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ABSTRACT

The present level of understanding of the psycholinguistic processes and capacities underlying the child's acquisition of language is reviewed in this publication. In the first chapter, linguistic theories, biological characteristics of language learning, and the distinctions between language competence and language performance are discussed. The remaining two chapters are a detailed discussion of the empirical findings of psycholinguists and psychologists about language acquisition: chapter two focuses on the nature and acquisition of syntax while chapter three considers the nature of phonology in a grammar and the child's acquisition of phonology. A bibliography is included. (JM)

HOW CHILDREN LEARN LANGUAGE

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Contents

Chapter 1

Theoretical Preliminaries

Section 1. Introduction

In this monograph we review our present level of understanding of the processes and capacities underlying the young child's acquisition of his first language. This study touches upon the fields of psychology and linguistics; in fact, it lies within the province of the offspring of these fields, psycholinguistics. We will have to deal with a number of matters which are usually considered wholly within the interest of theoretical linguistics, since it is our conviction that no understanding of language acquisition is possible unless it rests upon a thorough understanding of what is known concerning the end result of the acquisition process, namely, the language itself.

In the remainder of this chapter we discuss a variety of theoretical preliminaries to the content of the following chapters. The following two chapters are devoted to a detailed discussion of the empirical findings of psychologists and psycholinguists about language acquisition; Chapter Two is devoted to a discussion of the acquisition of syntax and Chapter Three to the acquisition of phonology. Due to a paucity of data and lack of our understanding concerning the acquisition of the semantic aspects of language, we do not attempt a review of that area here.

We must, in all fairness, say that the educator should not expect linguistics to provide very much by way of program guidelines, at least at the current level of understanding. Linguists

and psycholinguists are not in a position to make many profound predictions about what will work in the classroom but they are able to propose plausible theoretical models of the language acquisition process. However, there is not enough information to select just one of these as correct. Nevertheless, we feel that the material surveyed here does deepen our general understanding of the language acquisition process, and, therefore, of the learning process itself. Perhaps the most that can be expected by way of immediate applications is purely negative; certain educational programs may be shown to be ill-conceived because they are too atomistic or are based on premises which we have good reason to believe are false; nevertheless, teachers of English, speech and of foreign languages should not look to linguists for concrete answers to particular questions. We do feel, however, that we are asking the right questions, and that from these questions more effective educational programs are bound to flow. Despite the lack of a great many concrete answers concerning language acquisition, we feel that what follows here can serve to provide educators with some understanding of research developments which are bound to have a profound effect on educational perspectives during the course of the next few decades.

Section 2. S-R vs. the Nativist View

In this section we sketch the two most important theoretical approaches to the study of the processes and capacities which underlie the child's acquisition of his native language; since these two divide the field into two mutually contradictory camps, it is necessary to clarify the issues underlying the conflict before commencing the survey in the following chapters. Although this bifurcation of the field obscures many differences between the views held by various investigators, it is reasonably accurate to say that most studies of language acquisition fall into one of two categories: Either they rest on assumptions characteristic of what we will later define as Empiricism, or they are cast within a framework frequently called Nativism.

It is essential to distinguish clearly between the factual and

the deeper, more theoretical issues which characterize the difference between these two schools. This distinction has been obscured in most of the voluminous polemical literature. The reader should not infer that we are claiming that the factual and the theoretical questions bear no relation to each other; indeed, it is the underlying theoretical orientation of a scientist which determines which facts are important. Therefore, this section provides a conceptual framework for the survey reported in later chapters.

The next few paragraphs are devoted to a discussion of the theoretical differences between the two schools; following that, there is a discussion of more concrete issues which distinguish them. The latter discussion is followed by a brief descriptive account of the two schools, who their adherents are, and their orientation with respect to more purely linguistic questions.

Theoretical differences. There are two senses in which the term "empiricism" is frequently used—what we shall call a weak sense and a strong sense. In the weak sense of the term, all scientists, even Nativists, are Empiricists. For, all "empiricism" in this sense means is that the theory whereby we hope to explain phenomena must be empirically falsifiable. If there is no conceivable set of facts which can bear on the credibility of a theory which purports to explain a range of facts, then the theory is obviously worthless.

When we mention "Empiricism" below, however, we mean this term in the strong sense; that is, the assumption, or belief, that every aspect of an organism's behavior can be fully explained in terms of physically describable events in its life history. Thus, Empiricists would argue that an organism is born with his mind a clean slate, where the acquired markings are subject only to the vicissitudes of the organism's environment.

The Nativist's approach is diametrically opposed to that of the Empiricist. The Nativist argues for the existence of a highly structured, innate, or at least innately determined, cognitive system which determines to a large extent the manner in which the organism will respond to or assimilate events in its environment. An example of such a cognitive system is the system of

strategies and *a priori* knowledge which the child utilizes in learning his first language; this is frequently referred to as the Language Acquisition Device (LAD). The Nativists see their task to be that of giving a precise characterization of such a device, its ontology, and of the operations it performs on the inputs to the organism.

The Empiricists say that the Nativists are wasting their time, because such a device, even if it were to exist, would be forever hidden from our direct inspection. The Nativists argue that although it is certainly true that we may never actually *see* a child's Language Acquisition Device, there is nevertheless a broad range of facts which are relevant to justifying or falsifying a theory concerning the nature of such a device. The Nativists further contend that philosophically they are on as firm ground as theoretical physicists, who make strong claims concerning, for example, the existence of electrons; physicists, after all, point out that it is in principle impossible ever to observe an electron directly.

Factual differences. To place the dispute between the Empiricists and the Nativists in more concrete terms, let us first consider three purely *factual* ways in which they clash:

(1) The Empiricists usually argue that language learning is, in all essential respects, similar to the learning that is observed to take place in laboratory animals. For example, the animal psychologist can use programs of selective reinforcement to train rats and other animals to engage in highly complex sequences of behavior. That is, by either receiving positive reinforcement for behavior which the experimenter wants to elicit, or by receiving negative reinforcement for unwanted behavior, the animal can be taught complicated tasks. Although there are, of course, a number of elaborations on this paradigm, Empiricists maintain that this is the basic mode of learning of any kind, in any kind of animal. Thus, it is argued, children learn their native languages by selective reinforcement; when children engage in speech behavior which is acceptable to the community in which they live and which serves the desired communicative functions, the children become reinforced in some way. When

they engage in inappropriate speech behavior, they receive negative reinforcement, either in the form of absence of a positive reinforcer or in the form of punishment.

