

In search of ...

The interaction of cognitive and linguistic theories

The basic foundation of the generative theory of language was articulated most explicitly in Chomsky 1965. It was argued that the role of the linguist is to analyze linguistic data and thereby arrive at a theory of language, i.e., a grammar, with observational and descriptive adequacy while aiming for explanatory adequacy. In the present paper, I will analyze some of the assumptions underlying that approach to linguistic investigation. That discussion will necessarily entail scrutiny of the factors motivating those assumptions. I will accept the validity of those assumptions within the specific context in which they were made. I will then propose that the current status of linguistic research motivates a different set of assumptions, and essentially an alternative approach to linguistic theory. I do not claim to be proposing a novel theory. This paper is intended to develop a novel, contemporarily valid strategy for constructing a linguistic theory. Essentially, I am attempting to specify the assumptions that should underlie linguistic theory at the present time.

Transformational grammar, the initial product of generative theory, incorporated a rather bold endeavor in linguistic research. The linguist was essentially given a substantially new theoretical drawing board and forced into reanalysis of many phenomena already well analyzed from a different perspective. In many ways, this constituted a major revolution in linguistic analysis and threw the field into a temporary (perhaps quite prolonged) state of chaos. My present interpretation of the assumptions underlying this quasi-revolutionary theory (and one that I will attempt to defend in the coming section) is that they were well founded yet somewhat authoritarian measures to minimize chaos during the transitional period from structuralist to generativist linguistics.

The foremost assumption underlying the Aspects theory is that linguistic analysis is to be concerned with the competence of the native speaker. Under such an assumption, the study of linguistic competence, i.e., the internal(ized) knowledge system which underlies the human act of verbal communication, is crucially isolated from the general study of performance, the actual use of language in concrete situations. Chomsky points out that an adequate account of competence is a necessary precursor to any attempt to characterize performance. Linguistic competence is only one of a set of language performance factors. Other performance factors, such as attention, memory limitations, and the general organization of memory fall within the academic responsibilities of the cognitive psychologist, while affective matters pertaining to context should be scrutinized by sociologists, philosophers, and psychologists. The isolation of competence effectively allows the linguist to pursue a deep analysis of a single performance factor, linguistic competence. This intensive pursuit is optimally uncluttered by peripheral and tangential factors which have definite relevance to the broader extensive pursuit of a general theory of performance.

The goal of the analysis of linguistic competence is the construction of a theory of language which captures the essence of the human capacity for language. Thus, the job of the linguist is quite analogous to the language acquisition task faced by the human infant; both are attempting to arrive at a competence theory from the data of performance. Chomsky's discussion of the strategies available to the infant faced by that task reveal some further assumptions underlying the Aspects theory.

Chomsky assumes that the human infant is innately endowed with the capacity for language acquisition. He posits a language acquisition device (LAD) which supplies the human child with 'an innate theory of potential structural descriptions that is sufficiently rich and fully developed so that he is able to determine, from a real situation in which a signal occurs, which structural descriptions may be appropriate to this signal...' This single statement incorporates three crucial assumptions which I shall presently undertake to analyze.

The most explicitly introduced of the three assumptions is that language is innate to the human being; this is commonly referred to as the Innateness Hypothesis. It embodies Chomsky's strong objection to the Behaviourist (stimulus - conditioned response) account of language presented by B. F. Skinner. This claim of innateness is quite important to how we are to interpret the achievement of the language-learning child. If the structure of language is (in some way) innate, and therefore universal, the child can analyze primary linguistic data available in his/her environment without being forced to independently construct hypotheses about those data. Those hypotheses are already constructed and available at birth; the child is simply responsible for discovering, from that innate universal theory, a particular set of hypotheses applicable to the input data.

Chomsky claims innateness because it reduces the demands of language acquisition. The child is not responsible for constructing a theory of language but rather for discovering that theory. The crucial difference is that theory construction amounts to the imposition of a structural analysis upon an external entity, while the discovery task simply entails recognition of an organizational strategy imposed upon the human being, a birthright, which can be applied to the task of analysis.

For a number of reasons, Chomsky's position is quite sensible. First, the human infant exhibits an extremely limited set of cognitive abilities during the early acquisitional period. The structure of human language, on the other hand, is quite complex. As can be attested by any student of linguistics, the formulation of linguistic hypotheses places considerable demands upon the intellect. In addition, the child encounters only a finite amount of linguistic data during the period when language acquisition is most notable (for that matter, during its entire lifetime). The grammar arrived at, however, must be capable of generating (hence 'generative grammar') infinitely many sentences, the great majority of which have never

before been encountered. Such extrapolation would seem to demand intelligent activity at a rather high level.

