

## The Structuring of Language by Developmental Processes Group Report

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Inasmuch as language, a highly complex, rule-governed structure, must be acquired, it is not unreasonable to believe that an understanding of the acquisition process will provide at least some insights into the very nature of linguistic structure. For surely the fact that language must be learned must impose constraints on the nature of the language which is to be learned. Indeed, it is not inconceivable that evolutionary processes in the development of language may have been strongly influenced by the requirement that languages are acquired. All of which is to say that the requirement that language must be learned may have shaped the nature of language, i.e., its structure, both as it developed in evolutionary terms and as it develops ontogenetically.

In addition, it would seem reasonable, given that language must be learnable, that the learning situation should be such that it provides the maximum of structure to the learner or at least provides the maximum opportunity for eventually acquiring the structure. Yet, although virtually all children seem to acquire the full-fledged structure of language, the same is far from true of adults (or older children) who attempt to learn a second language or a first sign language. Thus, in some sense the learning situation must be impoverished, but whether in terms of environmental input or in terms of the organism's capacity,

is not known. That is, the young child may be able to go beyond the available data to derive linguistic structure, a capacity which is unavailable to older individuals, or if the environment provides all of the necessary data, then only organisms within a certain period of sensitivity are able to capitalize on this information. In any event, it is apparent that the acquisition process may provide insights not only into the nature of language but also into the constraints the organism brings to bear on the language learning situation. These organismic constraints pertain to processing strategies, some of which may be universal as recent evidence suggests, but which change with age either as a function of the accumulation of information or as a function of maturation. To the extent that such strategies are understood it may become possible to account for some of the productions, derivations, and interpretations that the language learner typically generates. Furthermore, if such processing universals are specifiable in several domains and/or modalities, it may become possible to determine which aspects of the acquisition process are general and which are specific to the acquisition of language.

A number of approaches can be taken to begin the vast undertaking of determining the constraints placed on the nature of language by modality, processing, and the fact that language must be acquired. These approaches, of which but three are briefly discussed below, range from analyses of the constraints that arise from consideration of linguistic structure in a nearly purely theoretical manner to inferences concerning constraints that arise from empirical studies of the acquisition process. The latter involve, at least in part, comparisons across the language modality, the age and experience of the language learner, and finally the type of linguistic system to be acquired, for example, pidgin versus creole.

One example of the study of the influence of learning on the nature of language is exemplified in the theoretical studies of Wexler (this volume and (8)) on the learnability of transformational grammars. The fact that natural languages must undergo a process of acquisition requires major constraints on the nature

of these languages, which are now in the process of being explicated. Of course, given that sign language is a natural language, the imposition of constraints by the demands of the learning process must be in principle as true for sign language as for spoken language. These constraints on the structure of language derive from a number of sources, for example, from the fact that learning a language is a form of language processing and hence the information that can be processed is in fact limited by the nature of the processing system. In addition, and more importantly for learnability theory, language contains an unbounded number of sentential structures, yet must be acquired by an organism which, for reasons of biology and environment, has access to only a small, finite set of these sentences and their corresponding structure. This boundedness of the available data must constrain greatly the nature of human language. Indeed, one need only imagine a situation in which a language learner had access to an unlimited (unbounded) set of structures, but no cognitive or computational limits imposed on the acquisition process to realize the extent to which the conditions of learning require enormous restrictions on the nature of a natural language. This argument is the traditional form of the argument "from the poverty of the stimulus." It recognizes that a part of the reason for the poverty of the stimulus is the biological organization of the language learner, which limits the information processing capacity of the organism. One obvious consequence of an impoverished input is that it is possible to infer an indeterminate number of grammars from the available information. As a consequence, one needs to assume processing and linguistic constraints to accommodate the fact that all members of a linguistic community arrive at the same grammar.

Learnability theory proceeds by making precise the argument based on the poverty of the stimulus. It is important to note that particular models developed to this point do not express all the possibilities for linguistic representation; that is to say, certain natural languages may have properties not expressed

in current theory. Sign may be one of these languages and, if this is true, demands further development of learnability theory to include sign language in our understanding of the ways in which constraints arising from processing (learning) shape the structure of human language.

