PSYCHOLINGUISTIC AND NEUROPHYSIOLOGICAL ASPECTS OF LANGUAGE ACQUISITION

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The purpose of this thesis is to propose a theory of language acquisition which could serve as a basis for further studies in this area. As indicated by the title, the scope of the thesis is broad. Materials are drawn from the fields of philosophy, psychology, and neurophysiology, as well as linguistics. The assumption is made that language is a human "species specific" quality that reflects mental activity unexplainable by mechanistic theories of the brain. Therefore, a valid theory of language acquisition would necessitate investigation in the aforementioned disciplines.

The thesis is divided into two sections, the first dealing with the psycholinguistic aspects of language and its acquisition, and the second dealing with the activities of the brain which relate to language ability, behavior, and acquisition. The study begins with a brief description of the philosophical origins of language theories as the groundwork is laid for a comparison between Empirical (Structural, mechanistic) and Rationalistic (Transformational-Generative, mentalistic)
linguistic theories which are exemplified in Chapters III, IV, and V. Chapter VI closes the first section of the thesis with a discussion of the dominant theories of language acquisition. The conclusion is drawn, from a linguistic viewpoint, that language acquisition is a mental quality which is specifically human.

Section Two begins with a description of language related activities of the brain, and then proceeds to a study of language pathology. The assumption is made that language problems which seem to have a genetic origin support the theory of a genetic basis for "linguistic" mental structures. Chapter IX deals with the evolution of language and the consequent evolution of the human species as this subject relates to the development of a qualitatively different mental structure (of a linguistic nature) in humans as opposed to other primates. The thesis closes with a theory of language acquisition based upon the Rationalistic philosophy of innate ideas, a theory which assumes that innate linguistic structures will be carried in the genetic code and transmitted via DNA/RNA messages from generation to generation.
PSYCHOLINGUISTIC AND NEUROPHYSIOLOGICAL ASPECTS OF LANGUAGE ACQUISITION

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Anyone attempting to study language acquisition today will find himself faced with a mammoth task which demands careful examination of contradictory, often nebulous material from several different fields. For determining what is involved in the acquisition of language encompasses not only linguistic questions, but psychological and neurophysiological ones as well. This thesis is a review of scientific literature bearing on language acquisition produced by the fields of linguistics, psychology, and physiology.

In addition to an acceptable theory of grammar which would account for language competence, an adequate explanation of the marvel of language acquisition would have to entail a theory of mind and its relationship to the brain. For this reason, the thesis begins with an examination of the philosophical origins of leading psycholinguistic theories of language. The classic issue of "mind versus matter"—which is, after all, the crux of the problem—
opens the discussion. The Rationalism of Descartes is contrasted with the Empiricism of Locke, as the foundation for the modern division between the "mentalis" and the "behaviorists" is laid.

Chapter Three deals with a mechanistic explanation of language based upon behavioral theories of the mind. Both classical Behaviorism as espoused by Pavlov and Skinner, and Neo-behaviorism of the Osgood-Braine group are examined. The type of grammar for which a behavioral theory could account is described in the close of the chapter.

Chapter Four begins with a description of the creative nature of language and includes an account of the recent revival of Rationalistic philosophies of mind and language. The theories of Noam Chomsky, a leading figure in the revival of Rationalism, are briefly discussed. The possibility of universal linguistic properties of language is examined, for Rationalism necessarily entails acceptance of such. Transformational-generative grammar, the most viable of all grammatical attempts to account for linguistic competence and linguistic universals, is explained in Chapter Five.

"The Innateness Issue," Chapter Six, deals with a comparison of the behavioristic and mentalistic positions regarding language behavior and particularly language acquisition. Theories of Skinner, Osgood, and Putnam are
contrasted with those of Chomsky. Observations regarding the psychological realities underlying generative concepts are stated before the stronger position of the Rationalists is summarized, closing the first section of the thesis.

The second half of the thesis is concerned with the physical operations of the brain, the neurophysiological structures which support or perhaps constitute the intellectual functions of man. What is known about the physical activities taking place when language reception and production occur is discussed as various scientific explanations of brain and mind are stated. Because abnormalities often provide the key to understanding normal behavior and states, an examination of language-related brain dysfunction is conducted. Various theories relating to the causes of these abnormalities are explicated. These hypotheses necessarily entail a discussion of a genetic basis for language problems which, if valid, would allow for their counterpart in normal language behavior. That is, a theory could be posited regarding the transmission of specific genetic factors which, in normal humans, guarantees the acquisition of language. It would propose that such an ability is "species specific" with humans, negating studies presently underway which are attempting to demonstrate syntactic capacities in apes. After discussion of the evolutionary aspects of language and language users,
the writer posits such a theory, hopefully providing the framework for extensive studies in a language-oriented research project of mind-brain activities. If, as seems to be indicated, Chomsky's transformational-generative grammar concepts have actual bases because of certain structures being encoded in the genes of humans, the ramifications of this fact would greatly alter the fields of psychology and psychiatry, as well as linguistics and education. Indeed, transformational-generative grammar has already "generated" a revolution. This theory is merely one of the many extensions.
CHAPTER II

PHILOSOPHICAL ROOTS FOR THEORIES OF LANGUAGE ACQUISITION

Men have probably argued the existence of mind as a reality since the emergence of language. Being somewhat distrustful of a device which they perceived but could not see, experienced but could not reveal, they set about to prove that either it existed, quite really, apart from matter, or, conversely, existed only as matter. Thus the two camps were divided and the battle begun. There were those who became extreme "spiritualists," denying the existence of the physical, material world—claiming that all reality was mental and that what seemed to be physically present was a deception. Their materialistic counterparts claimed that nothing existed except matter, that so-called "mind" was actually conditioned matter. The latter view is the most prevalent one today, for, to the common man, the material world is obviously real, but he cannot see the mind, although he may experience mental activity. Yet, he also experiences, albeit somewhat rarely, intuitive insights into the nature of his physical world which cannot be mere physical responses to stimuli. To the thoughtful, inquiring person, such insights indicate
to him that he has a "mind" and not just a brain. For this reason, the theory of dualism (abstract mind working through matter, but separate from it)—with its accompanying problems—was formulated by Western philosophers and dominated epistemological studies from the era of Descartes until the nineteenth century. By that time, Empiricism had developed into a mechanistic materialism which cut deeply into the accepted theories of "rational" man in a "rational" universe. To understand this development, it is necessary to trace the basic issues dividing the mentalists and the materialists from their formal inception.

Since the days of the Greeks, men have argued about the relative importance of two factors in the acquisition of knowledge: the power of thought—mind—and the power of observation and perception—experience. They were uncertain whether mind with certain innate capacities were more important in the attainment of knowledge than was experience—environmental inputs. They wondered if the mind, with its supposed reasoning power, could discover truth by itself, or if observation of the physical world alone were reliable. Was the "mind" originally just impotent matter, or did it contain a priori knowledge (Randall and Buchler 1957, 74)?

In modern times, those philosophers who stress reasoning or thought as the fundamental factor in knowledge
have come to be known as Rationalists, while those who stress observation of sensual experience have come to be known as Empiricists. There are many varieties of both philosophies; however, all ultimately trace their basic tenets to their conception of mind and how it acquires knowledge. The classical Rationalistic position was best stated by Descartes, who held that mind was an entity separate from, but working through, matter. This entity, he declared, was endowed with certain innate capacities which made intuitive perception of knowledge a certainty. In his *Rules for the Direction of the Mind*, he stated that only intuition and deduction were reliable routes to knowledge. Experience was subject to deception and was, therefore, suspect. Ideas were innate and needed only activation by experience to appear (1641, 40-41).

John Locke, stating the Empiricistic position, contrasts markedly with Descartes, as can be seen in the following quotation from *Essay Concerning Human Understanding* (1690, 75).

The senses at first let in particular ideas, and furnish the yet empty cabinet, and the mind by degrees growing familiar with some of them, they are lodged in the memory, and names got them. . . . In this manner the mind comes to be furnished with ideas and language, the materials about which to exercise its discursive faculty. And the use of reason becomes daily more visible, as these materials that give it employment increase.
Locke categorized the mind as "white paper, void of all characters, without any ideas." To the question, from where did ideas come, he answered, "... from experience " (1690, 75).

It should be noted that Locke was not an extreme Empiricist. Once the mind was supplied with ideas from experience, it could actively manipulate them, according to Locke. Later Empiricists would reject this "mental" activity as being too close to Rationalism. Also, Locke and the more moderate Empiricists accepted deduction as a valid insight and tool, if it were not closed-in and completely reliant upon intuition as conceived of by Descartes. He also accepted a form of intuition—one based upon the most direct and simple sensory experience. For instance, to differentiate between a Rationalist and an Empiricist, the former would affirm that intuition tells him every event has a cause. He knows this is true even though it is empirically impossible to prove it. On the other hand, only judgments of immediate perception such as "I am in pain" are acceptable empirical intuitive evidence. Also, the Empiricist relies more heavily upon the scientific method and induction as tools for perceiving knowledge, though in actual practice the lines are not so clearly drawn between moderate Empiricists and Rationalists.
Before proceeding to the trends modern Empiricism took, it is important that one note the points of difference between symbolical and intuitive knowledge. Intuitive knowledge is immediate and direct; it springs from the mind, as conceived of by Descartes. On the other hand, symbolical knowledge is discursive or mediate knowledge because the symbol mediates between the object known and the knowing mind. A symbol cannot give complete knowledge because it is just that—a symbol. It merely translates knowledge into concepts whereas intuition eliminates translation. Intuition presupposes certain concepts to be innate in the human mind. According to Bergson, symbolical knowledge is empirically analytical, breaking up the object of knowledge into aspects of elements, and, therefore, is incapable of ever attaining true complete knowledge. Only when empirical analysis is based upon intuitive theories can knowledge be fully apprehended (Randall and Buchler 1957, 107). Noam Chomsky has noted that the pragmatist Charles Sanders Peirce had similar ideas about the acquisition of knowledge, calling the intuition the "guessing" instinct. Like Bergson, Peirce regarded the inductive processes as tests of intuitive theories which are true. That is, humans can pass from intuitive into symbolical states but not vice-versa. As Chomsky observed, Peirce's "guessing" instinct is a type of Kantian pre-condition (1972, 90).
It will be noted later that this differentiation is a significant factor in the development of language theory. Symbolical philosophies can only allow "representation" of knowledge, and that in segments. A language theory which has "representation" as its basis must approach language from an unnatural position, that of analyzing segments to determine meaning, rather than determining the rules which govern these segments. Language segments are units within novel, creative utterances—utterances which are indicative of a mental apprehension far deeper and broader than "representation" can support.