The Empiricists would argue that any account of language acquisition in children must rest entirely on the assumptions just outlined. Thus, the process of language acquisition is presumed to be essentially similar to the processes underlying animal learning.

The Nativists object to this argument by pointing out that humans are the only animals which have been observed to learn a natural language such as English, Chinese or Navajo. If animals possess mechanisms which are essentially similar to those which account for human language learning, why do they not learn to speak? Nativists ascribe this species-specific aspect of human language to genetically determined cognitive capacities, unique to the human species. Empiricists, on the other hand, are likely to claim that this species-specificity is due entirely to our particular structure of the larynx, or of some other peripheral mechanisms. Thus, they would contend that humans are unique in this regard only because of differences in our peripheral perceptual and/or sound producing mechanisms.

The Nativists argue, however, that there are a number of factual matters which support their position and which can not be accounted for by the Empiricists' approach. For one thing, not only do all and only normal humans learn language, but they all do it in the same way. As we shall see in Chapters Two and Three, there are a number of milestones in language acquisition which are observed among the learners of a large number of languages. Since these universal milestones have not been accounted for in terms of correlated, systematic and universal changes in the child's linguistic environment, it seems at least plausible to argue that children are born with a highly structured capacity for language acquisition which determines the sequence of these milestones; thus, since the nature of language acquisition is genetically determined, we have every reason to expect that many very basic aspects of language acquisition will be common among all children, no matter what language they learn. Of

course, further support is given this view by the fact that animals do not go through this sequence of milestones; in fact, they do not learn to speak at all.

There is yet further evidence in favor of the Nativists' position that language learning is controlled by a highly structured, innately determined, species-specific, mental mechanism, and is not a special case of stimulus-response, reinforcement learning observable in animals; namely, the existence of what appears to be a critical period for language acquisition. If a person does not acquire his first language sometime between the period of about age two and puberty, he stands no chance of learning language after that period. Some evidence for this view comes from certain facts concerning the language acquisition of people who suffer a variety of pathological conditions. This and other evidence will be reviewed later in this chapter.

(2) Some very important evidence relevant to the Empiricist-Nativist controversy is the existence of highly abstract commonalities among the grammatical structures of all the world's languages. There are not only universals concerning general aspects of the organization of a grammar, but also concerning the specific content of grammars. In the course of this presentation these universals will be described at some length.

To exemplify the notion "linguistic universal" at this point it is sufficient to indicate that there is no language which fails to distinguish syntactically between nouns, verbs and adjectives, although languages do differ vastly from one another in terms of inflectional categories, word order, and other superficial grammatical devices. Furthermore, all languages possess grammatical relations such as *subject of a sentence, object of a verb phrase,* and others. Nativists argue that the existence of such universals can be accounted for only if one presupposes the existence of a Language Acquisition Device which develops in all children at a certain age as part of their intrinsic, human capacities; it is this device which specifies many essential aspects of the form and content of individual grammars. The universals which have been discovered are examples of those aspects of grammars which appear to be innately determined.

It may be argued that the existence of such universals proves no such thing, but that they might be the result of historical factors; that is, it may be that all the world's languages stem from one common source, the "first" language, of which all the present day languages are descendents. Thus, these so-called universals are really nothing more than characteristics of the original language which have been preserved down through the centuries.

This rejoiner fails to dispose of the Nativists' position, however; whereas linguists have acquired quite a mass of information concerning how languages change over time it is also known that certain conceivable changes never take place. For example, a language can never lose the categories of noun, verb, or adjective; moreover, historical changes can never cause a language to lose the grammatical relations of *subject of sentence, object of verb phrase,* etc. In short, we know that those aspects of linguistic structure which we say are universal always remain within the historical development of any given language. Even, then, if it turns out to be an empirically demonstrated fact that all the world's languages are historical descendents of a single proto-language (although highly unlikely, such a development is not beyond the realm of possibility), we would still have to account for the fact that it is just these universal aspects of language which remain selectively immutable. If it is not because we are born wired-up in such a way that our language must conform to these universals, then how are the facts to be explained? We will return in Chapter Three to some further ways in which facts concerning the historical developments of language are important to understanding how a child acquires his first langauge.

(3) The third factual point pertinent to the differences between Nativists and Empiricists is that the information we have about the relevant environment, linguistic and otherwise, necessary for, or conducive to, language acquisition does not support the contention that language learning is characterized by reinforecment schedules. It is obvious that parents, siblings, and others in the child's environment may react in widely varying and unsystematic ways, and yet the child still acquires a gram-

mar of his dialect. It is not necessary for mothers to smile, or react in any particular way when Johnny utters a sentence which the mother accepts as grammatically correct, or frown when he produces a sentence not acceptable to the adult's grammar. In fact, as we shall see below, there is good reason to believe that conscious attempts to modify the natural course of language asquisition in normal children are bound to fail. As we shall see in Chapter Two, children go through a series of stages in their acquisition of grammar where they produce utterances which are presumably grammatical to them, but not to adults. That is, when the child's grammatical capacity is not mature, he seems to have internalized grammatical rules which differ rather markedly from those of a mature grammar, and which produce sentences which would be ungrammatical in the adult's grammar. Under these circumstances, it seems that no amount of training or reinforcement can get the children to give up their old ways and begin to produce only sentences which are grammatical from the adult's point of view. The child's grammar will change according to a preset schedule of changes, triggered by poorly-understood conditions, and no amount of prodding can change the child's progress.

We have now summarized three major *factual* arguments in favor of the Nativist vs. the Empiricist positions. It is to be understood that, as in any branch of science, no such factual arguments can be considered absolute *proof* of any particular theory. Instead, all we may hope to expect from such facts is that they will make one theory appear more plausible than another. Thus, there is hope that facts such as the three sketched above and discussed in greater detail in the three sections of this chapter which follow, may be explained by a theory based on the Nativists' approach, whereas the Empiricists' approach shows little promise of accounting for such facts.