This innateness issue remains a rather controversial one among developmental psychologists. Piaget has based his entire theory of genetic epistemology upon the assumption that the innate human endowment is quite simple; the child comes to the world with the internal pressures to organize (sensations, perceptions, language, etc.) and adapt (through accommodation and assimilation). Others, notably T.G.R. Bower, have proposed a rather rich human endowment of quite specific innate capacities. At the present time, there is no compelling evidence for either claim. Investigation into general human cognitive development has been able to reveal relatively little about the details of innate human endowment.

There appears to be at least some sensible reasoning behind Chomsky's claim of innateness. Indeed, I find no reason to believe that the present state of linguistic theory is done any disservice by maintaining that assumption. However, at the same instant that he is presenting this rather unassailable position on innateness, Chomsky attempts to throw in the further assumption that there is a task-specific innate mechanism for language. The basis for such an assumption is not at all made explicit. Indeed, it appears to be a completely arbitrary assumption. It is as impossible today as it was in 1965 to specify details of innate cognitive mechanisms. Effective strategies for discovering such details have yet to be developed. It is crucial to note that acceptance of the validity of the Innateness Hypothesis does not necessitate acceptance of a claim that a task-specific language mechanism is a part of the human innate endowment. Later, I shall go so far as to suggest that present linguistic theory is done a great disservice by clinging to this assumption of task-specificity.

Finally, setting aside matters of innateness and task-specificity, we find that Chomsky makes yet another rather crucial assumption about the nature of the LAD. In claiming that it is an innate theory of potential structural descriptions, Chomsky is severely limiting the scope of the linguistic theory that will result from acceptance of that assumption. The LAD amounts to a theory of syntax, which is not a complete theory of language but only an integral part of such a theory. In acquiring language, the child must also discover the system of conceptualization common to the population in its environment, the system by which conceptualization is mapped onto syntactic structures, and the system for phonological realization of those structures. We are not told what role, if any, the semantics of language has in the LAD. Indeed, the question of acquisition of meaning seems to have been ignored completely.

We have seen that Chomsky makes the following strong assumptions about linguistic theory and language acquisition;

- 1) Linguistic theory is to be concerned with competence of the native speaker.

- 2) Human language acquisition, i.e., the discovery of a particular generative (competence) grammar, is dependent upon an innate mechanism.
- 3) There is a specific innate mechanism which has the unique function of language acquisition.
- 4) That innate language mechanism, the LAD, is essentially a universal theory of syntactic structures.

The overall effect of these assumptions is to focus linguistic research efforts upon the study of syntax, while minimizing concern with peripheral matters. As pointed out earlier, isolation of linguistic competence from other performance factors allows the linguist to conduct intensive investigation of the structural system internal to language. Whether or not it is practical to abstract competence from performance is not really an issue at this point. That abstraction is justified on a theoretical level, for it facilitates definition of the limits of theoretical linguistic investigation.

The entire discussion of the LAD serves the same purpose of establishing the limits and guidelines of linguistic theory. First, the claim of innateness gives the linguist tremendous freedom in developing linguistic analyses. Because the structural organization of language is internal to the human being, it need not be discoverable in other phenomena external to the being. It is not necessary for linguistic structure to follow the same natural laws that have been discovered for these other phenomena by physicists. This allows the possible analyses to be quite abstract. Moreover, the claim of innateness means that regardless of the degree of abstractness, the grammar arrived at can be claimed psychologically real in that it would represent a thought process consisting of in-born cognitive mechanisms.

The claim of task-specificity allows the linguist to fully explore the organization of language while ignoring other cognitive, perceptual organizational strategies that psychologists have found to be evident in other human activities. Again, we find that this assumption serves to more precisely define the limits of an autonomous field of linguistic research. While the competence-performance distinction allows the linguist to draw the line between linguistics and psychology in the construction of a general theory of performance - the linguist accepting responsibility only for adequate characterization of the linguistic competence that serves as input to actual performance - the assumption of task-specificity serves basically the same delimitation function within the domain of competence. The linguist assuming task-specificity is unconstrained by any system of cognitive, perceptual organization that might be discovered by psychologists. Because language is assumed to be a distinct and independent cognitive function, the linguist is under no obligation to seek corroboration of the grammar in those other cognitive organizational strategies. This is further evidence that the psychological reality of grammar is a natural assumption of the theory rather than a substantive goal of the theory.

Finally, narrowing the LAD to a theory of universal syntax again serves to maximize attention on the investigation of syntactic structure. The study of semantics (and semantic structure) and projection phenomena (from semantics to syntax) is reduced to a peripheral concern which, despite its obvious relevance to the study of language, greatly clutters up the search for syntactic generalizations. As with the competence-performance distinction, Chomsky may be making a distinction which is not, in actuality, possible. In the present case, Chomsky is abstracting pure structure from meaning, thus claiming that the syntax and semantics of language are distinct and autonomous components. Again, this is an artificial abstraction that serves the purpose of isolating syntax so that it can be studied independently.