The emphasis on analysis of symbols and data as opposed to intuitive insight is best exemplified in the Positivist Auguste Comte. Taking the basic postulate of Empiricism that all theories, in order to be validated, must be submitted to the test of experience, he and his followers went further, asserting that only those theories which could be tested directly by experience and realized in a physical sense were valid. An example of a testable theory would be one about atoms; such a theory is capable of being substantiated because, given a powerful enough microscope, one can see the atom. A theory about God, however, would be meaningless to a Positivist. In general, Positivists limit the scientific procedures to recording, describing, and classifying. A Positivistically oriented language theory would be limited to analyzing and classifying surface segments which could be physically tested.
Theories of grammar based on an intuitive philosophy would necessitate mental structures which cannot be presently physically tested via segmental analysis. Therefore, "intuitive" theories of language are derogatorily called "mentalistic" by linguists of a Positivistic bent.

The Positivists with their emphasis on the physical senses as the only valid experience were closely aligned with other Empiricists, the Sensationalists and Nominalists. The latter group, carrying materialism to the extreme, denies any sort of universals. To them only the specific, physical, observable (sensory) object exists. Concepts such as whiteness, mankind, fatherhood, and so on are mere verbalisms. Laws and other such concepts that presuppose relationships between facts do not exist. Like other materialists, they regard "mind" as merely complex brain functions, mechanistic functions of neurophysiological processes. Hugh Elliott, in defense of the materialistic position, states,

Now mechanism is a physiological theory which is proved. We must hold fast to it therefore at any expense to our metaphysical preconceptions. The only remaining alternative, then, is the abandonment of dualism. We must affirm that there is no shadow accompanying cerebral processes as alleged; that there are not two things, mind and body, fundamentally distinct. We must, in short, affirm that the mind is the cerebral processes themselves, not an imaginary accompaniment of them (1919, 320-321).
Thus by the end of the nineteenth century, the materialistic philosophy was firmly entrenched. With the twentieth century came Behaviorism, heralded as "the answer" to any lingering problems of how the mind actually operates and how the human comes to have ideas and express them. This extreme form of Empiricism departs radically from most of Locke's ideas regarding the mind except in the most important area: all knowledge arises from sensory stimulation. Steinberg summarizes the cardinal principles of Behaviorism as follows:

(1) Mind is considered something extranatural and illusory.

(2) Consciousness and mental processes are rejected as subjects of study and their very existence is doubted because what is real is matter.

(3) Mind is a superstition unworthy of scientific investigation.

(4) Human psychology is to be accounted for in physiological processes or, preferably, in terms of muscular and glandular activities.

(5) Behavior is composed of simple units like reflexes and all larger behavior units are assumed integrations of a number of stimulus-response connections, involving the operation of associationistic principles.

(6) Conditioning is the simplest form of learning.

(7) Everything that a person may learn in a lifetime must therefore be derived from the simple muscular and glandular responses which the child produces in infancy.

(8) An idea is a unit of behavior.
Behaviorism substitutes the association of motor responses for the classical doctrine of the association of ideas (Steinberg 1971, 486-487).

Certainly the Behaviorism of Watson was at opposite poles from the concept of intuition posed by Descartes. It hardly seems possible that Descartes originated the doctrine of the association of ideas, so deviant has its modern application become. However, as Coleridge pointed out, even by the time of Hobbes—who is often incorrectly credited with originating this doctrine—Descartes' ideas had been altered to fit the Empiricist mold. Descartes said that contemporaneous impressions, whether images or sensations, recall each other mechanically. Language, for example, was a continual process of association, once the innate ideas had been stimulated. Nevertheless, Hobbes built a purely physical system on this concept (Coleridge 1824, 484-485). His theory that external objects left impressions (via the senses) on the innermost and subtlest organs constituted the basic idea upon which Watson built his stimulus-response theories.

Steinberg, continuing his description of Watson's Behavioristic doctrine, comments,
Words were considered by Watson as substitutes for objects and concrete situations. . . . The meaning of a word is simply the conditioned response to that word (1971, 487).

It can be concluded from the previous remarks that language studies based upon Positivism and Behaviorism would stress the physical, measurable behavioral units of speech. Positivistic or Behavioristic linguists would analyze, classify, and describe the surface units of language, simultaneously denying validity to any intuitively based language theory. If the principles of Behaviorism are valid, then the Behavioristic approach to language is sound and will be able to describe a natural language accurately. It was the belief of Saussere, Bloomfield, and others that Behaviorism was an accurate, scientific explanation of "mind." Upon this belief, Bloomfield headed a branch of American linguistic studies which dominated the field until the 1950's. This mechanistic approach of the Structural Linguists is examined in Chapter Three.
Leonard Bloomfield, writing in his classic book *Language*, made the following statement which was to characterize linguistic studies for two decades.

"Speech results from cause and effect sequences exactly like those which we observe say in the study of physics or chemistry" (1933, 53). As was observed in Chapter Two, the mechanical view of language had become accepted truth after the appearance of Watson's theory of stimulus-response conditioning. Whether applied by a linguist, such as Bloomfield, or a psychologist, such as Skinner, no one seriously questioned the mechanistic explanations. Linguists concerned themselves with observation and classification of data which had been gathered by means of elaborate, rigorous, and—they believed—fully objective collection methods. In psychology and education, men concerned themselves with verbal behavior of the individual rather than with theories regarding mind, which, in their view, did not exist.
Central to any type of behavioral learning theory is the concept of association which springs from a Hobbesian material interpretation of Descartes' law of Association of Ideas. Supporting neurophysiological structures organize and are organized by behavioral experiences, according to the psychologists. Therefore, they make the following assumptions about stimulus-response events:

(1) Contiguity: The shorter the time between the stimulus and the response; the greater the increment in their association.

(2) Summation: Successive increments of associations summate to yield habit strength.

(3) Generalization: The habit-strength between one S-R event generalizes to other S-R events.

(4) Motivation: Motivation combines multiplicatively with habit-strength to yield performance.

(5) Reinforcement: Reinforcement is inversely proportionate to the size of the increment in association.

(6) Inhibition: The execution of any response produces an increment of inhibition toward making that response.

(7) Selection: Whenever two or more responses have been associated with the same stimulus, the reaction having the momentarily strongest habit strength shall occur (Osgood 1956, 55).

These seven principles seem to be basic in all Behaviorist theorists. Pavlov, applying some of these principles, devised a kind of learning known as substitution, which Osgood summarizes in the following manner:
"An object evokes certain behavior in an organism; if another pattern of stimulation is consistently paired with the original object, it becomes conditioned to the same responses and thus gets its meaning. The object is the unconditioned stimulus and the sign is the conditioned stimulus, the latter merely being substituted for the former" (1952, 159).

The obvious weakness of the substitution theory is that signs never evoke the same overt responses as do the objects they represent. As has been noted many times, the word fire has meaning without sending a person into headlong flight when he hears it.

A second theory of S-R conditioning, "sets" or "disposition," involves the proposition that any pattern of stimulation which is not the object becomes a sign of that object if it produces in the organism a "disposition" to make any of the responses previously elicited by that object. However, most Behaviorists find these "dispositions" are too mentalistic. Also, the set theory fails to differentiate sign behavior from many instinctive reactions and from ordinary "single-stage" conditioning. In the latter respect, it is merely a revival of substitution (Osgood 1952, 160).
It remained for the neo-behaviorists, in an effort to answer these criticisms, to devise a new theory, which they called representational mediation. That theory was explained by Osgood as a "process by which a pattern of stimulation which is not the object is a sign of the object if it evokes in an organism a mediating reaction, this (a) being some fractional part of the total behavior elicited by the object and (b) producing distinctive self-stimulation that mediates responses which would not occur with the previous association of non-object and object patterns of stimulation" (1952, 160). Osgood illustrates the mediation process in the model below.

(\text{Nipple} \rightarrow \text{Salivation, sucking, autonomic & muscular changes})

(Osgood 1971, 488)

(The "$r_m" is the fractional part of the total behavior elicited by the object. It is self-stimulating and therefore able to mediate further responses.)

The vast majority of signs used in ordinary communication are what we may term assigns ($r_m$). Their meanings are literally assigned to them via association with other signs rather than via direct association with the objects represented.
As the figure illustrates, the new stimulus pattern acquires meaning from the primary signs. In conjunction with hierarchial habit families, representational mediation provides the most viable of all Behavioral language models.

Turning from Behavioral theories of conditioning to grammatical theories based upon mechanistic views of mind and Positivistic methodology, one encounters the Structural Linguists, whose views in descriptive linguistics were dominant until the mid-fifties. In keeping with the symbolical account of segments, that is, the view that the only "real" knowledge was that which could be observed, classified, and described, the Structuralists devoted their time to such pursuits. A Structural grammar model, such as the one below constructed by Howard MaClay, consisted of several levels of analysis.

(MaClay 1971, 178)
Interpreting the figure, one sees that each level, though autonomous, is dependent upon the previous level for its inputs. In accordance with the Behavioristic approach to mind, the primary inputs are phonetically transcribed utterances capable of being processed into phonemes which combine to form the morphs for the next level. These morphs are analyzed into morphemes, which, at the highest level, are strung together to form sentences. The approach is linear, right to left, rather than "deep" to "surface." In this approach to linguistic description, syntax reduces to the identification of contextually-defined "slots" and the classification of words into classes of "fillers" for those slots. For example, structuralists use the slot in

The dog bit the ______.

to define the syntactic category noun. Because of their reluctance to refer to meaning, structuralists actually had very little more to say about syntax than this. This self-imposed limitation had this result: in comparison with earlier traditional grammars and with later generative grammars, the syntax of structural grammars turned out to be thin and uninformative. In agreement with Behaviorist theory, the structuralists accorded no meaning, initially, to the phoneme. Meaning was gained via physical conditioning governed by the associationistic principles previously described (MaClay 1971, 159-160).
The figure also indicates at the top level—the syntactic component—that the final outcome is "sentence types" or "sequences of word classes." Studies in speech behavior seemed to bear out the Structuralist's contention that English sentences fall into "basic sentence patterns," which, once mastered by the child, guaranteed his normal use of language. It was the simplicity of these patterns and their continual reinforcement in the child's environment which made language acquisition possible in children. As for application of neo-behavioristic theories to language acquisition, it is assumed that children are conditioned to language, that habits of language

1Gleason, tabulating the patterns used in Roberts' early school grammars, prepared the following examples of sentence patterns (1966, 301-302).