It should be pointed out that the three arguments given above are not factual in the sense that they consist of the presentation of reliable data acquired under controlled conditions. There are nevertheless factual issues which underlie these three arguments: either language is species-specific or it is not; either there

are linguistic universals or there are not; either language learning is independent of any sort of reinforcement or it is not. The Nativists argue the affirmative to each of these three questions, whereas the Empiricists argue the negative.

The investigators. Almost all of the Nativists currently work in the field of language acquisition are at least strongly influenced by the transformational-generative movement in linguistics, if not actually a part of that movement.[1] Transformational-generative linguists are distinguished from other linguistic schools in two essential ways: First and foremost, they diverge from other contemporary American and European linguistic traditions in that they are primarily concerned with a precise specification of a general theory of human linguistic competence as well as of individual grammars; they are not exclusively (or even primarily) concerned with the procedures whereby a linguist may discover a grammar given a restricted set of data of a given language; secondly, transformational-generative grammarians argue for a theory of grammar which is different in form and content from that suggested by other contemporary schools of thought in linguistics.

It should be made clear that, while linguists of the transformational-generative school are not even primarily concerned with discovery procedures, they are certainly concerned with empirical verification of their theory of language. Some of the evidence in favor of this approach to linguistic theorizing will be presented in Chapters Two and Three; for the most part, however, these arguments will not be dealt with in this presentation; the reader interested in further pursuing these issues is referred to the literature cited in the bibliography.

Whereas Nativists usually are associated with the transformational-generative movement in linguistics, Empiricists form a much more ideologically and methodologically heterogeneous group of investigators. For example, B. F. Skinner of Harvard University contends that human language and its acquisition can be completely characterized in terms of factors external to the organism, factors consisting solely of stimulus, response and reinforcement patterns; intrinsic qualities of the individual are

held to contribute nothing to language use or acquisition, which are supposed to be merely special cases of learning principles discovered in the animal laboratory. Investigators such as Osgood, on the other hand, consider the necessity of mediating constructs which relate the organism's input to his behavior. These mediating constructs, while considered internal to the organism, and, hence, unobservable, are conceptualized as being composed of a proper sub-set of the complete set of attributes of the external, observable stimulus or response. Thus, the mediating constructs are links in the input-output chain, but contribute nothing new in terms of structure. Similarly, the principles by which the mediating chains are constructed are assumed to be just those by which observable behavior chains are built up. Hence, they are the ultimate result of events which are external to the organism.

Section 3. Biological Constraints on Language Acquisition

In this section we shall argue that language acquisition is determined and constrained by genetically determined, biological factors. We are considering, of course, biological factors other than the obvious ones such as the anatomy and physiology of the vocal tract and the auditory mechanism. We are interested instead in higher level, cognitive processes. We list below five major points in favor of this view, and discuss them in more detail in the remainder of this section.

One piece of evidence in favor of the belief that the capacity for language acquisition is innate is the fact that language acquisition is limited to the human species. This has already been discussed above, and no further comment is called for here.

A second argument is that the course of language acquisition shows characteristics typical of the maturation of genetically determined processes, such as walking. This argument will be discussed in more detail below.

The fact that there appear to be definite age limits, beyond which language acquisition cannot take place is a third point in favor of the biological view of language acquisition.

Fourth, the existence of a highly regular sequence of milestones in language acquisition, even in the presence of gross abnormalities such as feeble-mindedness and mongoloidism is further corroboration. Although the normal sequence of milestones in the acquisition of syntax and phonology are discussed in Chapters Two and Three, respectively, certain aspects of them will be discussed here.

Fifth, the maturation of linguistic capacity seems to be closely correlated with physical maturation and the development of other skills and capacities.

We argue in more detail below that these points support the view that the child's capacity for language acquisition is biologically conditioned. We now turn to a more detailed examination of the last four of the above points.[2]

Language acquisition as a maturational process. There are four traits of behavior development which are traditionally taken as indications that a particular aspect of development is a maturational process: First, the behavior appears in all normal members of the species at about the same age, at about the same chronological point relative to some other maturational processes, and all members of the species exhibit the same sequence of milestones in developing the behavior in question. Second, the aspects of the environment which are relevant to the emergent behavior do not change in any essential way during the development process; thus, any change in the organism's behavior is due to internal changes, not environmental changes. The third hallmark of maturational development is the appearance of at least some essential aspects of the behavior before the behavior pattern is fully developed; that is, the inmature organism will engage in apparently useless activity which can be interpreted as a preview of an important aspect of a capacity or skill which the organism has yet to fully develop. The fourth characteristic of maturational development is that the "preview activity" does not exhibit signs of being goal-directed practice.

Language development possesses all of the above four characteristics. The regularity of appearance of certain milestones will be discussed below, and in later chapters of this study. Al-

though there is little systematic information with respect to environmental conditions, no empirical evidence has appeared which indicates that the linguistic environment of a child changes in any systematic way as his linguistic capacity matures. The fourth point is more difficult to establish empirically. Nevertheless, it does appear that children who have, for one reason or another, been deprived of the opportunity to engage in "preview" speech behavior (babbling and other non-speech vocalizations) nevertheless may acquire language in the same way as other children. Lenneberg (1967, p. 140) cites the case of a 14-month-old child who had been tracheotomized for six months. Lenneberg says: "A day after the tube had been removed and the opening closed the child produced the babbling sounds typical of the age. No practice or experience with hearing his own vocalizations was required." Lenneberg goes on to cite a few other cases of emotionally disturbed children who do not emit any of the vocalization during the period when most normal children engage in babbling. Yet, when and if they respond to treatment, some are reported to " . . . snap out of their state of isolation and almost miraculously begin to talk fluently and in accordance with their age level." This has also been reported by Luchsinger and Arnold (1959). This is a further indication that the "preview activity" is of the sort frequently observed in genetically programmed emergent behavior, and is not to be interpreted as "practice."

The critical period for language acquisition. There is evidence from various pathological conditions and the mode of recovery from them that there is both a too-early and a too-late age for language acquisition. There are five major areas which are germane here: First, the mode of recovery from traumatic aphasia in relation to the age of the patient; second, the age at which speech function is lateralized in the brain; third, the dependence of the effects of hemispherectomy of the brain on the age of the patient; fourth, the age at which language development is arrested in retarded children; fifth, the effect of sudden deafness, acquired at various ages, on language acquisition. Each of the five of these will be discussed briefly below; for a more

complete discussion, the reader is referred to Lenneberg (1967) and references cited there.