Thus, we have seen that the primary motivation for the assumptions underlying Chomskyan generative theory is to give the linguist total freedom and autonomy in the investigation of syntax. Firm external limits are established to avoid the possibility of getting lost in unproductive tangential concerns. Internal to that narrow field of syntax, all constraints are removed so that the linguist can freely interact with the primary linguistic data and propose any analysis that appears to be justified by those data.

This definition of a narrow, autonomous field of linguistics was necessitated by the fact that generative theory amounted to a major revolution which threw the field of linguistics into a temporary state of chaos. The research guidelines previously established by the structuralist 'power structure' had lost their legitimacy. The responsibility for putting the linguistic 'house' in order fell to the generativists. As with many post-revolution power structures, the strategy immediately adopted by the generativists was to shut themselves off from the rest of the academic world until they had sufficiently stabilized this new field of generative linguistics.

This isolationist philosophy, however unjustified I feel it is at present, was quite justifiable at the time it was adopted. Generative theory was so new that linguists had no indication of what novel and exciting doors it would open in the study of linguistic structure. The generativists did not want to be hampered by misconceptions carried over from structuralist theory or generalizations found to be significant in other domains of human behaviour. They wanted to be free to apply the new guidelines of generative theory to the analysis of primary linguistic data. In this sense, the generative linguist of the Aspects era wanted to limit him/herself to a strictly data-driven, bottom-up strategy for linguistic analysis.

This data-driven strategy has greatly furthered the cause of linguistic analysis. We have progressed through periods of unconstrained abstractness until it finally reached the point of being ridiculous. Since then, linguists have become increasingly concerned with finding a way to constrain abstractness. The notion of psychological reality, which had previously stemmed from acceptance of the assumptions of innateness and task-specificity, is coming to be seen as quite central to the constraining of abstractness. I intend to

argue that if psychological reality is viewed as a concrete goal of linguistic theory rather than a meaningless assumption (or by-product of assumptions), we will find it useful as an adequate constraint on abstractness in linguistic theory. As such, the pursuit of psychological reality could become a rather effective evaluation metric for comparing competing descriptively adequate grammars; the grammar whose organization most closely resembles the organizational system found to be underlying other cognitive processes would be judged superior on grounds external to language.

The question that now arises is this: if the linguist is to use psychological reality as a metric for evaluating grammars and constraining abstractness therein, how is that metric to be applied? More specifically, what are we to use as evidence in deciding which grammars more closely approach psychological reality, and what degree of abstractness is acceptable? I believe that the answers to those questions will begin to become evident once I have discussed the theoretical assumptions appropriate for contemporary linguistic research.

As I mentioned earlier, I find no reason to object to the abstraction of competence from performance; it serves a legitimate purpose in the construction of an adequate theory of language. Until an adequate theory of performance is proposed, we have no way of understanding the complex relationship between abstract knowledge and concrete action. As yet, no such theory is to be found. Thus, even though there is no evidence as to whether the competence-performance distinction can actually be realized, that abstraction can continue to be useful to linguistic theory. Because we have not yet arrived at an adequate understanding of language, the linguist needs the freedom to analyze the knowledge base that underlies verbal communication. The separation of competence from performance provides a justification for ignoring other performance factors, thus it affords the linguist that necessary freedom. Indeed, it may someday be found that such a separation is both impractical and theoretically counterproductive. At that point, we should be open enough to realize the problem and flexible enough to reanalyze our assumptions.

The assumptions for which I will propose major revisions are those embodied in Chomsky's account of the LAD. I believe that our present understanding of the structure and acquisition of knowledge, language included, justifies maintaining only the first of the three assumptions; innateness. It is no longer necessary nor desirable to adopt the extremely narrow perspective on the human capacity for language which resulted from the assumption of a task-specific, syntax-oriented LAD.

It is my belief that adopting a Piagetian approach to language acquisition is a very positive step toward the construction of a psychologically real theory of language. Such an approach forces a complete reanalysis of what Chomsky labelled the LAD. The Piagetian theory of cognitive development assumes that the human being is innately endowed only with the internal pressure (or strategy) to

adapt to its environment and to organize sensory input as completely as possible. In accepting such an assumption for constructing a linguistic theory, we summarily deny the existence of anything like Chomsky's LAD. The child has an innate strategy for organization (or perhaps an innate set of organizational strategies) which can be applied to any situation to which the child finds the need to adapt. There is no set of organizing principles specific to language. The innate strategies are the only analytic tools that the infant can access when faced with any novel situation. The child relies upon the same basic analytic tools when faced with the language acquisition task as it did, for example, when faced with finding nutriment in the first weeks of life.

In essence, I am proposing to treat language as simply a distinct instantiation of human behaviour. With such an approach, it is assumed that there is nothing particularly special which would set language apart from other cognitive abilities. Language is simply a concrete product of general cognitive development. On this point, I am in direct opposition with the assumptions articulated by Chomsky. I am assuming that there is no specific innate mechanism for the task of language acquisition. That projects naturally onto the further claim that that mechanism cannot be specifically oriented to the task of syntactic organization.