1. Subject + intransitive verb. Fish swim.
2. Subject + linking verb + predicate adjective. Grass is green.
3. Subject + linking verb + predicate noun. Dogs are animals.
4. Subject + transitive verb + direct object. Farmers grow food.
5. Subject + transitive verb + indirect object + direct object. She gave him money.
6. Subject + transitive verb + direct object + objective complement. They elected him president.
responses are built into the neurophysiological structures because the child is born with either an "empty box" or one practically empty, except for certain cognitive structures which allow acquisition to occur. Yet, even with extensive cognitive structures theorized, sentence formations are still assumed to result from associationally-governed principles. Braine would propose that contextual generalization is capable of conditioning the child's mind for acceptance of word order. Believing that syntax is a simple matter of slot filling in "basic sentence patterns," he would propose that contextual generalization is the device for achieving "predication " (Braine 1962, 232).

Mowrer had earlier suggested that "predication" is the bedrock of true language development because it involves the combination of two or more signs into a sentence. He saw the subject-predicate relationship as a conditioning device to produce new learnings and associations (1954, 8). All language behavior, according to Mowrer, was dependent upon S-R conditioning of some sort. That is, the child would supposedly be conditioned by sufficient exposure to simple declarative sentences which would stimulate him to imitation—reproduction—of these sentences. Rather like a

2Osgood says, "I have already suggested that behavior theory . . . must accept cognitive abilities as innate, although not necessarily species specific for humans. . . ." (1971, 527).
machine, the child could be "programmed" to reproduce language upon being properly "triggered." Therefore, though the Structuralists realized that infinite numbers of sentences could be produced in a natural language, because of the nature of their methodology and the consequent hypothesis regarding language acquisition for which it could account, their theory of grammar was limited to reproduction models. They had no formal method by which to account for infinite, novel sentences.

However, both Structuralists and Behaviorists were ignoring the logical consequences of their theories. If there is no "mental" activity involved in language acquisition, if the child is conditioned to communicate, then he is limited in uttering novel sentences. He could "learn" language by memorizing a set of well-formed sentences, for that is exactly what is implied by a learning theory which includes its sentences in its dictionary. The impossibility of such a task is aptly expressed by Miller, who says: "By a rough, but conservative calculation, there are at least $10^{20}$ sentences 20 words long, and if a child were to learn only these it would take him 1,000 times the age of the earth" (Miller 1962, 345).

The impossibility of memorizing a natural language is not the only difficulty facing the Structuralists. If one assumes that everything in the language is included in a
list of associations between semantic and phonetic segments, there would be no grammar (rules) nor syntactic features. Yet, the Structuralists admit the possibility of infinite sentences, and, therefore, infinite phonetic and semantic features—infinitely associations. Furthermore, the nature of the Structural model with the syntactic component last in the "levels" toward production of a string of words could only account for strings of words, limited to being sentences by the cancellation of co-occurring segments with the inherent restrictions of the number of slots to be filled. Obviously, the model just reviewed is inadequate for describing the creative potential of a natural language.
CHAPTER IV

THE REVIVAL OF RATIONALISM

Within traditional linguistic theory, furthermore, it was clearly understood that one of the qualities that all languages have in common is their "creative aspect." Thus an essential property of language is that it provides the means for expressing indefinitely many thoughts and for reacting appropriately in an indefinite range of new situations (Chomsky 1965, 6).

When Noam Chomsky began looking for an adequate explanation for the creative nature of language, he had already concluded that the methods of the Structural Linguists and the concepts of the S-R psychologists were inadequate in fundamental ways. They sought to explain language in terms of learned (habit) behavior of the brain; Chomsky felt that it was not degree of complexity (of the brain) which was involved, but quality of complexity (of the mind). Language study, he reasoned, is a topic concerning the nature of the human mind. Therefore, he sought the answer to a classical question regarding mind in the "century of genius," the seventeenth century, and rediscovered principles of philosophy and linguistics formulated by the greatest minds of that era (Chomsky 1972, 4-5).
In 1957, he published a book entitled *Syntactic Structures* and created a revolution in linguistics, the ramifications of which are still being noted (MaClay 1971, 63). Basing his theories on insights provided by the so-called Universal Grammarians of the seventeenth century, Chomsky proposed the construction of a formal theory of generative grammar by which all the grammatical sentences of a natural language, and only the grammatical sentences, could be accounted for. The model he proposed dealt with ideal linguistic competence, not with the actual use (performance) of language by a native speaker. However, the type of grammatical studies he proposed resulted from his observations of the creative capacities of finite humans as they used an infinitely productive vehicle of communication. These creative potentials of language and language users had been noted by Descartes centuries before when he observed that every human, no matter how limited his intelligence, could talk, while no animal, no matter how advanced his development, could (Chomsky 1966a, 4-5). His few observations about language and language users greatly influenced the development of the Universal Grammarians. Basing their linguistic theories on a Rationalistic theory of mind, these men proposed this guideline for their grammars: "General features are common to all languages and reflect certain fundamental
properties of the mind" (Chomsky 1966a, 59). These fundamental properties of the mind were noted after extensive observations of animals as well as humans. Chomsky says: "... the Rationalist theory of language ... developed in part out of a concern with the problem of other minds. ... (E)ffort was devoted to a consideration of the ability of animals to follow spoken commands, to express their emotional states, to communicate with one another, and even apparently to cooperate for a common goal; all of this, it was argued, could be accounted for on 'mechanical grounds' ... the properties of reflexes, conditioning and reinforcement, association, and so on. Animals do not lack appropriate organs of communication, nor are they simply lower along some scale of 'general intelligence.'"

Citing Descartes, Chomsky continues: "There is a basic element lacking in animals, Descartes argued, as it is lacking in even the most complex automaton that develops its 'intellectual structures' completely in terms of conditioning and association--namely Huarte's second type of wit, the generative ability that is revealed in the normal human use of language as a free instrument of thought" (1972, 9).

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3Huarte, a sixteenth century physician, distinguished between three levels of intelligence: docile wit, normal generative intelligence, and creative imagination. He maintained that the difference between man and beast was the difference between docile wit and human intelligence. Chomsky sees language as the evidence of "human" mind (1972, 8).
If an organism begins to exhibit creative use of language, we must suppose that it, like us, has a mind, and its language use, like ours, lies beyond the explanations of mechanistic S-R psychology. Langacker makes the following pertinent comments about the relevance of language studies to this philosophical-psychological conflict:

Insights about languages are of immense intellectual significance with direct and indirect relevance to other disciplines. Philosophers, for example, are greatly concerned with language. It is important for our view of man to know whether language is entirely a learned entity or whether it is largely innate. Language, in other words, could be one of the testing grounds on which to settle a long-standing debate between Rationalists and Empiricists. The Rationalist claim is that people are born with innate ideas, that much of psychological organization is "wired" into the organism and genetically transmitted. Empiricists, on the other hand, claim that a person is born, psychologically speaking, as a blank slate and that psychological organization is determined almost entirely by experience, not genetically transmitted. Both Rationalists and Empiricists have turned to language to find support for their views (Langacker 1967, 4).

If, as Langacker indicates, the issue involves theories of human mental structures, then men should try to account for human mentality by: (1) noting the general features common to all languages; (2) preparing a model of linguistic competence that can adequately describe a natural language; (3) demonstrating that language is "species specific" to humans by proposing a theory of language acquisition that necessitates innate structures.
The seventeenth century grammarians were, of course, not so ambitious in their aims, nor did they need to be as Behaviorism as a formal psychological theory had not been formulated. They did, however, devise a grammar form that recognized "deep" and "surface" structures. Using the sentence,

Invisible God created the visible world.

as their model, they observed, quite correctly, that included in this sentence was the information:

God is invisible.
God created the world.
The world is visible.

Somehow, the information had been combined together at a previous level before the sentence was actually said. That is, "deep structures" of sentences (or constituents thereof) exist in the mind of the speaker before the sentence is spoken in its final, surface, form (Chomsky 1966a, 31-32). The Port Royal grammarians (as they came to be known) also were the first to develop theories of phrase structure rules (1966a, 42). Lack of technique and understanding, however, prevented their formulation of an adequate formal grammatical theory. With the rise of the descriptive linguists and the consequent emphasis on a "scientific" description of language, universal grammar died out (Chomsky 1966b, 5). It remained for Chomsky to reintroduce it
to the world. 4

We have sketched the general background of the Chomskyian Revolution in linguistics, tracing it to its Rationalistic origins, noting its emphasis on language as a mental activity and its suggestions for linguistic studies. However, we have offered no evidence that the theories of the Universal Grammarians and Chomsky are valid. What is meant by the term "creative language"? How does this feature lie beyond the "bounds of mechanical explanation"? If there are common features in all languages, or linguistic universals, what are these features? Finally, why is a mentalistic theory more capable of handling these features than a taxonomic theory?

Katz demonstrates that the mentalistic theories by virtue of accepting the human mind, the one common constant feature in languages, can provide a psychological reality for linguistic universals (1964, 82). It is the human mind with its capacity to create novel, unique sentences never before heard that is the proper domain of investigation in psychology. It is the rules

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4 Chomsky believes we are on the threshold of an era in which a combination of the structural methodology and the insights of the universal grammarians can be combined to provide an insight into the "nature of mental processes, the mechanism of perception and production, and the mechanisms by which knowledge is acquired" (1966b, 7).
governing the production of these novel sentences that is the domain of investigation in linguistics. In this sense, language is creative—in the production of an infinite number of novel sentences, free from stimulus control, coherent and appropriate to the situation (Chomsky 1972, 12-13). It is because the human mind is capable of understanding these novel sentences which it has never heard before, that the Rationalists posit theories regarding linguistic universals.