The differences between the way in which adults recover from aphasia caused by brain injury and the way in which young children do are very interesting. An adult will usually show one of two patterns of recovery; either he will exhibit a fairly rapid reduction in symptoms such that he is fully recovered within three months, or he will show a slow, gradual reduction in symptoms, yet never fully recover. Children, however, not only have a much better chance for full recovery—the younger the child the better the prognosis—but they also recover in a different way. If the child is very young, during the age when its language acquisition capacities are at their maximum (between 20 to 36 months of age, during or immediately after the age of acquisition of the bulk of the child's first languge), Lenneberg reports the following pattern of recovery:

> Cerebral trauma to the two or three year old will render the patient totally unresponsive, sometimes for weeks at a time; when he becomes cognizant of his environment again, it becomes clear that whatever beginning he had made in language before the disease is totally lost, but soon he will start again on the road toward language acquisition, traversing all stages of infant vocalization, perhaps at a slightly faster pace, beginning with babbling, single words, primitive two-word phrases, etc., until perfect speech is achieved. (pp. 149-150)

There seems to be a turning point at puberty: Aphasias acquired before this time or which have cleared up by this time usually leave no traces, whereas the prognosis is not as favorable for older patients. That this means more than a general ability of younger children to adapt to handicaps is shown by evidence that the age at which lateralization (or, as we shall see below, relateralization) of speech functions in the brain takes place is also limited to the same critical age range.

It is known that in a very large percentage of cases, speech function is lateralized in the left side of the brain. For example, Lenneberg quotes statistics to the effect that, in adults, of all

brain lesions which cause aphasia, only 3% were in the right side of the brain. There also seems to be some evidence that the age at which lateralization takes place follows a natural history very similar to that of the age of recovery from aphasia. The fact that lateralization is not definitely established until about puberty is indicated by statistics concerning the effects of right-side lesions in children under the age of 10. In these children, speech was disturbed 45% of the time, although they usually recover by two years' time. In fact, if children before the age of two sustain lesions, the prognosis does not seem to depend on the side of the brain affected. These data point to the conclusion that lateralization of speech function is completed by the time puberty is reached, and has not begun before the beginning of language acquisition.

Even more striking in this regard is the evidence from cases in which an entire hemisphere of the brain had had to be surgically removed, usually in cases where the patient suffered from seizures or a tumor. In pre-teenage children, the prognosis for retention or recovery of normal speech is the same, no matter what hemisphere was removed. In adults, it seems that there is little hope if the left hemisphere is removed, while removing the right hemisphere hardly ever affects speech.

The implication of this discussion of aphasia, lesions and hemispherectomies is that there seems to be a common critical period for recovery from all these pathologies and for the crucial periods in language acquisition. Since these factors are clearly determined by developmental biological laws, and since language acquisition exhibits a highly similar natural history, it seems quite plausible to argue that language acquisition is an example of biological development.

Further evidence is supplied by the linguistic development of retarded and mongoloid children; such children make some progress in language acquisition as long as they are pre-pubertal. Lenneberg reviews a number of cases where mongoloid children attain essentially the same sequence of milestones in language acquisition as normal children, but they do so much more slowly. If, however, the children have not attained full language

development by the time they reach puberty, their linguistic skills will be "frozen" at the state they are in. Thus, it appears that puberty is the latest point for natural language acquisition.

It is more difficult to establish the earliest point for the effectiveness of the Language Acquisition Device. Lenneberg cites evidence from cases of children who become deaf. If the child becomes deaf much before the age of two, his prognosis for learning language skills is essentially the same as for cogenitally deaf children. If, on the other hand, the child had had some experience with language, his prognosis is much better. This is so despite the fact that the behavior of a child of four or less after about one year of deafness is indistinguishable from that of the congenitally deaf. The difference between cases of congenital deafness and of sudden deafness occurring before the age of 2, and those of deafness occurring between the ages of 2 and 4, is that the latter children can be trained much more easily in language skills, even if the training begins years later. Thus, the development of the Language Acquisition Device seems to be an important element in training the deaf; if it had a chance to develop at the normal age before the child became deaf, his language development is greatly facilitated, even if its earlier development did not follow the full course to language acquisition. Furthermore, this evidence indicates indirectly that the earliest age at which the LAD reaches a high degree of activity is the age of two or so.

The last type of evidence reviewed here concerning the biological basis for language development concerns concomitants of physical maturation. Studies of the maturation of the brain indicate that Broca's area of the brain, traditionally associated with the site of language, undergoes its most rapid period of maturation before the age of two years. Brain maturation consists mostly of the development of dendritic interconnections.

In general, it appears that the physical parameters defining brain maturation reach about 60% of their adult values by the time the young child reaches the age of two, when the Language Acquisition Device becomes most active. The remaining 40% of development is spread out over the years, at a decreasing rate,

until puberty, when the physical state of the brain has reached its full, adult maturity. Thus, there appears to be a correlation between the physical characteristics of cerebral maturity and language acquisition. Although these arguments do not elucidate the particular structure of the Language Acquisition Device, they do support the thesis that language acquisition is an example of maturational development, much as is walking and other physical skills. This fact has frequently been overlooked, perhaps because of the obvious dependence on the environment for the form of language the child acquires. Nevertheless, we are now led to approach the following problem: What is the general form of the Language Acquisition Device which is determined by our biological makeup, and what is the general nature of the strategies used in acquiring language?

Linguistic universals. A great deal can be learned concerning what children bring to the task of language acquisition by the study of linguistic universals. As mentioned previously in this chapter, it is argued that linguistic universals reflect innately determined linguistic capacities; the fact that they are innately determined accounts for their universality. These universals are as much a part of our linguistic behavior as our having an opposed thumb is of our manual behavior.

Serious questions arise when it comes to cataloging and characterizing linguistic universals. It is useful to distinguish two main types of universals: *formal* and *substantive* universals. Basically, formal universals are universals concerning the general form and organization of grammars. For example, one formal universal is that the grammars of all languages are believed to have three major components, syntactic, phonological, and a semantic. Furthermore, all languages are believed to have grammatical rules, some of which can be mathematically described as context free phrase structure rules, and others which can be described as transformational rules (these terms are defined and discussed in Chapter Two). Substantive universals, on the other hand, refer to the specific content of grammars. For example, it is considered a substantive syntactic universal that all languages possess the categories of nouns, verbs and adjectives; a

phonological universal is the universal presence of consonants and vowels.