Adopting this approach to language destroys the narrowly defined autonomous field of linguistic research created by Chomsky's assumptions. Acceptance of this particular version of the Innateness Hypothesis amounts to recognition of a unique organizational strategy (or coherent set of strategies) imposed on the human mind. The human being relies on that strategy when dealing with sensory input in any domain. Thus, one would predict that evidence of the same organizing principles captured in an adequate linguistic grammar can be found in other realms of cognition. If the same principles are responsible for the organization of language as well as that of general cognition, then generalizations made by cognitive and developmental psychologists can serve an important role in the understanding of language, i.e., the construction of linguistic theory. In fact, recognition that both fields (psychology and linguistics) are pursuing the same organizing principles, but using different data bases, should lead to a very productive coordination of efforts.

As discussed earlier, the assumptions behind early generative theory limited the linguist to data-driven, bottom-up analytic strategies. The current proposal amounts to a plea for addition of a conceptually-driven, top-down strategy for linguistic theory construction. That is, generalizations (or lack thereof) drawn in one theory can facilitate the search for corresponding generalizations in another theory. Rather than starting from the data and deriving a generalization from them, this top-down (or theory comparison) strategy enables the linguist to take a valid generalization from cognitive theory and search for linguistic data relevant to a corresponding generalization for language.

Let me try to clarify the potential productivity of this strategy for the task of theory construction. For any linguistic theory, T_1 , and cognitive theory, T_c , the two theories can interact productively in the following ways:

- 1) T_c can point out significant gaps in T_1 .

A generalization about cognition, G_c , proven to be valid in T_c , can cue the search for a corresponding generalization, G_1 , in T_1 that was not previously discovered during data-driven linguistic analysis. The investigator must understand T_c well enough to identify how G_c fits into T_c , that is he/she must recognize the theoretical context of G_c . That investigator must then be able to analyze T_1 well enough to recognize a) the appropriate theoretical context in T_1 in which the corresponding G_1 would fit, b) the fact that no G_1 has been found, and c) the type of linguistic data relevant to the search for G_1 .

- 2) T_c can constrain abstractness in T_1 .

Investigators in both fields may have independently discovered corresponding phenomena P and P_1 . If the generalization G proposed to account for P in T_c is descriptively adequate and simple, while the generalization G_1 proposed to account for P_1 in T_1 is descriptively adequate but quite elaborate and abstract, then the simplicity of G can motivate reanalysis of G_1 (and P_1) in pursuit of a less abstract generalization G_1' which more closely resembles G_c .

- 3) T_c can serve as a constraint on satisfaction with an oversimplified generalization in T_1 .

Consider the case of phenomenon P which is well understood and well analyzed, and found to require a quite complex generalization G_c in T_c . On the contrary, a corresponding P_1 is only partially analyzed, but that analysis has already suggested a simple generalization G_1 to the linguistic theorist. In this case, the complexity of G_c can help the linguist to realize that G_1 is oversimplified and that further data relevant to the analysis of P_1 must be sought.

- 4) The two theories could fail to interact in any way. This case raises two distinct possibilities:

A. It is possible that comparison of T_c and T_1 is basically an unproductive strategy for theory construction. Any generalization G_c would, in this case, consistently fail to have a corresponding G_1 . In such a case, which could only be discovered by comparing theories, we begin to have rather strong circumstantial evidence for task-specific sets of organizational strategies. The generalizations G_{c1-n} form a set of organizational strategies S_c which fails to intersect with S_1 , composed of a distinct set of G_{1n-x} .

B. It is also possible, and I believe quite probable, that S_c and S_1 intersect only partially. In such a case, generalizations G_{11-n} would neatly correspond to generalizations G_{c1-n} . At the same

time, it could be the case that there is no G_{ln+1} that corresponds to G_{cn+1} , while there is a G_{ln+2} that fails to have a corresponding G_{cn+2} .

This final case is an important one. The human being is faced with the necessity of organizing input at many different levels. In adapting at the sensori-motor level, the infant must apply the innate organizational strategy to data that take the form of sensations. As a result of this adaptation, the child constructs egocentric percepts which form the basis of a new perceptual level at which the child must again adapt. The percepts become input to which the child again applies the innate organizational strategy to arrive at a set of concepts. Similar adaptation to this conceptual level require application of the organizing principles to the meaning and structural systems of language. Notice that the assumption is that the same organizing principles are accessed for application at various levels of cognitive processing to arrive at an understanding (i.e., an internal representation) of egocentric reality. This greatly oversimplified account of intellectual adaptation can be schematized as in Figure 1.

