perspective, such cases would provide the evidence necessary to specify under what conditions certain "principles" apply or do not apply.

Incidentally, Operating Principle A cannot speak to the acquisition of prefixing languages such as Navajo. Thus, paying attention to the ends of words would not help Navajo children acquire their functors. Yet there is no evidence we know of that Navajo children acquire their mor-

phological structure later than children acquiring suffixing languages, such as Turkish.

From the foregoing discussion, it has become obvious that a description of universal second language learning strategies is indeed a long-range goal. Nevertheless, in pursuit of this goal, two observations may be helpful.

i. The description of acquisition sequences, including those in our own research studies, have consisted of "rank orders", i.e., given a certain numerical criterion (such as MLU or SAI, or the mean score of a given sample of subjects for a functor), functors are ranked according to the decreasing (or increasing) numerical value of the chosen criterion. This results in a linear sequence, say, from 1 to 11 (or 14). Such linear descriptions of acquisition order go hand in hand with the linear explanations that have been offered for such orders. In other words, the use of rank orders increases the tendency to think of syntax acquisition as an additive process. The converse may also hold, namely, if one thinks of acquisition as the addition of increments of linguistic material, one would probably set out to look for rank orders in children's emerging syntax.

ii. The notion "acquisition strategy" (operating principle) refers to cognitive operations that are presumably universal. If this is their status, then strategies must be able to account for an enormous body of diverse facts about children's developing syntax. For example, a strategy must be able to account for the acquisition of both suffixing and prefixing languages, or of languages with different basic word order such as NVN (SVO) or NNV (SOV). Furthermore, strategies must not contradict each other in terms of what children are observed to do within a given language. As discussed above, most of the recently suggested strategies seem to fall short of universality, in the sense that there is much acquisition data they cannot explain, or that contradict their predictions. It seems that the formulation of strategies has been too dependent on the description of the observed facts about children's developing syntax. While the description of the product (e.g., acquisition sequences or errors) is useful for the discovery of a learning strategy, it is not sufficient, and may even be misleading.

The rest of this paper is a response to these two observations.

An Alternative to Rank Orders: Acquisition Hierarchies

Rank orders imply additive explanations of the learning process (such as derivational complexity). Our methodological alternative to this approach is to look for groups of functors that are acquired together and that are ordered. If such groups of functors can be found, a search for the underlying characteristics that define each group and set it apart from others would become possible. It was with much excitement, then, that we discovered a recent development in measurement that does just that.[1] The method is formally called the "Ordering-Theoretic-Method" by its authors (Bart and Krus, 1973), but for short it is also known as the "tree method" (following its origin in mathematical tree theory.)

Other methods of measurement, such as Guttman scaling, "invariably assume that the trait measured is linearly ordered and can be measured with a single additive model" (Bart and Krus, p. 201). The tree method, on the other hand, assumes that there is a logical relationship among items, and it is designed to determine those relationships.

The relationship worked out in the version of the method presented here is that of "X is a prerequisite to Y". For our purposes, it is stated as: the acquisition of functor X precedes the acquisition of functor Y.

One requirement for the method to be used to interrelated items is binary coding, i.e., that the items be scorable as correct or incorrect with values of 1 and 0 respectively. Accordingly, functors were treated as items for which a child received a "1" if the functor had been acquired and a "0" if it had not been acquired. A functor is acquired if it is used 90% correctly given at least 3 obligatory occasions per child for a given functor. (See Dulay and Burt, 1974b: 45-46). Thus if a child scored 90 or higher on a given functor he received a 1 for that functor, but if he scored 89 or less he received a 0 for that functor.

The requirement for positing a relationship between a set of items, say, for positing the acquisition of Case before Copula is as follows: The acquisition of Case precedes the acquisition of Copula if and only if the disconfirming response pattern: Case =0(not acquired) Copula =1(acquired) does not occur. It is the number of such "disconfirmatory response patterns" that comprises the test of the relationship. If there were more than a tolerable number of disconfirmatory response patterns (5% of the total), the relationship would not hold.

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[1] The method was introduced to us by Professor Marcus Lieberman, Harvard University

To test the efficiency of this method for language acquisition research we reanalyzed data that we had previously used to study Spanish and Chinese-speaking children's acquisition of 11 English functors.[1] (Dulay and Burt, 1974b). Since we had found that the acquisition sequence of these functors was approximately the same for both groups of children, we combined both groups for this analysis.