Later chapters will deal with both of these types of universals in greater detail. It is important, however, to consider some very general aspects of all languages in this chapter in order to better understand the accomplishments which all children perform at about the age of two years.

Let us first consider that any native speaker of any language has the capacity to produce and/or understand entirely novel utterances of his language. Indeed, most of the utterances with which children and adults deal every day are entirely novel to them; the only thing that they have in common with each other is that they are produced by the same grammar. In addition to being able to produce and perceive any of an essentially infinite set of novel sentences, speakers can usually identify sequences of words either as sentences of their language or as ungrammatical strings. Thus, one thing that is a very important formal linguistic universal is what we call the recursive property of grammars; the grammar of any human language must consist of a finite set of rules which can identify, generate and describe an infinite set of sentences. One task of the psycholinguist is to describe how children acquire this infinite capacity with a finite means.

It should be noted that we have not been claiming that children are born with a full specification of the form and content of grammar. That is, although we do claim that universals are innately determined, we do not claim that they are fully developed at birth. Instead, we make the weaker claim that children are born with a very general set of learning principles which constrain their learning processes in such a way that the only hypotheses they can form concerning the form of their grammar are those which conform to what is known about linguistic universals.

This leads us to a very deep and puzzling question concerning linguistic universals and the nature of language acquisition. Since we assume that language learning takes place by a process of hypothesis formation (cf. Chapter Two), how can we account

for the child's ability to form a hypothesis as complicated and as detailed as the grammar of a natural language in a period of just a few months, when we realize that the child is never directly presented with grammatical rules? Upon hearing a limited set of sentences, many of which deviate from full grammaticalness themselves, the child goes through a series of hypotheses which he tests, the last of which he finally accepts as the grammar of his language. In all cases, the hypothesis finally accepted is a complete grammar of the language to which the child was exposed during his learning period. The question is: How does the child manage to pick the correct hypothesis after such a short period of time when it is obvious that, with a little imagination, one could make up a huge number of absurd hypotheses which would have superficial plausibility? For example, the child knows never to consider such features of sentences as the eye-color of speakers, or the time of day in which the sentences are uttered, when attempting to discover the syntactic principles of the language spoken in his environment. Obviously, the child must bring to the language learning situation at least the knowledge that any such considerations are irrelevant to the language learning task. Even if we consider more reasonable criteria for hypothesis formation, it is difficult to imagine any which can constrain the set of possible hypotheses so narrowly that the child is inevitably led to the correct hypothesis after just a few months, and with no formal instruction.

We are faced with no alternative but to consider the necessity of discovering the set of principles which constrain the form of any grammar in the world, with the stipulation that they must be a very narrowly constraining set of principles. Many proposals have been made concerning these principles, some of which are well confirmed, others of which are highly questionable. These concern mostly syntax and phonology, with the area of semantics largely not understood. In the area of phonology, moreover, there seems to be a much more richly developed set of substantive universals, due partly to the fact that this area has been under scientific investigation to a larger extent during the last few decades, and partly to the fact that phonological data are

more amenable to analysis. In the chapters on syntax and phonology, these universals will be reviewed. Before concluding this introductory chapter, we turn to a consideration of the important distinction between linguistic competence and linguistic performance.

Section 4. Competence vs. Performance

Basically, the distinction between competence and performance is that between knowledge and the use of knowledge. Thus, linguistic competence consists of the language user's knowledge of the grammatical rules of his language, the rules whereby he can generate any of an infinite set of sentences of his languages, complete with a syntactic description of each. Linguistic performance, on the other hand, consists of a large number of factors, including, among others, the strategies used in production and perception, heuristics used by the child in language acquisition, and other factors.

This distinction can be made clearer by means of an analogy with the game of chess. There are two major aspects to the game of chess; knowledge of the rules of the game and knowledge of the strategies which can lead to a winning position. The rules of the game constrain the moves of the pieces, and define possible vs. impossible moves and positions. However, more is needed than knowledge of the rules of the game in order to be even a mediocre player. It is also important to know what moves and strategies are appropriate under particular circumstances. Someone who knows the moves of the game but does not have any knowledge of strategy will always make nothing but legal moves, but rarely sensible ones. Analagously, knowledge of the rules of grammar may assure that the speaker will produce nothing but grammatical sentences, but will not assure that the sentences will be appropriate. Moreover, grammatical rules can not automatically discover the semantic content of a spoken sentence unless under the control of a set of strategies; grammatical rules can only generate all and only the sentences of a language and syntactic descriptions for each sentence. Thus, a fully adequate

grammar assigns to each of the infinite sentences of a language a structural description which indicates how each sentence is understood by native speakers of the language; one may think of these structural descriptions as roughly similar to a parsing diagram of a sentence. For many reasons, to be reviewed in Chapter Two, it is necessary to consider such syntactic information in order to understand a sentence.

In summary, we say that linguistic competence is concerned only with a characterization of the grammatical rules which generate all and only the sentences of a language and their structural descriptions; linguistic performance, on the other hand, is concerned with all other factors which play a role in actual language usage, such as the mechanisms underlying production, perception, limitations of memory, attention, emotion, etc. Noam Chomsky characterizes the same idea somewhat differently when he says that competence is concerned

> . . . with an ideal speaker-listener, in a completely homogeneous speech-community, who knows its language perfectly and is unaffected by such grammatically irrelevant conditions as memory limitations, distractions, shifts of attention and interest, and errors (random or characteristic) in applying his knowledge of the language in actual performance. (1965, p. 3)

We thus see that linguistic competence is the characterization of the set of grammatical rules which provide a full set of sentences of a language complete with the syntactic, semantic and phonetic specification of each. We may think of grammatical competence as specifying a three-way pairing between the phonetic, semantic and syntactic features of each sentence of a language. The problem of speech production is to find a sentence —by using the grammar to generate sentences, each one of which is checked for appropriateness—which has the semantic representation corresponding to the meaning which the speaker wishes to convey. The sentence with the semantic representation closest to the desired one will also have a syntactic and a phonetic representation associated with it because it has been generated by the speaker's internalized set of grammatical rules. The pho-

netic representation of the sentence to be produced can be viewed as a representation of the instructions to thc speaker's vocal organs necessary to pronounce the sentence in question. Speech perception, on the other hand, works the other way around; the listener is presented with the phonetic representation of the sentence, and nothing else. The task of the listener is to internally generate, according to his internalized grammar, a sentence which comes as close as possible to having the same phonetic representation. This matching sentence also has associated with it a syntactic and semantic representation, providing the listener with the meaning of the sentence.