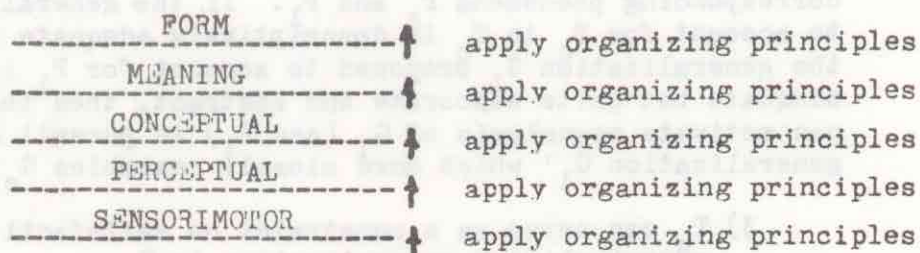


Figure 1.

Adaptation is essentially a distinct task at each different level of cognitive organization. The human being approaches each of those tasks with the same potential strategic repertoire. Because each adaptation task is in some way unique, it seems reasonable to assume that it places different demands upon the innate organizational strategy. Thus, in applying our theory comparison (top-down) strategy, we should not expect a perfect one-to-one mapping of generalizations at different levels. What we should expect to find, and indeed what we should seek, is a set of generalizations common to all levels, along with certain generalizations specific to a particular level (or a particular set of levels). The goal of the theory, then, is not only to capture generalizations within each level, but also to discover a global set of generalizations common to all levels and a set of transition rules for projecting from one level to another when generalizations are level-specific.

This is an appropriate point at which to summarize what I have attempted to accomplish so far. I have pointed out that in developing the generative theory of language in Aspects, Chomsky makes four crucial assumptions:

- 1) There is a competence - performance distinction.
- 2) The LAD is innate.
- 3) The LAD is task-specific.
- 4) The LAD is syntax-oriented.

In analyzing those assumptions, I claimed that the primary factor motivating them was the desire to give the linguist total freedom and autonomy to apply the principles of generative theory to a data-driven analysis of syntax.

My alternative proposal involves taking a Piagetian approach to language acquisition and linguistic theory in general. With such an approach, assumptions (1) and (2) above can be maintained, but the claim of a task-specific, syntax-oriented innate mechanism is rejected. Language development is attributed to the same mechanisms as those that underlie all of cognitive development (according to Piaget): organization and adaptation. Thus, linguistic research should reveal that the organizational strategies of language bear strong resemblance to those found in other behaviours.

This reanalysis of the theoretical assumptions is not intended to deny the linguist that data-driven analytic strategy so carefully constructed by Chomsky. To the contrary, I simply wish to add a conceptually-driven strategy to the linguist's theory construction repertoire of strategies. With this approach, the linguist can appeal to general cognitive theory for insight into productive avenues of research.

There are two crucial factors motivating my efforts to reanalyze the assumptions underlying linguistic theory. First, I wish to define a coherent area of linguistic research in which the linguist must realistically confront the issue of psychological reality of grammar. It is my opinion that Chomsky's assumptions have allowed linguists to neatly circumvent discussion of this issue. The assumption of task-specificity and syntax-orientation of the LAD afforded the linguist the freedom to propose descriptively adequate analyses that need not bear any resemblance to analyses of other human behaviours. To a point, this analytic freedom was desirable. However, the theory, thusly defined, seems to have no adequate system to constrain abstractness. Any analysis, however abstract it might be, can be claimed to be psychologically real because it is assumed to be innate. The Piagetian approach to language acquisition which I favor effectively avoids this problem. The linguist now becomes responsible for developing a grammar which captures the essence of the same organizational strategies which underlie all of cognitive adaptation. The generalizations made in linguistic analysis must then bear some (strong) resemblance to generalizations that can be made about other cognitive abilities. In this way, the linguist is forced to directly confront the issue of psychological reality.

The pursuit of psychological reality has a couple of advantages for linguistic theory construction. First, it can serve as a desperately needed evaluation metric for comparison of competing descriptively adequate grammars. The grammar which most closely approaches

explanatory adequacy would be one that maximizes the number of generalizations common to linguistic and general cognitive theory. In doing so, it would minimize the problem of projecting linguistic structure onto conceptualization, perception, and sensation. Second, the establishment of this theory comparison technique provides the linguist with an additional strategy for theory construction. By appealing to theories external to language but relevant to general cognition, the linguist gains access to a top-down strategy for theory construction. Generalizations from such external theories can 1) point out significant gaps in linguistic theory, 2) constrain abstractness in linguistic theory, and 3) point out inadequacies in linguistic analyses based on insufficient data.

The second factor motivating the alternative approach that I am proposing is that the present state of linguistic analysis is beginning to show a readiness for it. It is quite significant, I believe, that linguists from such divergent schools of thought as Ray Jackendoff (lexicalist/interpretivist heritage) and Ron Langacker (generative semantics heritage) have begun to approach the analysis of language in a way that seems to bear a curious similarity to that which I am supporting.