As an example of the operation of learnability theory, Wexler (this volume) has shown that the requirement that we must learn a natural language provides support for the notion that a part of the structure of language includes the Uniqueness Principle. This principle specifies that for any deep structure there is only one surface structure. This support, which is derived from the problem of learning negative linguistic devices such as filters, is briefly as follows. When the child receives data that a given surface structure is associated with a particular deep structure, he will create a negative device that will eliminate any additional surface structures that his grammar will generate from the same deep structure. Only in cases where the creation of such a device is not possible, or when data are received to the contrary, will an exception to the Uniqueness Principle be permitted. This part of the structure of language seems to relate to the data on "transparency" as discussed by Slobin on early language acquisition (this volume).

Learnability theory must by its very nature make a number of very strong assumptions concerning the state of the organism just before the acquisition of the structures under consideration - transformations, in the work of Wexler. These assumptions include the presence of at least a word level analysis of the incoming linguistic information, an ability to use contextual information to help derive the base structure, and an ability to understand the semantic structure of the linguistic input. On a more cognitive level, the very young language learner must be able to compare surface and deep structures and recognize identity when it occurs, as well as to impose correction procedures when inconsistencies are found. A major task would seem to be to determine the plausibility of these assumptions. Thus, for example, is it reasonable to assume that the

cognitive structures of the child are sufficient to permit storage of enough information to permit the base structure-surface structure comparisons that are essential? And, does the presence of a phrase structure grammar at this age find any support? Or, in a more extreme manner, does one need to assume the linguistic sophistication equivalent to a phrase structure grammar in order to show that a transformational grammar is learnable with greatly reduced input, that is, with a poverty of linguistic forms? It will be instructive to determine the classes of grammars that are "learnable" as the initial assumptions are varied.

In a similar vein, it will ultimately be necessary to determine whether all forms of "learnable grammars" can in fact be learned by human observers. The nature, or even feasibility, of a research program of this form is difficult to determine, since it may necessitate use of adult learners and languages which, while conforming to the grammar under study, are artificial. Of course, there is support for some assumptions. For example, the early data of Brown and Hanlon (1) indicating that acquisition of syntactic competence is not directly controlled by reinforcing events in the environment certainly suggests that the development of syntactic competence, that is, changes in grammatical rules with age, is governed by internal processes. To date, the success of learnability theory is encouraging and already requires that any grammar posited for human language meet the test of learnability.

Theoretical studies of the conditions of language acquisition have then provided information on one form of constraint imposed by the simple fact that language is acquired. Additional support that acquisition processes mold the nature of language comes from empirical studies of language acquisition, both spoken and signed. First to be considered are the studies of morphological development during the acquisition of sign language by first and second generation deaf children, described by Newport and Supalla (this volume).

Words in spoken language are constructed in what we call an analytic fashion: They are composed of discrete morphological components, combined in restricted ways, that is, by ways that are rule-governed. In order to acquire these individual components and the rules of combination, the language learner must at some level and at some time be capable of analyzing gestalt-like inputs, formed from combinations of these components. Interestingly, it has been argued that signs in a signed language could, in principle, be constructed quite differently, since the physical dimensions which form the signs are free to vary continuously, rather than discretely, and hence to represent information in an analogic form - for example, the movement of objects in the dimension of movement. However, linguistic analysis of the morphological structure of second generation deaf signers shows that this potential is not realized (Newport and Supalla, in preparation, and (3,4,6)). Rather, signers, like their speaking counterparts, use a componential system as the basis for their morphology. What is interesting about this particular development is the manner in which this competence is achieved. Newport and Supalla (3,4,7) have shown that the morphological process becomes more and more analytic (i.e., componential and rule-governed) both within and across generations. Thus, the acquisition process in the young native signer begins as it does in the young native listener with a single, unanalyzed morpheme form. (This form has within it, of course, more than one component; however, the young child simply does not use the components contrastively in a productive manner.) The acquisition process then proceeds through some process of analysis to yield more and more of the discrete components, not using at any stage of development any or all of the morphological units in an analogic manner. These children then use the components of the morphology in single units before the rules of combination are acquired. These rules are evidenced by multiply-inflected stems that are orderly and systematic in their use. What is of great potential interest in these findings is that first generational signers, who typically learn to sign relatively late in life, do not achieve this level of control, but rather control predominantly unanalyzed, single-morpheme forms. Of course, the ultimate