The study of language acquisition is concerned with how the child acquires the grammatical competence which can accomplish these pairings, especially when the child starts off with no specific information about the language in question.

Chapter 2

The Acquisition of Syntax

This chapter is divided into two sections; in the first section we sketch the structure of the syntax of languages as currently understood by transformational-generative theory. The second section consists of a survey of recent investigations into the child's acquisition of syntax.

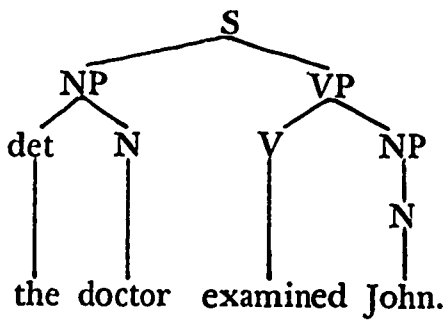
Section 1. The Nature of Syntax

Syntactic rules. The transformational-generative theory of grammar specifies that the syntactic structure of any given language can be completely characterized by a set of rules—unique to each language—which generates an indefinitely large number of sentences; the set of sentences generated by the grammar must be all and only the sentences in the language described by the grammar. In addition, a generative grammar must provide an explicit characterization of the syntactic structure of each sentence in its output. Thus, the grammar is recursive—i.e., it generates and recognizes an infinite set of sentences with a finite set of rules.

As a simplified example of what is meant by the notion of syntactic rules, let us consider the derivation of the sentence *The doctor examined John.* The reader should bear in mind that the rules presented for this example will be revised and complicated in the exposition in this chapter.

Phrase structure rules. The rules we shall present are called

phrase structure rules (PS rules); they define a hierarchy of syntactic constituents, starting with the greatest constituent and proceding to the smaller ones. In particular, we want to end up with a constituent structure essentially like the following:



Diagrams such as this provide an explicit means for indicating the phrases which make up the constituents of sentences; in accordance with customary terminology we will refer to them as Phrase Markers (PMs).

In this diagram, S, which means *sentence,* is the greatest constituent, comprising the entire sentence. The sentence has a typical structure, consisting of a noun phrase (NP) and a verb phrase (VP). In order to express this by means of a rule which participates in the generation of all sentences of this type, we posit the following rule:

(PS 1 ')[3] S $\longrightarrow$ NP + VP

That is, the symbol S is expanded into the sequence of symbols, NP + VP (where ' + ' means that the units it sets off are themselves constituents of the constituent to the left of the arrow).

The verb phrase, in this example, is made up of a verb (V) followed by a noun phrase (NP); this is the case of every sentence containing a transitive verb and an object noun phrase. This may be expressed as follows:

(PS 2 ') VP $\longrightarrow$ V + NP

Turning now to the structure of the NP, we see that the first NP—the 'subject' NP—consists of a determiner (*det,* represented by definite article in this example) followed by a noun *(N).* The second NP in the example—the 'object' NP— consists of a single proper noun. The noun phrase thus appears to consist of a noun optionally preceded by a determiner; if there is no determiner,

the noun is usually a proper noun (especially if it is a singular count-noun). Our mechanism for indicating optionality in rules is parentheses; anything included within parentheses can be optionally not included in the expansion of the symbol to the left of the arrow:

(PS 3 ') NP ⟹ (det) N

We have presented three rules which generate at least some aspects of the example sentence. These rules can be seen to be generative if we think of them as defining steps in a derivation of the sentence, rather than as describing the tree directly. For example, if we always commence with the symbol S, PS 1 ' will yield the second line of the derivation below, PS 2 ' the third line, and PS 3 ' the fourth:

S
NP + VP
NP + V + NP
det + N + V ± N

The derivation of the sentence will be complete when we insert the proper lexical items into the last string of the derivation given above. This requires some further considerations which we leave out of consideration for the moment; the point is that the grammar contains an automatic procedure which will assure that an animate count noun such as *doctor* will only replace an N which appears within an NP which also includes a *det;* furthermore, a proper noun such as *John* will only replace an N which is within an NP which does *not* contain a determiner. There must also be restrictions placed on which verbs can replace V in particular environments; this example, however, does not exemplify the nature of these restrictions. Suffice it to say here that a transitive verb such as *examine* may only appear in a VP which also contains an NP.[4]

An essential aspect of derivations like those presented above is that there is a procedure for automatically deriving a PM from every derivation. Although the procedure for producing PMs is not given a technical description here, it is intuitively obvious how PMs correspond to phrase structure rules and their associated derivations. To summarize the discussion to this point,

then, PS-1 through PS-3, which constitute a miniature syntax, mechanically produce the derivation of the example sentence; the PM is, in turn, derived from the derivation.

Grammatical relations. Such rules and the structures produced by them also provide a basis for the definition of such concepts as *subject of a sentence, object of a verb phrase,* etc. The noun phrase represented by the NP in PS-1 ' is defined as the *subject* of the sentence represented by the S to the left of the arrow; the noun phrase in PS-2 ' is the *object* of the verb phrase to the left of the arrow. These relations can also be directly read off the branching diagram: The NP which is immediately dominated by S is the subject of the sentence, and the NP which is directly dominated by VP is the object of the verb phrase.

Deep structure and surface structure. Any native speaker of English can tell well-formed English sentences from obviously ungrammatical strings of words. This ability is due to the language user's possession of a set of rules which he utilizes to determine if a given sequence of words can or can not be generated by his rules; if it can, it is grammatical and the hearer can perceive its structure. Otherwise, the sentence is deviant in some way. By examining revealing examples of typical grammatical (and sometimes ungrammatical) sentences, we can gain significant insights into the syntactic rules of a particular language. Consider the following examples:

(1) The doctor examined John.
(2) The doctor examines John (every week, regularly, . . .).
(3) The doctor has examined John.
(4) The doctor is examining John.
(5) The doctor had examined John.
(6) The doctor has been examining John.
(7) The doctor had been examining John.