How the human being acquires this ability to understand new sentences is directly related to the existence of linguistic universals. Consider Postal's comments on "learning a language."

A substantial portion of the structure of any particular language is not learned, but determined by the innate linguistic organization of the human organism. This innate organ specifies the over-all grammar, the kinds of rules it can contain, the kinds of elements and the possible interrelations among these. It also determines to an unknown extent part of the actual content of particular grammars, that is, the particular rules and elements these contain (1968, 282-283).

He further states that it is necessary to assume that such an innate universal language structure exists because it accounts for fundamental similarities of all languages as well as the remarkable feat of first language learning.5

5Observation tells one that the child hears ill-formed and incomplete utterances, yet he produces, within a short while, grammatical sentences. He had internalized systems of rules of a particular language, rules so complicated and abstract that to suppose he "learned" them would be absurd (Postal 1968, 283).
Innate structures do not mean, of course, that the child inherits structures of English or Chinese, or some such specific language; a child inherits linguistic, not just cognitive, structures which enable him to internalize the features of the language of his environment, whatever that language may be.

Linguistic universals, then, determine the "form of a complete and accurate representation of what human beings know when they know a language. . . . (T)hese concepts tell us exactly what makes human intelligence so human . . . . Taken together with a complete and accurate description of a particular language, constructed in accordance with them, these universals would provide the information necessary to answer questions about the strategy by means of which human beings acquire a language in the first place " (Jacobs and Rosenbaum 1968, vi).

Grammarians other than the Port Royal group and the modern generative advocates have also noted features that seem universal. Jesperson quotes C. Alphonso Smith who believed that the "principles of syntax are psychical and therefore universal " (Jesperson 1924, 48).

Other grammatical features, such as phonological ones, may also be universal. Jakobson has observed that no language uses both the feature labialization and the feature velarization for distinguishing non-repetitions. Such a phonological generalization could be offered as a law of universal phonetics (Chomsky 1972, 123).
Of course, neo-behaviorists state that what features are universal are not linguistic in nature, but cognitive. Their belief brings up the question of strong and weak linguistic universals. McNeil differentiates between these in this manner: "Weak linguistic universals have a necessary and sufficient cause in one or more universals of cognition or perception. Strong linguistic universals may have a necessary cause in cognition or perception, but because another purely linguistic ability also is necessary, cognition is not a sufficient cause" (McNeil 1971, 534). He sees the only way to properly designate a universal feature as strong or weak is to examine each suggested universal in detail. His paper, "Are There Specific Linguistic Universals?", summarizes his reasons for designating the sentence as a strong linguistic universal.

In short, while language may vary considerably in surface structures, there is little variance in the deeper levels which reflect man's unique intellectual abilities. The German scientist Wilhelm von Humboldt, holding this Rationalistic view, argued that one could not really teach a first language, but could only "provide the thread along which it will develop of its own accord" (Chomsky 1972, 76). Therefore, any attempt to formulate a formal theory of grammar or a model of language acquisition could not ignore the question of linguistic universals. If they exist, then each human being will be equipped by nature
with structures which guarantee the internalization of these. However, before examining the question of innateness, it is necessary to examine Chomsky's formal theory of linguistic competence, transformational-generative grammar. The claim has been made that his grammatical model will accurately accommodate "all--and only all--the grammatical sentences of a natural language," a claim which must be examined. For as Miller states,

It is grammar that is so significantly human, so specific to our species, so important for psychologists to understand more clearly. I do not in any sense wish to criticize psychological studies of the referential process, or of the intricate associative network that supports the referential process. My goal is rather to persuade psychologists, by argument and illustrations, that there is much more to our linguistic skills than just the referential process. I do not see how we are going to describe language as a skill unless we find some satisfactory way to deal with grammar and with the combinational processes that grammar entails (1962, 39).

An examination of Chomsky's grammatical model in the ensuing chapter deals directly with the issue of language as more than referential skills.
CHAPTER V

TRANSFORMATIONAL GENERATIVE GRAMMAR

To study a language, then, we must attempt to disassociate a variety of features that interact with underlying competence to determine actual performance; the technical term "competence" refers to the ability of the idealized speaker-hearer to associate sounds and meanings strictly in accordance with the rules of his language. The grammar of a language, as a model for idealized competence, establishes a certain relation between sound and meaning—between phonetic and semantic representations. To discover this grammar is the primary goal of the linguistic investigation of a particular language (Chomsky 1972, 116).

In Syntactic Structures, Chomsky demonstrated the power of a Markovian grammar model, but immediately eliminated any possible application of it as a model for a natural language by the observation that English is not a finite state language (1957, 21). English is infinite because every human being has the linguistic competence to create novel, unique sentences of any length, being limited only by physical features such as memory. The human's vehicle of communication, therefore, has to have features which can accommodate such creativity.
One of the features of a natural language is recursiveness. A natural language can embed sentences into the basic sentence form infinitely in either of the three ways illustrated below.

Self-embedded: The race that the car that the people whom the obviously not very well dressed man called sold won was held last summer.

Left-recursive: The obviously not very well dressed man has arrived.

Right-recursive: The obviously not very well dressed man called the people who sold the car that won the race that was held last summer.

While people can understand all three types of sentence embedding, left or right embedding is more commonly used in speech. Yet, with very little help, speakers are able to adapt to self-embedding, indicating the flexibility of the human mind as it maneuvers in language processes. However, as Miller observes, a finite-state model of grammar cannot handle the center embedded sentence. Humans can. Only their physical limitations preclude facile production of these forms. Nevertheless, such physical limitations of the speaker do not in any way limit the creative potential of language itself (Miller 1962, 46).
Postal makes an analogy with mathematics to demonstrate that a finite organism does have knowledge whereby it can produce infinite sets of objects.

(1) A X
(2) X X + X

"... the arrow is to be interpreted as the instruction to rewrite the left symbol as the right-hand string of symbols. It is evident that continued application of these rules will specify an endless, unbounded, i.e., strictly infinite set of strings of the form X, XX, XXX, XXXX, etc. And a person who learned these two rules plus the finite set of instructions for applying them would, in a precise manner, have learned the infinite set of possible outputs. It is exactly in this sense that we must postulate that a speaker has learned the infinite set of rules which can enumerate, list, specify, or, as it is usually said, generate these sentences. Such a set of rules can be called a grammar or syntax." (1964, 247).

Since the number of sentences in a natural language is infinite, the only way of describing them is in the terms of rules which generate these sentences.⁶ Linguistic rules

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⁶Sentences, incidentally, are not random strings of words, but are units of meaning—words grouped in specified relationships which must be understood before meaning can be assigned. These relationships are what made grammatical studies necessary. Stockwell says the grammarian's task is to characterize these restrictions in detail (1968, 259).
must provide for "disambiguation" of sentences, also, a capacity humans have which behavioral-structural models of grammar inadequately explain. Miller states, "We cannot understand a sentence until we are able to assign a constituent structure to it" (1962, 43). That is, we must comprehend its meaning by analyzing constituents rather than by interpreting words in "slots" via conditioned responses of some sort. If sentences are ambiguous, we must assign proper constituent structure to them to understand them. However, we can only assign proper structure when we have a formal means by which ambiguity of surface structures is explained by discovering "deep" structures from which the ambiguous forms were derived. For instance,

She is a beautiful dancer.

may mean that she is a beauty who happens to be a dancer, or that she dances beautifully. Such a sentence demonstrates the problem of ambiguity. Unless "deep" structures exist, there is no adequate explanation (formally) for the obvious differences in meaning.

Therefore, to account for the creative capacity of a natural language, we must explicate the properties of that language in such a way that recursiveness and disambiguation, as has been demonstrated in the examples above,
fall within rules.\textsuperscript{7} As Gleason says: "A completely explicit grammar would describe the processes in such detail that one might follow the statements precisely and mechanically, using nothing outside the grammar, and by so doing duplicate the actions of the native speaker or some part of it" (1966, 244).

In order to determine the nature of the rules, one could postulate a theoretical model of "linguistic competence" for an ideal speaker-hearer, being careful to emphasize that such a model is an attempt to explicate (formally) grammatical properties, not specify what actually happens in "linguistic performance." It is not intended to specify the way sentences are actually produced in the brain. No one contends that humans apply rules in sequential order per the linguistic competence model. It is merely a model that demonstrates and adequately handles the features of natural languages,

\textsuperscript{7}Miller says: "Rules are not laws, however. They can be broken, and in ordinary conversation they frequently are. Still, even when we break them, we usually are capable of recognizing (under appropriate conditions) that we have made a mistake; from this fact, we infer that the rules are known implicitly, even though they cannot be stated explicitly. A description of the rules we know when we know a language is different from a description of the psychological mechanisms involved in our use of these rules. It is important, therefore, to distinguish here, as elsewhere, between knowledge and performance; the psycholinguist's task is to propose and test performance models for a language user, but he must rely on the linguist to give him a precise specification of what it is a language user is trying to use" (1965, 342).
properties for which structural models and behavioral learning theories cannot account. In this sense, the model is an abstraction of information required for language-users' processes.

Chomsky, attempting to accommodate natural linguistic properties, proposed a generative language model whereby the infinite production of novel sentences is governed by rules. The model on the following page is one example of applied Chomsky theory, whereby the property of recursiveness is formally accounted for. To account for ambiguity, he, like the Port Royal grammarians, postulated that surface forms of sentences have been derived (transformed) from deeper structures, and that by determining the structures at the base level, one can assign proper interpretation of the surface forms. Therefore, a complete model would also include transformational rules which would provide for changes in base to surface forms. The sentence tree in the model given is a "surface" structure tree. Therefore, lexical information is not attached to the constituents. When "deep" structure trees are mapped, the lexical information is included. The arrow means "can be rewritten as." That is, $S \rightarrow Np + Vp$, means: A sentence can be rewritten as a noun phrase and a verb phrase.
Simplified Generative Model
(non-transformational)

Rules

1. \( S \rightarrow \text{Np} + \text{Vp} \)

2. \( \text{Vp} \rightarrow \text{Vb} (\text{that S}) \)

3. \( \text{Np} \rightarrow \text{Art} + \text{N} \) (Rel)

4. \( \text{Rel} \rightarrow \text{who} + \text{Vp} \)

Dictionary

\text{N} \quad \text{doctor, nurse, patient, family}

\text{Vb} \quad \text{knew, believed, suspected, reported}

\text{Art} \quad \text{the}

Possible Sentences:

The nurse knew.
The doctor believed.
The patient reported.
The family suspected.