The recent work of Ray Jackendoff reveals that he is a proponent of what can be called the Projection Simplicity Hypothesis. That hypothesis, first articulated in Jackendoff 1976, assumes that linguistic analysis ought to be concerned with the structural organization found at three levels, conceptual structure, semantic structure, and syntactic structure. Jackendoff assumes that there is a great deal of equivalence in structural organization at the conceptual and semantic levels, so much so that he seems to find little need for any projection rules from one to the other. The aim of his present approach to linguistic analysis, then, becomes the description of syntactic and semantic structures which optimally simplify projection from one to the other. In essence, this is a specific, narrow example of the general theoretical pursuit that I outlined earlier.

Similarly, the recent work of Ron Langacker in the development of what he is calling the theory of Space Grammar reveals an inclination toward sensitivity to psychological reality in linguistic theory construction. Langacker's approach to linguistic analysis incorporates an even more radical departure from the pursuit of the Aspects theory. Rather than claiming that projection from one level to another ought to be simplified, Langacker totally rejects the notion of distinct levels. Space Grammar assumes a close relation between form and meaning in language. Grammatical structure is seen to be simply semantic structure in a conventionalized form. A grammar is, then, an inventory of such conventionalized units. Language diversity is attributable to the fact that different units have been conventionalized by different populations, even though the semantic structure underlying those conventionalizations might well be universal. Langacker perceives of Space Grammar as a non-generative inventory of conventional units used to symbolize conceived situations. The generative nature of language, that is the statement of linguistic well-formedness conditions, is seen to require a full theory of

cognition. Thus, the generative nature of language is characteristic of a cognitive theory subsuming linguistic behaviour, not specific to the particular task of language. In terms of the earlier discussion, generative capacity is a generalization common to all levels of cognitive activity.

Before closing, it seems necessary to discuss the type of generalizations that might be common to the organization of language and general cognition. In this section, I will present four areas where parallel generalizations might be possible. This discussion is presented with the understanding that it introduces prospective areas for investigation, not phenomena already well analyzed from the present perspective.

The Grammar of Prehension

In the first month of life, the new-born infant exhibits three differentiated reflexes which will eventually be coordinated into a schema for prehension. Those three reflexes are grasping, sucking, and looking. At first, the child fails to be able to coordinate those reflexes. The primitive 'grammar' of these reflexes at this point would take the form of a simple expansion rule:

$$\text{reflex} \text{ -----} \rightarrow \begin{Bmatrix} \text{GRASP} \\ \text{SUCK} \\ \text{LOOK} \end{Bmatrix}$$

During the next three months, the child begins to coordinate those reflexes into schemata for prehension. This is an adaptation task that involves application of the innate organizational strategy alluded to earlier. The development of the coordination of these reflexes reveals an extremely interesting sequential elaboration of the 'grammar'.

The first development occurs when the child successfully coordinates GRASP and SUCK. At first, this schema is obligatorily ordered, GRASP activates SUCK. The expansion rule for this first ordered coordinated schema (OCS I) would be:

$$\text{OCS I} \text{ -----} \rightarrow \text{GRASP} - \text{SUCK}$$

The next development comes when the child discovers that ordering is a useful variable, i.e., order can vary. Thus, not only can GRASP activate SUCK, but now SUCK can activate GRASP. OCS I is reanalyzed into an unordered schema, UCS I.

$$\text{UCS I} \text{ -----} \rightarrow \begin{Bmatrix} \text{GRASP} - \text{SUCK} \\ \text{SUCK} - \text{GRASP} \end{Bmatrix}$$

The 'grammar' has begun to develop. The child has applied a combine elements strategy and a vary order strategy. These are strategies that play a crucial role in the syntactic organization of language.

A further development occurs when the LOOK reflex is coordinated with UCS I. At first, the coordinated schema is obligatorily ordered, LOOK activates UCS I. This, then, is OCS II:

OCS II -----> LOOK - UCS I

This reveals some important points. First, although a vary order strategy has been applied to arrive at UCS I, that strategy is not immediately carried over to the novel coordination of LOOK with the others. Only the combine elements strategy is applied, suggesting that it has some primacy to the vary order strategy whenever the two must be called upon in novel situations. This very well may be a primitive instantiation of what Piaget has labelled a 'vertical decalage', when a strategy discovered at one level is not carried over to the next but must be rediscovered.

Notice that a new strategy has developed in OCS II. The child has discovered an embed schema strategy by which a schema (UCS I) can be used as an element in the 'grammar'.

Once again, the next advancement involves application of the vary order strategy, so that OCS II is reanalyzed into UCS II.