Notice that a past participle ending ('-d ' or '-en ' in examples (3), (5), (6) and (7) henceforth abbreviated as *en,* is invariably associated with a form of *have;* the form of *have* always precedes *en* with either just the verb stem or just the stem *be* intervening. Moreover, the progressive suffix '-ing' (henceforth referred to as *ing*) occurs only and always when some form of *be* precedes

it, separated from it only (and always) by the verb stem. Notice also that the combination of *have* and *en* is optionally present; the same is true for *be* and *ing*. The problem now is to discover a set of rules which can account for this distribution of elements.

It is an easy enough matter to write a set of rules of the type we have already exemplified which will provide for the optionality of *have, en, be* and *ing* and for the invariability of the elements which are associated with each other. In particular we can interpose a construct which we call the *Auxiliary* (Aux) to precede the verb phrase, and then expand Aux into a sequence of elements, including an obligatory tense element (either *present* or *past*), an optional perfective form, and an optional progressive form. This is accomplished in rule PS-3 of the following set of rules:

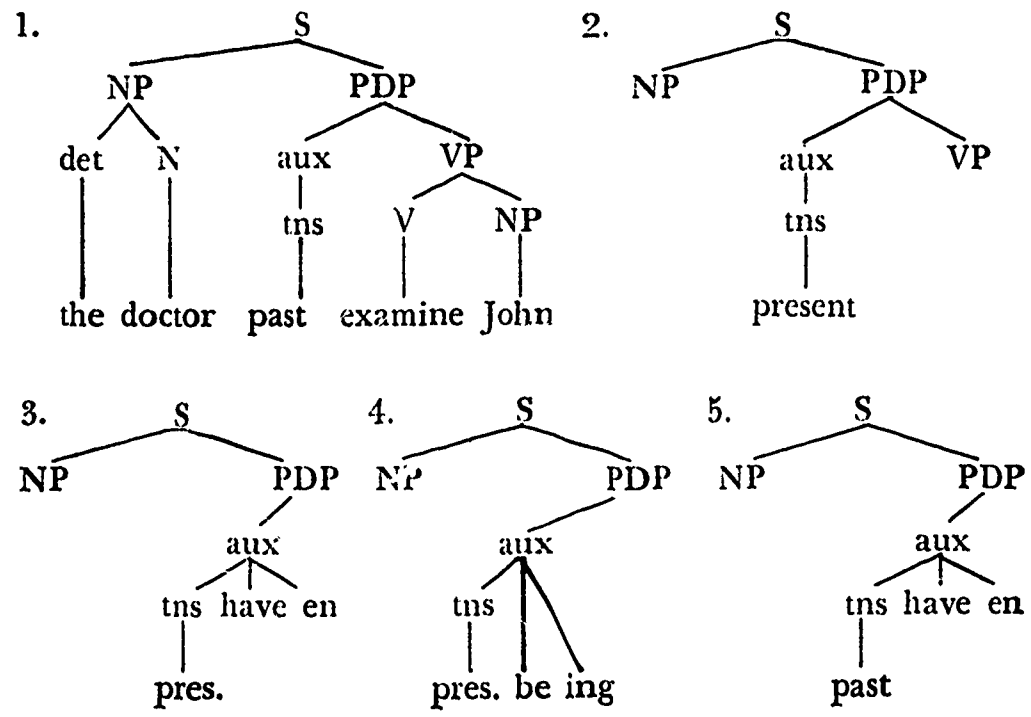
(PS-1 ') S ⟶ NP + PDP
(PS-2) PDP ⟶ Aux + VP
(PS-3) Aux ⟶ tns (have + en) (be + ing)
(PS-4) VP ⟶ V + NP (same as PS-2 ')
(PS-5) NP ⟶ (det) N (same as PS-3 ')
(PS-6) tns ⟶ pres, past (braces mean 'either')

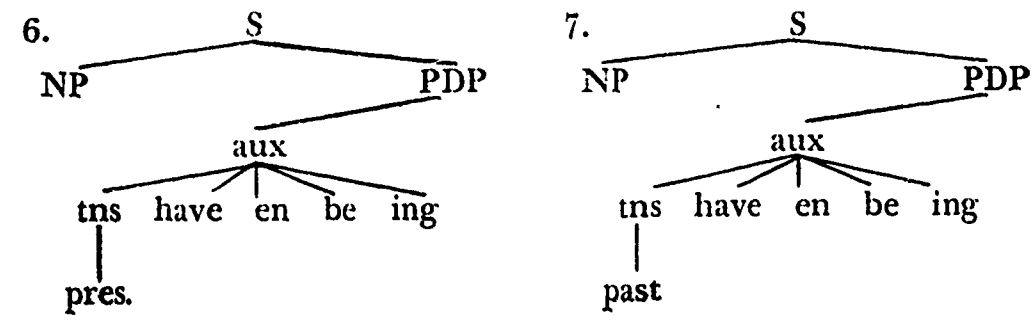
This is the final set of rules for this example, comprising the rules needed to handle the examples we have presented. PDP in PS-1 'and PS-2 stands for *Predicate Phrase,* a higher level constituent than VP which included both Aux and VP. Aux consists of an obligatorily appearing tense element (tns) followed by an optionally appearing *have,* with *en* invariably following it; the latter is in turn followed by the optional combination of *be* and *ing*. Notice that these rules do not provide the correct order of elements; *en* never appears immediately after the form of *have* in actually occurring sentences. *en* always follows *be* when it is present, otherwise it always follows the stem of the main verb (V in PS-4). The order of *ing* with respect to *be* also requires further rules. It is impossible to write a plausible set of rules which correctly account for the order of elements in actual sentences if we restrict the form of the rules to that which we have already seen exemplified in this study. As we shall show in the next few paragraphs, it is essential to consider a different type of rules

which we call *Transformational Rules* (T-rules). T-rules have the power to rearrange elements already generated by PS-rules.

At this point we illustrate the PS-rules presented above by means of a PM for each of the six sentences generated by rules PS-1 through PS-6.

Diagram II-1





These PMs indicate clearly just what reordering must be done by a transformational rule in order to correctly account for the organization of the auxiliary phrase in English: The suffixes *tns, en* and *ing* must each be transposed one element to the right in these examples, no matter what the next element to the right

is. This analysis of the auxiliary by means of an Affix-reordering T-rule (which is somewhat simplified for illustrative purposes) provides a natural account for the distribution of elements discussed at the outset of this example.