scientific value of these findings rests on the results of future studies that precisely define the language acquisition environments for first and second generation deaf children. This difference between first and second generation signers corresponds to similar differences between first and second generation contact vernacular users, i.e., speakers of pidgins versus creoles (e.g., (5)). Yet it is these first generational signers who provide the linguistic environment for the second generational signers, who do achieve control of discrete morphological components. This suggests that complex internal morphological analysis is performed by second generation children on input which does not itself contain this morphology, at least in a readily discernible form. That is to say, the input does not provide sufficient contrasts to derive the morphological structure unambiguously, this aspect of acquisition being a good example of indeterminacy arising from an impoverished input. There is most likely not a total absence of external support for this particular analysis as evidenced by the fact that different second generation learners converge on similar analyses; however, as in many spoken language creolization situations, the second generation children apparently regularize component form-meaning relation in ways that go beyond the data or the analytic and formalizing capabilities of the first generation.

These results suggest that the acquisition process itself, particularly in young children, may influence and change the structure of a language. This influence can be found in spoken languages as well, and in its most extreme form learning can be claimed to have shaped the very nature of established languages.

Goldin-Meadow (2) has reported data on the acquisition of signs in a group of children who received no formal signed input - a group of children who were literally constructing their own language. They also went through a period wherein a complex act was signaled by only one of the several components of the event and then a stage wherein multiple components were signed, sometimes successively and sometimes simultaneously. It would seem that



these children likewise performed some form of internal analysis, in this case on some internal representation of the actual event rather than of some complex conventional symbol, i.e., a signed pattern representing the event. The tendency to analyze appears to be a part of the acquisition system, perhaps a universal of language acquisition, and one that drives languages to take on discrete forms that are combined in rule-governed ways rather than to signal information by analogic processes.

While one can find much in these data that provide intriguing hypotheses about the nature of language and its acquisition, a number of problems remain to be resolved. Foremost of these is an explanation of why first generation signers, with presumably no worse input than their offspring receive, fail to achieve the morphological system of their children. Several possibilities exist, including restrictions imposed on learning by age. That is, it is possible that analytic learning strategies are predominantly a property of the very young or that they are less efficiently used by older learners of language, and perhaps particularly by older learners of sign language. Another possibility is that late learners of sign experience interference effects from their partial acquisition of their parental language. Whichever explanation ultimately proves correct, the study of sign acquisition, which will always include first generation signers beginning their instruction at various ages and with various amounts of first language competence, should provide an exceptional opportunity to begin to unravel experiential and biologic effects on the acquisition of a natural language. Comparisons with the acquisition of a second spoken language may also prove illuminating, although individuals learning a second spoken language almost invariably would have had greater experience and competence in their first language than would late learning first generation signers.

What is also apparent from these studies is that, regardless of modality (i.e., whether language is achieved by means of the mouth and ear or the hand and eye), lexical processes are acquired

early and without regard to the age of the language learner. Morphological structure, on the other hand, is a later acquisition, an added structure, that appears to be influenced by previous experience or lack of experience. Certainly one program of research for the future is to extend the research of Newport and Supalla, Goldin-Meadow, and Slobin to other aspects of the rule systems of language.

A second line of empirical research, which we considered, is that described by Slobin (this volume). He has shown quite clearly that there are a number of very early acquisitions, at least in spoken language, although quite possibly in sign language as well, which might indicate aspects of a universal acquisition process and which at least in these early stages impose an interesting order on the input that the child receives. One major generalization of his findings is that the child strives to impose greater regularity than would actually be permitted by the input. This quest for regularity is readily discovered in the child's overregularization of rules with exceptions (as the English past -ed). It is also evident in the child's attempt to impart to the language a semantic transparency according to which the bases for the application of grammatical inflections and word order rules correspond to definite conceptual categories of quite limited scope, for example, the marking of those utterances which define a prototypical transitive scene. What is of particular interest for those concerned with the universals of language and the universals of processing and acquisition is that there appears to be a limited but readily definable, set of these conceptual categories which are drawn upon for the purposes of creating grammatical categories, that is regularizations. These categories presumably have a privileged status in the child's conceptualization of the world, although we do not as yet know the basis of this privilege. One might conjecture that they originate in some special adaptations of the child's perceptual systems that make some sets of features more salient than others.