The nurse knew the doctor.
The doctor believed the patient.
The patient reported the nurse.
The family suspected the nurse.

(and so on)

The nurse who knew the family believed the patient.
In a transformational-generative grammar, words in sentences are classed by categories and functions. Grouping by categories is demonstrated in the way words combine with other words which, therefore, would mark them with specific syntactic features. For example:

She placed it

must combine with a \([\text{Directional Adverb}]\) such as,

She placed it \underline{on the table}.

Therefore, the verb \textit{place} would be marked with a syntactic feature of \([+\text{Directional Adverb}]\) so that a verb would be inserted only if there were a directional adverb with it.

In other words, word categories are "various intersections of the syntactic features required for the description of the way words can combine in a language" (Stockwell 1968, 264).

However, words are grouped by function also, since any class can serve several functions (NP can be subject, object, and so on). Function, a relational notion, is generated by the base component which contains constituent structure (or phrase structure) rules. These rules produce constituent units marked in such a way that the most closely related elements of a string are tied together as a unit, then the next most closely related elements, and so on, up to the final string of all items—united as a sentence.
The base component generates the abstract (deep) structures which contain all the necessary syntactical and semantic information for sentence formation. In addition to specifying categorical and functional information, it also specifies the recursiveness of simple sentences into more complex sentences. The output of the base component (as seen in the following diagram) is a labeled tree structure with formative elements (comprising syntactical, semantical, and phonological information) contained in the lexicon. The phonological rules (not shown here) map the sentence into a string of appropriate noises; syntactic features indicate the transformational rules needed to map deep structures into surface structures; the semantic component maps the minimal meaning units (in ways not yet clear) onto the base component.

The professor talked.

\[
\begin{align*}
S & \quad Vp \\
| & \quad Vb \\
Np & \quad Aux \\
| & \quad +aux \\
| & \quad -M \\
| & \quad +v \\
n & \quad -pro \\
& \quad +def \\
& \quad -demon \\
& \quad +con \\
& \quad +ani \\
& \quad +sing
\end{align*}
\]

professor talk

\[
\begin{align*}
S & \quad Vp \\
| & \quad Vb \\
Np & \quad AUX \\
| & \quad +aux \\
| & \quad -M \\
| & \quad +pres \\
Art & \quad N \\
& \quad +vb \\
\end{align*}
\]

The professor talked

\[
\begin{align*}
S & \quad Vp \\
| & \quad Vb \\
Np & \quad AUX \\
| & \quad +aux \\
| & \quad -M \\
| & \quad +pres \\
Art & \quad N \\
& \quad +vb \\
\end{align*}
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The professor talked

The professor talked

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\begin{align*}
S & \quad Vp \\
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Np & \quad AUX \\
| & \quad +aux \\
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Art & \quad N \\
& \quad +vb \\
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The professor talked

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\begin{align*}
S & \quad Vp \\
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Np & \quad AUX \\
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| & \quad -M \\
| & \quad +pres \\
Art & \quad N \\
& \quad +vb \\
\end{align*}
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The professor talked

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\begin{align*}
S & \quad Vp \\
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Np & \quad AUX \\
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The professor talked

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S & \quad Vp \\
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\end{align*}
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S & \quad Vp \\
| & \quad Vb \\
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\end{align*}
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The professor talked

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\begin{align*}
S & \quad Vp \\
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| & \quad -M \\
| & \quad +pres \\
Art & \quad N \\
& \quad +vb \\
\end{align*}
\]

The professor talked
The model of a transformational-generative grammar could look something like this:

(MaClay 1971, 176)

In a TG grammar model, a syntactical organizational feature is primary. Indeed, a model of a natural language must have syntax as a basic feature. The implications of this statement are that the human has some "organizational" language device which governs creative utterances, or as Stockwell says:

If Chomsky is right, then ordinary conversation is a creative performance (not reproductive conditioning) governed by such abstract and complex rules that no child could acquire them unless he were born into the world with highly specific innate gifts for this particular kind of learning. Thus the notion that human beings acquire language merely as a set of conditioned responses—the notion that the use of language is habitual behavior in some meaningful sense of the term habit—is rendered quite impossible. On the contrary, the Rationalist notion that this behavior is dictated by a set of rules, and uniquely human mental capacities is strongly supported (Stockwell 1968, 266).
As one can see from the model just presented, syntax is an essential feature in TG grammar; whereas it is not in structural models. Viewed by Chomsky as the primary constraining feature in formal grammars, syntax has become the central topic of investigation in determining where sentences originate. Obviously, syntax is more than slot filling; it does seem to govern categorical and functional relationships in the deep structures. However, McCawley believes that selectional constraints are semantic rather than syntactic. He asserts that deep structures are equivalent—formally—to semantic representations, and these are in symbolical logic forms. Thus he questions the autonomy of syntax (McCawley 1971, 217-230). If the autonomy of syntax is denied, the existence of a distinct level of syntactic deep structures becomes unacceptable (McClay 1971, 178). Osgood, basing his psycholinguistic studies upon representational mediation theories, asserts that the "job of syntax is not central, but rather peripheral in ordinary language—merely accommodating lexical decisions made on the basis of the fleeting interests and motivation entertained by speakers . . . " (Osgood 1971, 520). Osgood, of course, has crossed from the realm of linguistic competence into that of linguistic performance. Yet if he can demonstrate that sentences are derived from cognitive pre-suppositions (i. e., a type of visual or sensory paraphrasing) via
representational mediation, he will have shaken one foundation of TG grammar claims and made viable behavior learning theories. That is, the behavioral theories will be viable if the brain can accommodate the sort of associations such theory necessitates. One must, therefore, examine the theories regarding language acquisition to see if the Rationalist claim for "mental" activity is valid.
CHAPTER VI

THE INNATENESS ISSUE

Throughout this paper references have been made to the human's amazing capacity to produce and understand novel sentences though he has not been formally taught this "skill." Furthermore, such ability is in no way dependent upon his I. Q., for mentally retarded humans use language, as was noted by Jensen (1964, 112). Even more amazing is the ease by which a child acquires language, internalizing very complex abstract rules from fragmentary, frequently "ungrammatical" models. Somehow, despite this lack of formal training and the inadequate models provided for him, the child learns a language. When one reflects upon this, he may conclude that language is simple, that it is merely a process of building a vocabulary and putting that vocabulary into "basic sentence patterns." He may conclude that the child's brain is conditioned and appropriate language activities reinforced until the proper habits have been learned. Or he may study language and determine that it is not simple; he may discover that any natural language is
quite complex and that it is governed by highly restrictive rules that explicate sentence production. Furthermore, he may discover that some basic language features are present in all languages. He may, then, seek another explanation of linguistic competence: innate linguistic structures that guarantee language acquisition. If he is limited to a theoretical acceptance of S-R behavioral theories, he will be in a dilemma, for as demonstrated in earlier chapters, no learning theory or taxonomic grammar model can formally account for language as it is. Yet, if he accepts a grammar theory which can account for a natural language, he will be accepting a model which clearly demonstrates mental activities, theoretically impossible in S-R psychology. He may, however, continue within this framework, as did B. F. Skinner.

Skinner sought to explain language activity as simple, physical behavior, learned by means of "operant conditioning" (Skinner 1957, 320). In reality, his theory is simply single-stage conditioning. Chomsky offers the following criticisms of Skinner's theories. First, Skinner mixed "analogic guesses" and "experimental results" so that his work is substantially unscientific. Second, Skinner's concepts of reinforcement and conditioning are too general. Surely, in a sense, all instruction is conditioning; however, in its
literal sense, the conditioning of Pavlov was strikingly (and scientifically) different from Skinner's. Simply to say "it is the function of predication to facilitate the transfer of response from one term to another or from one object to another" is to say nothing at all. What laws of conditioning apply? What behavior is controlled; what is not controlled? Furthermore, Skinner's assertion that there must be "careful arrangement of contingencies of reinforcement by the verbal community" for a child to acquire language is utter nonsense! A child learns a highly complex language system under conditions from which a dog could not learn the simplest command. Chomsky closes his criticism with the observation that neural structures could as easily accommodate generative as behavioral theories for "neural structures capable of accounting for even the simplest kinds of learning have defied detection" (1959, 327-333).

One would have to revise his Behavioral theories considerably if he still sought an explanation of language activities in the empirical realm. Indeed, Osgood, accepting the existence of "innate cognitive structures"—and the obviously valid claims of Chomsky and the TG competence models—moves the issue into the arena of performance via representational mediation. He makes the following criticisms of the Rationalist viewpoint.
(1) Grammars can produce sentences of any length and complexity; finite humans cannot. A theory of performance must account for this.

(2) Grammars deal with ideal speaker-hearers; performance theories deal with real, fallible people.

(3) Grammars are not time-bound; performers operate within time constraints.

(4) Grammars contain no learning principles; performance theories must.

(5) Grammars do not provide for selection of expansion rules; any performance model must account for the antecedents of such selections.

(6) Grammars do not account for the non-linguistic antecedents of the symbol S; performance theories must. (That is, where do sentences come from?)

Osgood contends that the process of "simply describing" (the origin of sentences) has its roots in a cognitive, non-linguistic ability of paraphrasing—an ability which can be explained by his representational mediation theory.