The total sample consisted of 115 children, 60 Spanish and 55 Chinese. However, the sample for each pair of functors for which a relationship was ascertained differed according to the number of children who had at least three occasions for the functor pair in their speech corpus. The sample sizes ranged from 20 to 115. Any pair of functors for which the sample was less than 20 was excluded from the final analysis (3rd person - Auxiliary: Possessive-Past Regular; and Past Regular-3rd person). There were about the same number of Spanish and Chinese children in the sample for each functor pair.

The data analysis for the tree method is straightforward. Six steps are involved:

i. Calculate an individual functor score for each child for each functor (see Dulay and Burt 1973: 45-46)[2] in order to determine whether the child had acquired a given functor. (The criterion of acquisition used was an individual functor score of 90 or higher.)

ii. Convert functor scores into binary values, for example,

Functor Score	
90-100	1 (acquired)
0-89	0 (not acquired)

iii. For each functor pair, count the number of children who received scores for both functors in the pair.

iv. Count the number of children whose response patterns disconfirm a relationship between each possible pair of functors. That is, in the relation

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[1] Pronoun Case (Nominative-Accusative), Progressive -Ing, Copula (is), Auxiliary (is), article (a, the), Plural (-s) Past Regular, Past Irregular, Possessive ('s), 3rd Person (-s), Long Plural (-es).

[2] Any other method to calculate individual functor scores can be used.

"Functor X precedes Functor Y", the disconfirming pattern would be:

Functor X = 0 (not acquired)
Functor Y = 1 (acquired)

This pattern is obviously the only one that disconfirms the above statement.

v. Calculate the percent of disconfirmatory response patterns for each relationship tested. That is, for each functor pair divide the number of children who had disconfirmatory response patterns by the total number of children in the sample for a given pair. The resulting number is the percent of disconfirmatory response patterns for a given relationship. The matrix in Table 6 illustrates this analysis. In the matrix, for each functor pair, the relationship tested is: "the acquisition of the functor designated by the row precedes the acquisition of the functor designated by the column." If the percent of disconfirmatory response patterns is 5 or less, the relationship holds, Reading the matrix, we conclude, for example, that the acquisition of Case precedes the acquisition of -Ing, Copula, Article, etc. while we cannot conclude that -Ing is a prerequisite to Copula, as 19% of the children acquired Copula before -Ing.

vi. From the matrix, construct a "tree". (See Figure 2.)

Arrows from one functor to another designate the relationship between those functors. An arrow that connects two functors designates that the functor from which the arrow originates is acquired before the functor at the other end of the arrow. For example, the acquisition of Case precedes the acquisition of Copula. A sequence of functors connected by arrows are all part of a sequence starting with the functor from which the first arrow originates and ending with the functor to which the last arrow points. For example, Case → Copula → Auxiliary → Past regular → Long Plural means that not only does Case precede Auxiliary in acquisition order, but that Case also precedes all others in the sequence. The height of the functors is determined by the mean functor score for that functor (indicated by the numbers in each box). The position of the functors on the horizontal plane is a purely aesthetic arrangement.

The tree in Figure 2 illustrates the acquisition hierarchy obtained. It shows clearly that certain groups of functors are acquired before

Table 6

DISCONFIRMATION MATRIX FOR TREE ANALYSIS

	Case		-ing		Cop		Art		Plu		Aux		Past-r		Past-i		Poss		3rd		LPlu	
	N	%D	N	%D	N	%D	N	%D	N	%D	N	%D	N	%D	N	%D	N	%D	N	%D	N	%D
Case			87	(0)	86	(1)	109	(1)	109	(1)	34	(0)	33	(0)	103	(0)	69	(0)	51	(0)	51	(0)
-Ing	87	39			84	19	102	22	102	9	35	11	31	6	96	(2)	61	(5)	43	(2)	37	(3)
Cop	86	35	84	14			91	22	91	(4)	30	(0)	28	(0)	86	(0)	53	(2)	40	(0)	37	(3)
Art	109	37	102	19	91	20			115	10	36	17	33	6	106	(3)	67	6	51	(2)	41	(0)
Plu	109	57	102	26	91	20	115	28			36	14	33	(3)	106	(1)	67	(4)	51	(2)	51	(2)
Aux	34	56	35	34	30	27	36	36	36	11			25	(0)	33	(0)	20	(5)	13		20	(0)
Past-r	33	70	31	48	28	50	33	45	33	42	23	13			32	13	18		18		20	(0)
Past-i	103	72	96	48	86	50	106	50	106	30	33	21	32	13			63	16	49	8	39	(5)
Poss	77	66	61	48	53	40	67	43	67	25	20	35	18		63	6			34	6	26	8
3rd	51	84	45	47	40	45	51	57	51	31	13		18		49	8	34	9			22	9
LPlu	51	84	37	49	37	43	41	63	41	44	20	25	20	35	49	12	26	19	22	9		