UCS II -----> { LOOK - UCS I
UCS I - LOOK }

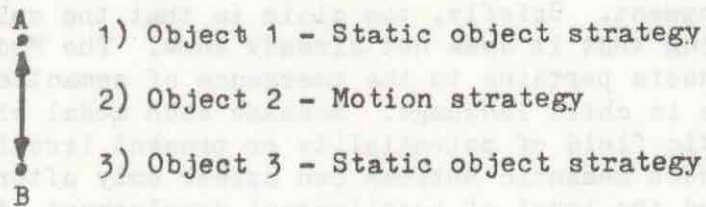
My feeling is that the progressive coordination of these reflexes may indeed reveal application of some of the same organizational strategies used in acquiring language: combine elements, vary order, and embed. Piaget's notion of 'vertical decalage' can account for the fact that even though the strategies have been discovered for this early adaptation task, they must be painstakingly rediscovered in the language acquisition task.

Perception of Static and Moving Objects

The development of the notion of object permanence, the so-called object concept, occurs gradually over the first two years of a child's life. Early in the sensori-motor period of development, the child has a very egocentric notion of objects. In essence, the child perceives of them as extensions of her/his own motor activities. Thus, an object at this stage exists for the child as long as the child perceives that object (visually, tactilly, etc.). When the child no longer can operate on the object, the object no longer exists for the child. There are a number of interesting developments involved in coming to the realization that objects are permanent through movements in space and time.

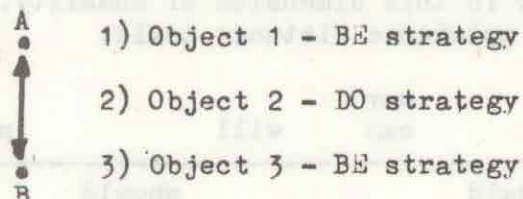
T.G.R. Bower presented an interesting analysis of the perceptual strategies available to the child before the development of a mature object concept. He was studying the phenomena in which infants look at still objects and track objects in motion. His conclusion was that at one point during this developmental process, the child has two distinct and uncoordinated perceptual strategies, one for per-

ception of static objects and another for perception of the movement of an object in motion. In applying these strategies to a situation in which an object is at rest at point A, then moves along a path to another point B and stops, Bower claims that the child applies the following sequence of perceptual strategies:



In essence, the child perceives three different objects, a static object at A, a moving object (or pure motion), and a static object at B. Each time the child is forced to change perceptual strategies, the previous object disappears and a new object appears. This is due to the fact that the child has not yet developed the ability to coordinate these strategies.

There seems to be a direct parallel between these perceptual phenomena and Langacker's Space Grammar account of the existential predicates BE and DO in the English auxiliary. Langacker argues rather convincingly that BE predicates the existence of a state and DO predicates the existence of a process. Thus, I would venture to propose that BE is the linguistic correlate to the child's static object strategy while DO corresponds to the motion strategy. Carrying the pursuit of cognitive generalizations to its natural conclusion, one might posit that the same strategies are operating at two different levels. The figure above could then be reanalyzed as below:



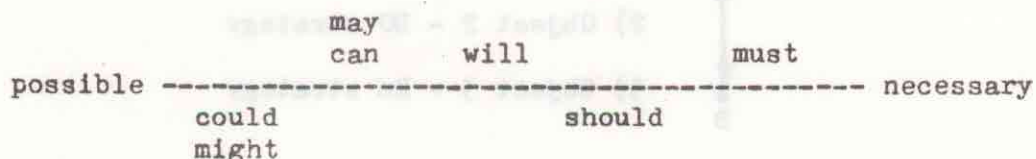
The mature object concept is reached when the child can coordinate the BE and DO strategies so that a single object can be perceived as stopped at A, then initiate and terminate motion so as to come to rest at B. In essence, this amounts to the ability to perceive a motion bounded by a beginning and an end point.

This points out yet another parallel with Langacker's account of the English existential predicates. A final possibility at the existential level in Space Grammar is the case of BE +ing (John is running). Langacker argues that BE is predicating the existence of a state which was created by the stativizing predicate +ing. Together, they specify the existence of a bounded process. By analogy with the child's perceptual achievement, BE +ing amounts to the linguistic coordination of the BE and DO strategies.

The Modal Egocentrism Hypothesis

In an earlier paper (Hawkins 1979), I developed a hypothesis concerning child acquisition of modal auxiliaries in English. The assumption underlying that hypothesis was that the semantics of child language is directly dependent upon the child's intellectual development. Briefly, the claim is that the child cannot mean anything that it does not already know. The Modal Egocentrism hypothesis pertains to the emergence of semantically epistemic modals in child language. Because such modal elements refer to a semantic field of potentiality or present irrealis, I hypothesized that such semantic notions can appear only after the child has reached the level of intellectual development at which he/she is capable of hypothetical reasoning and modal logic. According to Piaget, that point is reached sometime during the child's progression from concrete to formal operations, between the ages of seven and eleven. Unfortunately (for the hypothesis), children are found to be in full command of the lexical and syntactic rules for modals much earlier than this. The problem that arises is that, from the existing data, there is nothing to suggest what the child's semantic intention is when using those modals. English modal auxiliaries can be used in a non-epistemic sense which has no relevance to the claims of the Modal Egocentrism hypothesis.