Our mind, Osgood contends, non-linguistically grasps a situation and synthesizes the sensory information it is receiving before it imposes linguistic forms on the information. That is, we do not go from a series of deep structure linguistic observations that we, linguistically, paraphrase. Rather we paraphrase first with a non-linguistic ability. He, therefore, denies the Rationalist claim that man has some innate language device which operates separately from general cognition (1971, 521-523). Chomsky would argue that man does have an innate linguistic organizer (perhaps $S \rightarrow NP + VP$). Dr. Lucius Waites, Neurologist for the Scottish-Rite Crippled Children's Hospital and specialist in language-related brain dysfunction, in personal communication with this writer theorized that neurons are genetically coded as Nouns or Verbs, accounting for the "noun" and "verb" people so categorized by Wepman, and giving physiological support for Chomsky's claim.
He believes that his $r_m$ model is the only serious approach to incorporating the symbolic process within the S-R associationistic theories, finding the origins of mediation processes in non-linguistic, perceptuo-motor behavior. Fodor, however, says that the problem of ambiguity cannot be resolved by the $r_m$ theory, for an ambiguous sign is simply a set of univocal signs which correspond precisely to one R. For even though $r_m$'s are componential in theory, in application they are not. That is, an $r_m$ corresponds one-to-one to the R. Therefore, if the R can be ambiguous, the $r_m$, the mediator, can also be ambiguous. The representational process proposed by Osgood resolves, therefore, to a single-stage theory and is subject to the previously mentioned criticisms of single-stage conditioning (1971, 567).

If the foremost theory of the Behaviorists is an inadequate explanation of linguistic activity, one must look elsewhere for a solution. Chomsky, summarizing his views on the creative aspects of language use, the abstract nature of deep structures, and the universality of TG grammar mechanisms, proposes a language-acquisition device that can incorporate the linguistic competence of the ideal speaker-hearer. (Such competence, even in a child, is far more extensive than any ability which could be learned.) The language acquisition device which he
proposes is simply:

\[ \text{data} \rightarrow \text{LA} \rightarrow \text{knowledge} \]

The only means we have for determining the character of LA is by empirical analysis of the output: recursive, unique, novel utterances explicated according to rules which can account for disambiguation. He denies that what is innate is merely a receptor system and mechanisms of association (the classical empirical view), for such specifications cannot provide deep structures or abstract principles which generate deep structures. It is not that the empirical view lacks refinement; it is inapplicable to the question of language competence (Chomsky 1967, 2-11).

Putnam, nevertheless, criticizes Chomsky's hypothesis in the following areas:

(1) The innate schema which supposedly accounts for linguistic universals does not account for anything except innate intellectual equipment—a computing system—for so-called linguistic universals are nothing more than similarities resulting from a common origin; the only linguistic universal property is a "short list of phonemes." Above that level, there exists a phrase structure component explained as an algorithm system comparable to that of any computing system.

(2) Children learn language because they are exposed to literally thousands of hours of instruction over a number of years (1967, 12-21).
Chomsky answers Putnam by demonstrating that Putnam's criticisms are based upon a misconception concerning grammatical transformations. Putnam called them rules which "abbreviate sentences generated by phrase structure rules." In fact, however, transformations are operations that form surface structures from underlying deep structures which are partly generated by phrase-structure rules. Such operations are not analogous to anything known in mathematics or computer technology. As for the common origin of language as an explanation of linguistic universals, Chomsky finds that question as beside the point. The grammar of the language has to be discovered by any child on the basis of the data he has and the innate capacities within him. When a child masters, for instance, the cyclic application of phonological rules—linguistic universals—he knows nothing of the common origin of languages and need not know that. That children do master those rules common to every language is empirical proof of an innate LA device. As for Putnam's discussion of the ease of language acquisition versus the hours spent in hearing language, Chomsky observes that he still has not explained how the learner succeeds in acquiring the specific and detailed knowledge which enables him to use language. Until Putnam can demonstrate that "learning structures" can, indeed, account for language acquisition, Chomsky's
own innate theory stands (Chomsky 1972, 182-184). Thus far, only Osgood's pre-suppositions of a cognitive, non-linguistic, referential nature challenge Chomsky's theory. And Osgood is left trying to explain—adequately—"simply describing things" in non-linguistic terms.

Even Piaget, who professes to be a Cognitive Empiricist rather than a Rationalist, notes that there seems to be some unexplainable linguistic structure that exists independently of general cognitive processes. He has noted that a small child quickly understands that "all of the flowers" is greater than "some of the flowers." However, the same information in symbolic logical form (AB > B) is not grasped by him until a much later period of development. Stepping into the fold of Rationalism momentarily, he says that ideas exist which cannot possibly be derived from a child's experience, and that he has abstract notions which are a product of dynamic deduction apart from experience. The maturation process allows the prelogical structures to co-ordinate with experience and allow acquisition of knowledge and language to occur (Piaget 1961, 273-274).

What has become involved here is the fact that language knowledge (a system of rules) is regarded by Chomsky as actual knowledge that a person has, and as such, is a real psychological characteristic of the mind. He views
the linguistic universals (deep structures, grammatical categories, etc.) as specifying actual mental characteristics. So while linguistic competence "may be neutral in a sense with respect to use, it is evidently not neutral with respect to how that knowledge is stored or organized in the person" (Steinberg 1971, 491-493). Thus differentiation between rules for performance and competence sometimes becomes a problem. (For example, Chomsky says rules regulating disambiguation of sentences belong to competence; Steinberg says that Weinreich views these as performance rules [Ibid., 493]). Trying to find psychological realities to support the theories of generative grammar, psychologists and linguists have discovered what they feel is supportive evidence for the theory of syntactic structures and of transformational rules (Miller 1962, 38-55). Miller found that people remember words in context in sentences more than in isolation. Repeated testing revealed that the "functional unit of speech perception is longer than a single word or a single morpheme and more nearly the size and shape of a syntactic constituent" (Ibid., 44). The psychological reality underlying the form of syntactic structures which allow unlimited self-embedding (something a Markovian model cannot do) must therefore be something qualitatively different from the association principles of behavioral
models. Since how we perceive, understand, and remember sentences depends upon what we decide about their structure, the speaker-hearer (ideal or real) must have an intuitive understanding of syntactic structures and grammatical processes before he can grasp sentence meaning. Once again we are brought back to the LA device postulated by Chomsky. As Miller says, "It is difficult to imagine how children could acquire language so rapidly from parents who understand it so poorly unless they were already tuned by evolution to select just those aspects that are universally significant. There is, in short, a large biological component that shapes our human languages" (Miller 1965, 342).

Theorizing about the physiological and anatomical processes man brings to language acquisition, Lenneberg holds that the naming capacity of humans is a species specific ability. Its formal counterpart in the animal world is the categorical discriminatory and relational propensities of animals. Cognitive organization is present in all higher animals; however, manifestations of this ability differ with each specie and must be determined empirically. Lenneberg asserts that words—the dictionary of a natural language—are a "sample of labels of categories natural to our species; they are not tags of specific objects." Indeed, naming is a secondary
cognitive process of concept formation. Conceptualization is the cognitive process itself, a process not peculiar to man (i.e., the physiological mechanism for such is present in all higher animals) though the behavior of attaching words to the concepts is restricted to man. He calls cognition "the psychological manifestation of a physiological process," and as such is not a static process. Words, therefore, are not labels stored away for future response; they "tag the processes by which the species deals cognitively with its environment" (Lenneberg 1971, 537-539).

In summary, the evidence for innate specifications of language ability is very strong. First, language is acquired (with no formal instruction) uniformly throughout the human race, though other skills such as reading and writing are not acquired without instruction, and performance then varies with intellectual ability. Apparently, linguistic experience serves only to activate the genetically specified system, not to train the child in a learnable skill. If we were trained to talk, then we would expect language acquisition to correlate directly with one's intelligence. This is not the case; bright children, average children, and stupid children learn to talk (barring, of course, brain damage) and sometimes the less intelligent are the most talkative! Second, only human beings learn to talk. If language were merely a matter of intelligence
(that is, the empirical view of some cognitive process, non-linguistic in its primitive stages) then we would expect the apes, anatomically similar to humans and reasonably intelligent, to acquire language. If language is "learned" by conditioning principles, apes can acquire it. However, experiments involving primates raised exactly as children demonstrate that there is something qualitatively different between apes and humans, for no ape has ever acquired language. Language is therefore peculiar to our species (Langacker 1967, 237-239).
CHAPTER VII

BRAIN FUNCTIONS IN LANGUAGE ACTIVITIES

The earlier portion of this thesis has dealt with the linguistic and psychological aspects of language acquisition. The remainder of the paper will deal with the neurophysiological aspects of language acquisition. It has been said that those who study the neurophysiology of the mind are "... like men at the foot of a mountain. They stand in the clearings they have made on the foothills, looking up at the mountain they hope to scale. But the pinnacle is hidden in eternal clouds" (Ganong 1969, 207). For though the cerebral cortex is the largest part of the nervous system—and the portion considered to be the site of the mind and the intellect—less is known about it than any other part of that system. Scientists do know it is the area wherein the final integration of neural mechanisms relating to intellectual activity occurs. Therefore, study of learning, memory, judgment, and language is primarily the study of the cerebral cortex.

In general, data for such study is made available by four methods: (1) correlation of clinical observations of
humans with the site and extent of brain pathology discovered at autopsy, (2) noting the effects of stimulation on exposed areas of the cerebral cortex during neurosurgery, (3) studying the effects of stimulating subcortical structures with chronically implanted electrodes in patients with cortical diseases, (4) studying conditioned reflexes of animals and man (Ganong 1969, 208).

All areas of the cerebral cortex have afferent and efferent connections with the thalamus which, when cut, leaves the cortical areas non-functioning. Therefore, it is generally considered that the cortex is an outgrowth of the thalamus both anatomically and functionally. All pathways from the sensory organs (except the olfactory tract) to the cortex pass through the thalamus (Guyton 1966, 850). More will be said of the thalamus at a later point in this chapter.