In addition, at least in the case of spoken languages, children, as reported by Slobin, appear to avoid homonymity and conflation

of underlying meaningful units in surface forms, preferring instead one-to-one mappings between meaning and form. This often results in grammatical forms (frequently invented by the child) which exceed the input of the language. This indicates that clear meanings, that is, transparent semantics, would result in relatively little formalism, whereas when semantics becomes less transparent, when mappings are no longer one-to-one, for example, formalism must increase.

In essence, the acquisition of language involves the construction of a language by a child on the basis of linguistic input (visual or auditory) which occurs in interpretable situations. For this task to be possible, there must be an initial means of segmenting, representing, and storing aspects of the linguistic and non-linguistic inputs. (Of course, capacity limitations in these domains must impose their own limitations on the form of language.) There must also be the knowledge that the linguistic system has the means for representing entities and events in the world as well as their interactions and interrelations with other entities and events. It seems that very early on a child constructs a linguistic system in which some parts of the code represent entities and events of the world (content words), whereas other parts of the code represent relational information (i.e., function words and morphological inflections). An early strategy, in addition to holistic interpretation of morphological elements, seems to be a narrow semantic interpretation of the role of certain closed class elements. Soon thereafter, the child begins to apply grammatical markers on the basis of nonsemantic criteria. This convergence of formal and semantic principles marks a mid-period of development during which the child attempts to build a system based on the principle of maximal transparency. Beyond this period, the child must forego attempts to attain maximal transparency and must eventually conform to the adult model, which does not have the degree of transparency imposed earlier by the child

At issue is whether these acquisition strategies are in some as yet unknown way an inherent part of acquiring a natural language,

whether imposed by the nature of the input to the organism or whether imposed by the nature of the linguistic and/or cognitive systems in order to make possible the acquisition of a complex rule-governed system. Also at issue is whether the utilization of these strategies is at all related to the age at which the acquisition process begins or the amount of experience the individual brings to the material to be learned.

As conclusion to our discussion, we offer the following brief remarks:

1. From the meager data so far available, it seems that if there is any modality effect on the structure of language it is marginal. Yet we acknowledge the absence of detailed comparative studies of syntactic structures that could alter our conclusion. The absence of a major modality effect is shown by the fact that sign and spoken languages are fully intertranslatable. Thus, these two forms of language must share significant structural properties and thereby make it unlikely that the difference in modality has created unique structures. This conclusion is also supported by the findings that the acquisition of sign and speech under optimal conditions yields grammatical structures that are very similar at the various stages of learning.
2. Though data indicate that children have a better disposition to acquire fully structured sign language than adults, further research should make such evidence more reliable by showing that there are no input differences that could account for the observations.
3. There seems to be a universal tendency to end with a more rigorous linguistic structure than the one on which learning was modeled. This tendency to search for and impose structure as well as analyze and fixate the elements that appear even idiosyncratically in the model structure may well turn out to be a processing universal that is lost with increasing age.
4. There is some evidence that during the acquisition of speech the child goes from single global units which do not seem to

have internal structure to more and more analyzed elements. Likewise in sign acquisition, the emergence of frozen signs is followed by signs which become complex morphologically inflected forms. There is also evidence that both in speech and sign language acquisition, children go from a transparent structure with little formalism to a more opaque structure with increasing formalism.

5. The comparison of sign and speech acquisition becomes a privileged ground for testing hypotheses about the mechanisms responsible for linguistic structure. Indeed, the roles of universal processing strategies, linguistic universals, and maturation are capable of receiving examination and explication in this comparative domain.

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# Signed and Spoken Language: Biological Constraints on Linguistic Form

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