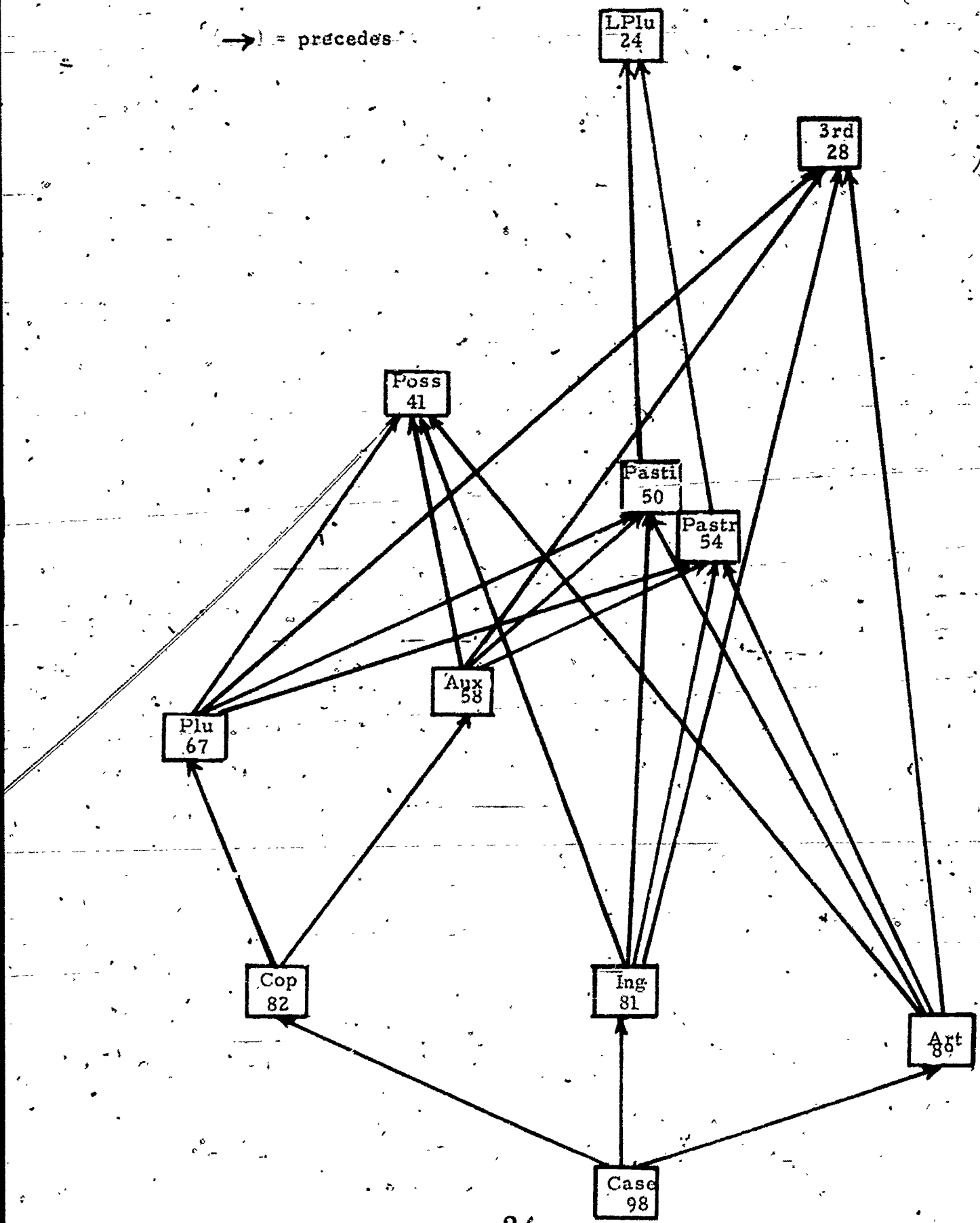
N = Total number of responses

%D = % of disconfirmatory response patterns

Tolerance level = 5%

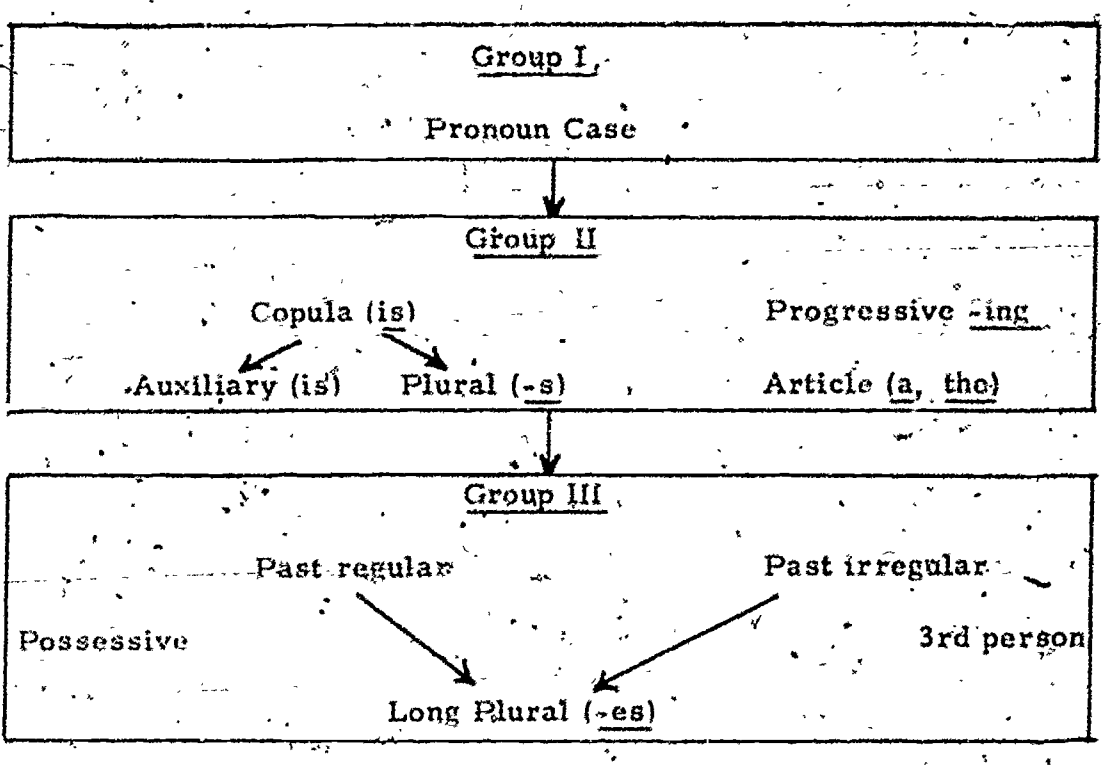
Figure 2
L2 FUNCTOR TREE

(→) = precedes



other groups: The acquisition of Case precedes the acquisition of all the other functors. Copula precedes Plural and Auxiliary, and these three, together with Ing and Article precede the last five in the hierarchy: Past-regular, Past-irregular, Possessive, 3rd person and Long plural. In addition, Past-regular and Past-irregular precede the acquisition of the Long plural. Figure 3 illustrates these relationships more clearly.