In earlier times men thought that all cortical areas performed independent, specific, and discrete functions. Now it is generally accepted that except for a few areas, cerebral activity is integrated activity. Interestingly, the areas still thought to have specific functions are those related to language. The following drawing shows the primary sensory areas (light shading) and the voluntary motor area (dark shading). These areas are responsible for acceptance and partial analysis of the sensory
information they receive via the thalamus as such information comes up from the lower centers of the brain.

elaboration of voluntary motor
thought somatic sensory
speech (hand skills)

primary sensory memory

bilateral vision

contralateral vision

lateral fissures

The secondary sensory areas extend from 1 to 5 centimeters in all directions from the primary sensory areas. Whenever the primary sensory areas receive sensory inputs, collateral impulses spread, immediately, into the secondary areas. The parietal cortex, posterior to the somatic sensory area, seems to control hand skills. The temporal lobe and the angular gyrus at the posterior end of the lateral fissure are important for the interpretation of sensory experiences and are believed by some to be the "memory bank" where complicated memories are stored. Like other areas of the cortex, the temporal lobe and the angular gyrus are highly developed only in a single hemisphere.¹⁰ The prefrontal areas which lie anterior to the

¹⁰ No one is sure why one hemisphere develops over the other. Guyton says: "The attention of the mind can be directed to one portion of the brain at a time. . . .(O)n e angular gyrus region begins to be used to a greater extent than the other, and, thenceforth, because of the tendency to direct one's attention to the better developed region, the rate of learning in the cerebral hemisphere that gains the first start increases rapidly while that in the opposite side remains slight. Therefore, in the normal human being, one side becomes dominant over the other" (1966, 853).
motor regions make possible concentration on and elaboration of intellectual activities such as solving one's complicated legal, mathematical, or philosophical problems or controlling one's ethical and moral behavior. Destruction of the sensory areas greatly reduces the brain's intellectual capabilities, as will be shown in Chapter VIII (Guyton 1966, 852).

Activities of the Cerebral Cortex

Although we might define a thought as an instance of awareness or consciousness, man does not know the neural mechanism of it. Destruction of large portions of the cerebral cortex does not preclude a person's thinking, though it does greatly reduce his degree of ability for such. On the other hand, when only small portions of the thalamus or the mesencephalic tegmentum are destroyed, complete unconsciousness may be the result. A thought, in neural terms, probably results when a pattern of stimulation occurs involving the cerebral cortex, the thalamus, the rhinencephalon, and the upper reticular formation of the brain stem. Watson, equating thought and speech, believed that sub-vocalic utterances would always be present when "silent" thought was taking place. However, tests have not borne out his theory (Lashley 1951, 187). Also, there are other types of thought than just verbal;
one can surely think about music in purely non-verbal symbols. Essentially the question is: Can a thought "exist" that is not wholly dependent on or the equivalent of some neural activity? The traditional mentalistic approach is that it can, that the stimuli necessary for brain function merely initiate thought sequences. One might picture such occurrences as "bridges" from stimulus to stimulus, yet completely independent of such stimuli.

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\end{array}
\]

Because such "mental" behavior is beyond the range of physiological investigation, scientists do not speculate about this phenomenon. Most content themselves by saying that man's present state of knowledge does not account for such behavior, indicating that eventually some sort of physical basis will be found for all thought processes.

Whatever a thought is, recollections of such is memory. Scientists, again, do not really know how memory is stored, but there are several interesting theories about it. First, one must differentiate between remote and recent memory, for different mechanisms seem to be involved. Ganong says there are three such mechanisms: one mediating immediate recall of the events of the moment; another mediating memories of events that occurred minutes to hours before; a third mediating memories of the distant past (1969, 211).
Temporary memory depends upon prolonged excitation of the involved neurons, while prolonged memory probably depends upon alteration of the synapses. In temporary memory, excitation, if not reinforced, eventually dissipates; the "post-tetanic potentiation" is not lasting. Whenever a memory is stored, it is assumed that there has been some alteration of the synapses, for prolonged memory does not depend upon continued activity of the nervous system. The common theory has been that there is an anatomical change in the terminal fibrils of the neurons (the synaptic pathway) and there is some evidence that these fibrils are slightly different after prolonged excitation. However, recent studies with RNA have advanced the theory that the synapsis is biochemically altered. Such a theory really is more viable than the former one because stable memory trace is resistant to electroshock and concussion. Also, doctors are well aware of the effects of drugs on memory, particularly magnesium pemeline which improves memory and general cognition, and improves learning. It has also been shown to stimulate RNA synthesis (Ganong 1969, 212). If it can be definitely demonstrated that memory is indeed "stored" in the biochemicals (RNA) of the neurons, support for the theory of inherited "learning" would be provided.
As was mentioned earlier, though certain types of memory are "stored" throughout the nervous system, the temporal lobes seem to be most important in the organization and correlation of memory facts. Electrical stimulation of the temporal lobes in patients with epilepsy evokes detailed memories of the distant past which immediately cease when stimulations are stopped. Nevertheless, scientists do not now think of the temporal lobes as a "memory bank." Rather they seem to be the "key" that unlocks memory traces throughout the brain. Also, recent memory seems to depend more upon the hippocampus than the temporal lobes. This factor can be demonstrated by noting destruction of the hippocampus. Remote memories are intact, but new learnings are somehow not "encoded," and recent memories are not retained (Ganong 1969, 211).

It is the retention of such memories which constitutes learning. The most basic form of learning is that of the conditioned and unconditioned responses to stimuli, external or internal. Taken in conjunction with mediated responses, an elaborate network of reflex functions could eventually be formed upon which the brain depends for mental activity. Such is the opinion of the physicalists who see all thought as a result of some sort of physical response. However, conditioned reflexes by themselves are not sufficient to explain chance happenings that can
lead to new learning. Learning by precept in the absence of new sensory experiences can occur. One can think about previous sensory experiences and generate completely new, abstract thought processes which can continue indefinitely. For example, suppose one has never seen an automobile but is completely familiar with the wagon and the gasoline engine. Only a slight amount of thought can generate the idea of the automobile. Such thinking is beyond the S-R conditioning, yet scientists can postulate these sorts of intellectual operations which occur in the brain and result in abstract thought processes (Guyton 1966, 858).

These facts are known about intellectual brain functions: (1) The brain can focus its attention on specific types of information. (2) The different qualities of each set of information signals are split away from the central signal and are transmitted to multiple areas of the brain. (3) The brain compares new information with old information. (4) The brain determines the patterns of stimulation. When stimuli are received by the nervous system, information is sent to specific parts of the brain. (If one's hand is on a hot stove, the thalamus learns it is painful while the somesthetic cortex learns what part of the hand is involved, etc.) The experience may be new, but the brain analyzes the information by comparing it with old memories. Likewise, the brain can determine
that a square is a square regardless of its position.\textsuperscript{11}

It is believed that the signal is transferred to some "analyzer portion" of the brain that would classify all sensory information into a few analytical patterns. An example would be that of "differentiating contrasts" as is used in visual contexts. A few lines on a piece of paper do not represent the actual picture of a person, but they do give the visual cortex the same pattern of contrasts to work with. The analytical pattern information is then converted to specific information in the association areas of the cortex, each of which has connections with the thalamus. In the association areas, the different auditory, visual, and tactile information are combined for analysis. Sometimes inhibition of stimuli occurs; sometimes facilitation; yet, the interactions of the association areas are still a mystery (Guyton 1966, 856-857).

Language Activities

More is known about the sensory and motor areas involved in communication than any other area of the cerebral cortex, and that through study of pathological language functions. These functions are localized in the neocortex, though they depend upon integration of the entire association

\textsuperscript{11} Descartes affirmed that we know a triangle is a triangle because we compare it with the idea of the perfect triangle within us—an innate idea, not an acquired one.
areas for their completeness. Again it is emphasized that all pathways to and from the communication centers pass through the thalamus and mesencephalic areas. Gatz notes: "The thalamus serves as the station from which, after synaptic interruption, impulses of all types are relayed to the cerebral cortex. Processes of correlation and integration occur within the thalamus but conscious interpretation of peripheral sensory stimuli, except for the vague sense of their awareness, is not considered to occur at this level. The thalamus may be concerned with focusing the attention, perhaps by temporarily making certain cortical sensory areas especially receptive and others less receptive" (1970, 102). It may be that the thalamus is the key to understanding the intellectual functions of the brain. It may be that it is the "analyzer portion" which governs the integration of sensory inputs within the association areas of the cortex. Certainly its importance in intellectual operations in the brain cannot be minimized.
Facile use of language and speech is a remarkable attribute of the human brain, an attribute that is shared by no animal. A disturbance of that language function is known as aphasia, a form of agnosia and apraxia which interferes with the use of written and spoken word symbols (Gatz 1970, 113).

Ganong, expressing the traditional view of aphasia, states:

In a general way, the aphasias can be divided into sensory (or receptive) ... and motor (or expressive) ... . They can be further subdivided into word deafness, inability to understand spoken words; word blindness, inability to understand written words; agraphia, inability to express ideas in writing; and ... motor aphasia, inability to express ideas in speech ... . Frequently, the aphasia is general, or global, involving both receptive and expressive function (1969, 213).

However, Wepman and others saw aphasia as a disorder of symbol formation resulting from overall integration problems of the cortex, even though, paradoxically, aphasic patients may suffer only partial language disorder. Thus a disparity existed in a system divided solely between
input and output if symbolic formulation existed as a separate function. This disparity was first noted when it was seen that aphasic patients suffered modality-bound transmission problems rather than problems of symbolic formulation. So a theory was devised to accommodate agnosia and apraxia—disruption of transmissive, non-symbolic processes—and aphasia—disruption of integration, not a sensory or motor problem. Such a division was valuable in therapy. However, it failed to show the role of lower level function of language and the effect of internal and external feedback. (Patients could imitate and have normal reflex behavior—low level functions—but could not form concepts—high level functions.) A more complex language model had to be devised (Wepman 1960, 335). The model looked something like this:
As can be seen from this model, language functions all seem to be reliant upon the memory bank. Indeed, Wepman characterizes all aphasia as a memory defect involving symbolic formations. This disintegration of memory may alter the semantic or syntactic features of language (Wepman 1960, 337-338).

How does one become aphasic? Orton, who identified the syndrome of Developmental Reading Disability and separated it from mental defect and brain damage, felt that such language problems have an hereditary basis.

The data we have assembled from the study of left handedness and of various language difficulties in the family stock of children who have a specific disability in learning to read and show the strophosymbolia syndrome give what to me is convincing evidence that such children present intergrades between right-sided and left-sided familial tendencies and that the reading disability follows fairly definite hereditary trends. . . . In families with this disturbance there are also more than the expected number of left-handed members and persons with delayed speech, stuttering, reading, writing, and spelling disabilities, and abnormal clumsiness (developmental apraxia). In the childhood histories of children who come to attention as presenting reading and spelling problems we not infrequently find indications of developmental deviations in their acquisition of speech and motor problems (1966, 123).