A further claim of this hypothesis is that the sequence of acquisition of the epistemic modals could be predicted. In his Space Grammar account of epistemic modals in the English auxiliary, Langacker proposed that they can be placed on a scale of probability, ranging from necessity to mere possibility. Those closer to the necessity pole are nearer to the speaker's present reality, while those nearer the possibility pole have a greater epistemic distance from the speaker in this dimension of modality. The figure below represents this epistemic distance scale.



The claim of the Modal Egocentrism hypothesis is that epistemic modals place a demand on the ability to decenter in the dimension of modality. Based on Piaget's notions of egocentrism and decentration, I proposed that modals closer to the necessity pole would be acquired before those nearer the possibility pole because they place a lesser demand on the ability to decenter in modal dimension.

Once again, the difficulty in discovering the semantic intention of children acquiring language and the knowledge underlying it proves to be a major obstacle in attempting to verify the claims of this hypothesis. At present, no data confirming or denying the claims of the Modal Egocentrism hypothesis are available.

Second Language Acquisition and the Formal Operations Hypothesis

It has long been recognized that children acquire foreign languages in a rather easy, natural manner until puberty, around the age of eleven or twelve. After that time, there seems to be some major impediment to natural (foreign) language acquisition. Because of this phenomenon, it has been assumed that there is a critical period for language acquisition which ends when a child reaches puberty. Lenneberg (1967) attempted to demonstrate that there is a neurological basis for the close of the critical period. He claims that the factor underlying the child's ability to learn languages naturally and completely is that the development of cerebral dominance (lateralization) is not yet complete. Lenneberg argues that cerebral dominance is established at puberty, thus accounting for the close of the critical period.

Krashen reexamined much of Lenneberg's data and found evidence to suggest that lateralization is complete by the age of five. Thus, a different factor must be found to account for the critical period ending at puberty. Both Krashen and Rosansky have pointed to the significant coincidence of the close of the critical period and the beginning of the formal operational period in the child. They are proponents of what Krashen has labelled the Formal Operations hypothesis, which rests on the crucial factor that the formal operational adolescent has developed the strong tendency to construct hypotheses in an attempt to arrive at explicit explanations of perceived phenomena. This amounts to the development of explicit problem-solving strategies in the adolescent. The inhibition of natural language acquisition at puberty is claimed to be attributable to the fact that the formal operational person approaches language acquisition as a problem-solving task, i.e., the adolescent and the adult have the distinct ability and need to formulate explicit rules which the pre-operational and concrete operational child is not even capable of formulating.

I find this hypothesis quite interesting for it seems to be quite strongly related to the Piagetian approach to language acquisition for which I have been arguing. If, as I claim, language is a natural outgrowth of general cognitive development, then it would be quite reasonable for the emergence of formal operations to have such a profound effect on language acquisition abilities.

Interestingly, there might be an effective way to test the Formal Operations hypothesis. It has been noted that many people are slow to reach this stage, and in fact, some people may never achieve formal operational reasoning. If the Formal Operations hypothesis is correct, those people who never achieve formal operations (or do so quite late) should be quite successful in natural language acquisition during adolescence and adulthood. Given accurate tests for formal operations and the adequate natural acquisition environment (immersion in a second language situation rather than a classroom situation), it would be possible to test this claim.

A further claim of this hypothesis is that those people who achieve formal operational reasoning begin to approach language as a problem-solving task. In this regard, Krashen has made the crucial distinction between acquisition and learning of language. Acquisition refers to the unconscious absorption of language structures characteristic of early child language. Learning, on the other hand, results from the conscious focus on rules and their application to foreign language production. Krashen has proposed that learned second language material amounts to a monitor which the language learner accesses in attempting to output correct utterances in the second language. If there is a correlation between problem-solving and language learning as the Formal Operations hypothesis would seem to predict, then we should find that people more adept with problem-solving strategies would have a more successful monitor in second language production. In attempting to test this prediction, we would have to look for a correlation between performance on intelligence tests and ability to perform monitored speech in a second language. Given a metric for measuring successful use of the monitor (and Krashen seems to claim to have such a metric), such a test would be possible.

Footnotes

¹Chomsky 1965, p. 32 It appears to be a matter of semantics whether the LAD is considered to be the child itself or an innate cognitive mechanism of which the child is the possessor. I feel more comfortable with the latter position, although the former is apparently quite acceptable to many students of linguistic theory.

²I am of the opinion that this is another of those assumptions which has the purpose of allowing him to focus on projection at one other level. That assumption is not yet justified by his approach for any other reason than narrowing focus of investigation. It is my feeling that increased sensitivity by linguists to projection from language to conceptualization and perception will reveal the need for transition (projection) rules at all levels similar to those Jackendoff is pursuing at the level of syntax and semantics.

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