Figure 3
L2 FUNCTOR ACQUISITION HIERARCHY

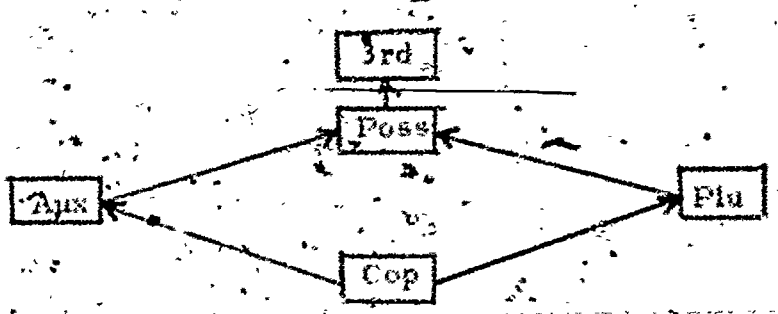


The strength of these relationships lies in the fact that no more than 5% of the children disconfirmed these relationships. Of major importance in this analysis is that membership in a group does not depend on a numerical score. For example, from the tree, we see that the mean functor score for Article was 89, for Ing 81, and for Copula 82. Despite these differences in scores, these three are not ordered with respect to each other, as would occur in a rank order analysis. Rather, they are all members of the group that precedes the last 5 functors mentioned above.