Sodeman and Sodeman, specialists in pathological physiology, observe that dyslexia is frequently part of a "more generalized disorder of language, i.e., as part of an aphasic syndrome. . . . This tends to appear as a family trait; the underlying pathological changes, if any, are unknown " (1970, 992).
Schuell and Jenkins also note that aphasia is part of a general hierarchy of language deficits, though they do not comment upon the origin of such (1959, 432). Jakobson's studies seem to indicate that various levels of language are disturbed in brain injured people—differentially according to their inherent complexity in the language. His position led to the hypothesis that contiguity disorders first interfere with those obligatory grammatical forms which express syntactic relations and are not a matter of semantic choice. Studies by Goodglass and Hunt support his theory (1959, 448-453). From his observations, it would seem that the synergistic movements of muscles in the motor speech area have been interfered with because of some inherent deficiency of the individual. The deficiency may spread to other parts of the brain involving language activities, so that semantic aphasia and syntactic aphasia both result. The primary deficiency seems to be in the area which controls the order of language functions. The specific area of the cortex that relates most directly to this syntactic problem of serial order is that known as Broca's area, the premotor region immediately anterior to the laryngeal portion of the motor cortex. Removal of this area causes the loss of ability to form words and put them into proper syntactic categories. However, it must be stressed that
all areas of the cortex play a part in the integration of language-related stimuli; therefore, problems of serial order probably stem from a deeper origin, albeit still a genetic one.

Whatever the areas involved or the functions, most scientists who study language disorders find that the general problem of global aphasia (evident in specific families) has its origin in some genetic disorder. It may take the more easily recognized form of dyslexia (Specific Developmental Reading Disability), but careful investigation will show that if it is truly this malady, other related language problems exist—and have existed from birth.

One must conclude that if language problems can be inherited, then language abilities must likewise be. However, before positing a theory which suggests how these innate abilities are transmitted, it is necessary to glance at the question of the evolution of language and the corresponding evolution of the human species.
In Chapter IV, reference was made to Descartes' observation that all normal humans acquire language, whereas acquisition of even the barest rudiments of language skills is beyond the most capable ape. Yet because man is assumed to have evolved from the great apes, many feel compelled to explain the evolutionary development of man and his language, an evolution which left out his ape relatives.

The boldest attempt to trace this evolution was made in 1964, by Hockett and Ascher, who posited a theory of blending which was eventually responsible for the opening of a "closed-call system," presumably characteristic of our proto-homonoid ancestors. The assumption of such evolution seemed necessary to them as they saw language as a natural behavior, not an invention, of man. Their explanation involved the supposition that calls ABCD (food here) and DFGH (danger here) might have become accidentally combined one day and repeated numberless times. Then, for some unexplained reason, one day someone
realized he had an important and useful device in the blends of ABCD and EFGH (whatever combination may have arisen). Thereby the "closed-call system" was opened and language was "born." Their supposition is based upon the idea that an open system cannot be transmitted wholly through genes, that what allows language learning and acquisition was already present in the proto-homo-noids and merely was enlarged upon by the development of the open system of communication. Probably, the proto-man engaged in pre-language calls and through tradition, not physiology, passed on his development of calls (1964, 142-143).

Orr and Cappannari say essentially the same thing in their comments about language development, though they write more than Hockett and Ascher about the neuro-physiological aspects of evolution, and realize that some sort of genetic mutation had to occur to produce a physiological framework for language such as humans use today. They postulate that proto-man learned "duality" and used vocalizations in some call systems before the internal neurological systems evolved which permitted phonologically symbolic speech. That is, social aspects of language preceded genetic changes. As for the cortical aspects that determine language activity, they conclude that genetic mutations brought about inhibitory rather than excitatory
controls. As proto-man developed, neurophysiological mechanisms became more restricted, and that restriction was responsible for the development of language (Orr and Cappannari 1964, 65-66).

Count, however, points out the inherent weakness of such theories as that posited by Hockett and Ascher. That is, finding the base for pre-language in the accident of blending is far too narrow and is attacking the problem from the wrong end. He believes that the explanation of language development must be sought in the evolution of brain mechanisms. Phasis develops, he says, not because of the loosening of the call system, but because the brain has developed to allow symbolopoesis (1964, 158). Perhaps scientists should study the evolution of the association areas and the thalamus in man, as such area development is comparatively greater in humans than in the other primates (Diebold 1964, 158).

Chomsky finds any such study of language evolution pointless. If language is specifically human, as it indeed seems to be, he thinks it is quite senseless to raise the problem of explaining the evolution of human language from more primitive systems of communication that appear at lower levels of intellectual capacity (1972, 59). Criticizing Karl Popper's "Clouds and Clocks," he says to suppose that human language evolved from lower to higher stages (between which cannot be demonstrated
discernible continuity) is analogous to supposing that walking evolved from breathing; entirely different processes and principles are involved. Furthermore, so-called language properties such as purpose, syntax, and proposition can exist in other forms in other species. Walking is "purposive" behavior. Walking is also "syntactic" in that serial order, rhythmic organization, is present. It can also be propositional, informative, because the walker can signal his intentions by regulating his pace. What then is unique about language? Chomsky sees the difference between language systems of humans and call systems of animals as one involving entirely different mechanisms. He finds no basis for the assumption that language is simply a more complex instance of something to be found elsewhere in the animal world. If indeed language is unique to humans, biologists are faced with a problem—explaining the "true emergence" of a "qualitatively different phenomenon at a specific stage of complexity of organization" (1972, 67-70).
CHAPTER X

A THEORY OF LANGUAGE ACQUISITION

It must be generally agreed that acceptance of the linguistic universals generative grammarians have postulated and the acceptance of insights provided by language pathology leads one to the conclusion that language is "species specific" with humans, and that, by means of genetic endowment. Finding a neurophysiological basis for this theory of genetic endowment would have been impossible fifteen or twenty years ago. However, with the breakthrough in reading the genetic code and the consequent understanding of DNA (deoxyribonucleic acid) and RNA (ribonucleic acid), more is known about cell behavior, function, and differentiation.

Briefly, the processes involving the genetic code are these. DNA, from which all systems of the organisms are derived, is coded with information which determines every aspect of a species' development. This information is sent to the cytoplasm via RNA. In the cytoplasm of the cell, the RNA "informs" the chemicals of the DNA message, and protein synthesis begins. The result will be
a specific enzyme sent out to do a specific job. Since every nucleic cell contains the fully coded DNA nucleus, different aspects of DNA must be inhibited in each cell. "Regulatory" genes are keyed to inhibit, and thus cell differentiation is guaranteed. Breaking the genetic code entails discovering which enzymes are responsible—in each cell—for specific functions, such as toenail growth or bone shape (Robbins 1969, 172). RNA, as has been earlier noted, is probably responsible for "neuronal" memory. Coded with the messages of "immortal" DNA, directing the formation of irreplaceable neurons, RNA becomes central to the issue of language structures. That is, what RNA initially encodes in the neuronic cells (in the embryo) provides the permanent structures for the human's language and intellectual functions.

However, before stating a theory of language acquisition, this writer will examine Lashley's insights regarding serial order in behavior. Taking a semi-linguistic approach to cortical studies, he demonstrated that temporal integration characteristic of human language could not be explained by associative chain theories, primarily because these theories assume the inputs come into a static nervous system. The system, he observed, is already excited, in a systematic, orderly way. Knowing how that is possible or knowing what governs such systems was, he felt, behind the syntax of grammar. He postulated that some other
mechanism determines the serial activation of the motor units and thought structures. That is, syntax in language is not inherent in the words being used or in the idea being expressed but in a "generalized pattern imposed upon the acts as they occur." He believed that syntax is basic and independent, not the result of associative linkage of words. Supporting evidence for his theory he found in the mistakes of order, the slips and interferences which occur in writing and speaking. Furthermore, he believed that, since memory traces are stable, they are spatially differentiated even though reproductive memory appears as a temporal sequence. He would, therefore, have spatial and temporal order as almost completely interchangeable in cerebral action, the translation from the spatial distribution of memory traces to temporal sequences being a fundamental aspect of the problem of serial order (Lashley 1951, 185-192).

That associative chain theories are inadequate as explanations of language and intellectual functions is supported by grammar theories examined in the first section of this paper. If neurologically, association of S-R inputs is an inadequate explanation of language activity, a neurological control of serial order must be found. Lashley thinks it can be accounted for at primitive levels by rhythm and space co-ordinates. It is his opinion that the rudiments of every human behavioral mechanism will be
found far down in the evolutionary scale and will also be represented in the primitive activities of the nervous system. In other words, he does not see the mechanisms which control grammatical syntax in human language as significantly different from the mechanisms which control the gait of a horse or the buzzing of a bee (1951, 197).

While Lashley's insights are intriguing and illuminating, it is this writer's opinion that the controlling mechanism involved in grammatical syntax is specifically human; and that it is not a spatial distribution of memory trace involved, but a biochemical one reliant upon RNA instructions. Furthermore, it would seem that the control of integration comes out of the thalamus, which organ, it has been previously noted, is inferiorly developed in the other primates.

Bringing these threads together, one can postulate that the human embryo receives from its parents genetic coding which determines that thalamic nuclei and associative areas will be endowed with mechanisms which make possible integration of stimuli related to language activity. Furthermore, the RNA particles which carry these messages will be able to contain new memory engrams, and thus enable the thalamus to direct "scanning" of the brain's memories (Guyton 1966, 842). Comparative genetic
and neurophysiological studies of primates and humans will probably reveal that apes have demonstrably different cortical structures in these areas. Even if our present stage of decoding does not permit the discovery of specific enzymes which determine such structures, this writer believes that it will be soon when reading the genetic code will reveal which enzymes control these cortical developments in man and not in apes. By studying embryonic cell differentiation, one, theoretically, would be able to determine the specific enzymes responsible for such cortical differences. The problem still will remain, however, of explaining this "true emergence of a qualitatively different phenomenon at a specific stage of complexity of organization." There also remains the large possibility that there will be no demonstrable chemical differences in man and primates. If that is the case, and apes still cannot acquire language, then the occurrence of language could only be explained as a mental phenomenon peculiar to man because he, alone, possesses a mind—apart from matter.
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