The tree also reveals a sub-hierarchy for the 5 s-morphemes among our functors: Copula is a prerequisite to Auxiliary and Plural,

and these two are a prerequisite to Possessive and 3rd person. (See Figure 4). This s hierarchy clearly shows that phonetic shape does not determine the order of acquisition, but that some sort of differentiation of function underlies it.

Figure 4
HIERARCHY FOR S-MORPHEMES



Suggestions for Future Research

The ultimate value of the tree analysis lies in its potential to uncover the sorts of empirical facts needed before one can begin to specify with any confidence the nature of language acquisition strategies. Of course, empirical facts of any sort are of little interest if not placed within a theoretical framework. The above discussion of complexity and strategy thus focussed on two distinct approaches to the nature of language learning. In the first approach, one accepts the notion of complexity as the primary explanation of language learning and thus relies on variables that are linear (or additive) to explain acquisition phenomena; that is, variables that can be broken down into units, the number of which determines learning sequence. The more units there are in a particular item to be learned, the later that item will appear in the learning sequence. This approach relies totally on descriptions of what is to be learned and assumes that learning strategies correspond perfectly to those descriptions, i. e. descriptions of what adult native speakers know about their language.

The second approach does not assume this perfect correspondence between learning process and learning matter and thus, it must rely on variables that have to do with criteria for the cognitive organization of linguistic data (language acquisition strategies). There is no reason to assume that the nature of these criteria is additive, nor that a description of the target language (learning matter) is the most productive source for explanations of the speech language learners produce. One

might instead begin to explain acquisition orders by searching for critical characteristics of those parts of syntax that children produce in a predictable order. For example, a characteristic such as "'X's are exceptions to a general rule (syntactic, phonological or semantic)" might be among those that define a late group of structures.[1] A group that is acquired earlier might be defined by characteristics that are not directly related to those that define a late group such as "'Y's express a basic semantic relation". Notice that such characteristics do not rely on "preconceived notions about the form of grammar underlying a child's utterances" (Bever 1970: 349), nor are they in any way increments or units of an overriding variable. Rather, they are characteristics that emerge from the particular aggregation of structures that children produce at a particular point in the acquisition process. In sum, critical characteristics are those features (or attributes) of syntactic structures that distinguish each group of structures in an acquisition hierarchy from any other group in the hierarchy. It seems that such characteristics may provide a rich empirical source from which language acquisition strategies might be inferred.

If this line of reasoning is correct, and if its potential is to be realized, then specific kinds of empirical data which are not yet available become necessary.

First, acquisition hierarchies of English syntactic structures that are of a higher level than functors must be obtained. The presence of such structures within an acquisition hierarchy should make the relationship among items in a group more apparent than they are now.

Second, effects of native language phonology and semantics on second language acquisition must be clarified along with the relationship of these aspects to the acquisition of syntax in a second language.

Third, information on the acquisition hierarchies in second languages other than English would offer important insights concerning the accuracy of critical characteristics that are based only on English syntax acquisition, and would add new dimensions that English alone could not offer. Characteristics that define corresponding groups in the acquisition hierarchies of two or more languages should be related in some significant way that should strongly indicate the shape of universal language learning strategies.

Fourth, within a given language, second language acquisition hierarchies may vary depending on the type of exposure available to the second language learner. For example, if the child is exposed only to

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[1] This was the defining characteristic of the four structures studied by C. Chomsky (1970), which were still being acquired by 5-10 year old children.

a list of vocabulary words and a predetermined sequence of syntactic structures via classroom drills and dialogues, the resulting acquisition hierarchy might be quite different from that resulting from the exposure to the entire target language system as in exposure to natural speech. Likewise, exposure to natural speech of adults only might also result in a hierarchy different from that resulting from exposure to peer speech in the target language. Thus data collected in immersion programs in Canada, where only the teacher speaks the target language fluently, might reveal a different acquisition hierarchy than data collected in U. S. bilingual programs where non-English-speaking children interact with English speaking peers (as well as an English speaking teacher). Very little is known about the effects of such radically different types of language learning environments on the shape of the "interlanguage" produced by children.

Much remains to be done before we can describe in sufficient detail the creative construction process in child second language acquisition.

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