The Affix-reordering rule—like all transformational rules—does not actually generate any structures, but rather modifies the PMs generated by the phrase structure rules. Thus, we see that we have two sorts of rules: rules which generate PMs and T-rules which operate on these structures, yielding modified structures called Derived Phrase Markers. The Affix-reordering transformation may be given the following form, which is interpreted immediately below:

Af + stem ⟹ stem + Aff #; where Af means *tns, en,* or *ing* and stem means any verb stem, *have,* or *be.* # means word boundary, indicating that the form 'stem + Af 'always constitutes one word.

The Affix-reordering rule must apply to every PM—it is an obligatory transformation. We will present examples of T-rules which are optional, further distinguishing them from phrase structure rules, which are never optional.

The Affix-reordering rule, then, always reorders each of these affixes to the position immediately following the stem adjacent to it on the right in the PMs generated by the phrase structure rules. We shall see below that there are situations where an affix does not have a stem immediately to the right, creating a situation to which the Affix-reordering rule does not apply. In these situations, which correspond to common syntactic structures in English, the affix is not reordered with respect to a stem generated by phrase structure rules; instead, a *do* is inserted in front of the affix, corresponding to the actual occurrences of *do* in English sentences.

We are now in a position to discern two levels of syntactic analysis: one level is attained when the phrase structure rules have operated, yielding structures such as in Diagram II-1—this level is called that of Deep Structure; the other level—that of Surface Structure—is attained when the transformational rules

have operated on Deep Structures, yielding Derived Phrase Markers.

Passives. The distinction between Deep Structure and Surface Structure can be further illustrated by an analysis of the passive form of six of the seven sentences given previously:

(8) John was examined by the doctor.
(9) John has been examined by the doctor.
(10) John is being examined by the doctor.
(11) John had been examined by the doctor.
(12) John has been being examined by the doctor.
(13) John had been being examined by the doctor.

Let us first note that, in an important sense, each of the above six sentences has two subjects. Superficially, *John* is the subject of each of these sentences; at a deeper level of analysis, however, *John* is the object of the verb phrase, and *the doctor* is the subject of the sentence. This view is supported on syntactic grounds as well as semantic. One syntactic consideration is the following: Some transitive verbs, such as *amaze,* require an animate object noun phrase (if the object noun phrase is present at all). Thus, sentences such as the following are ruled out on syntactic grounds:

(14)⊕ The doctor amazed the lamp.

Now, in all such cases as this, where the active sentence is ungrammatical, the passive is likewise ungrammatical:

(15) ⊕ The lamp was amazed by the doctor.

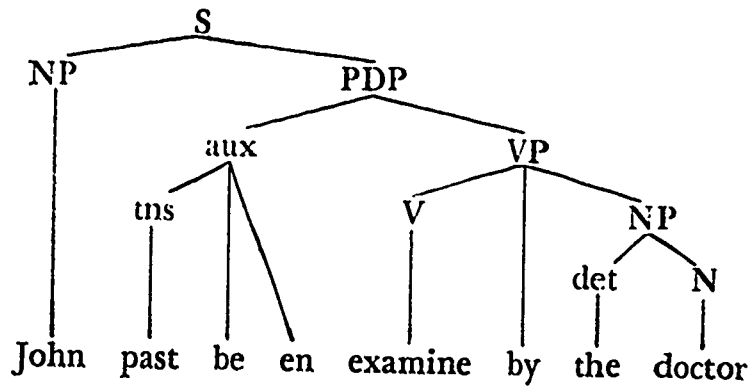
We might say that the same co-occurrence restrictions obtain between the surface object and the main verb of active sentences as obtains between the surface subject and main verb of passive sentences. At the level of Deep Structure, where the surface subject of the passive sentence is analyzed as the object of the verb phrase, all we need state are the restrictions on the choice of object of the main verb.

We are led, then, to seek a rule which may optionally be allowed to operate on structures such as those in Diagram II-1

and yield structures essentially like those of sentences (8)-(13). In order to see precisely what such a rule—which will have to be a T-rule since it operates on whole PMs—must do, observe that if the Affix-reordering rule given above applies to structures like those given below, exactly the correct results are achieved:

Diagram II-2

8.



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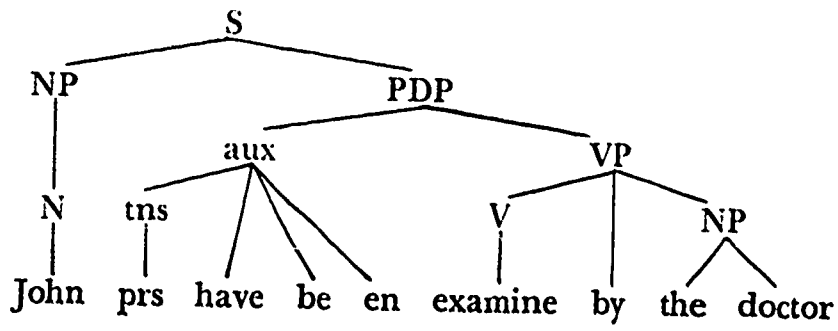

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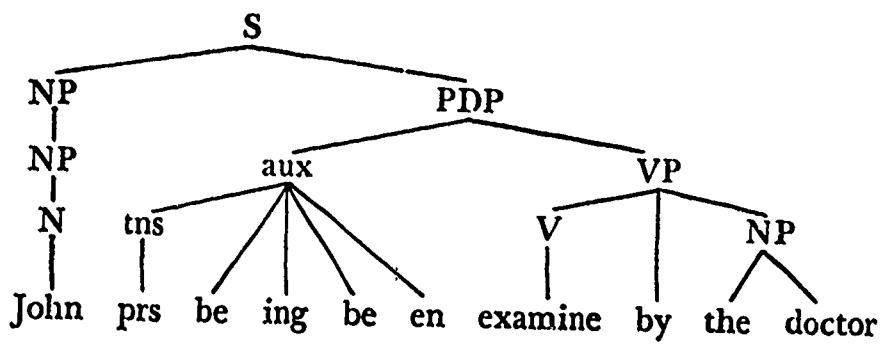
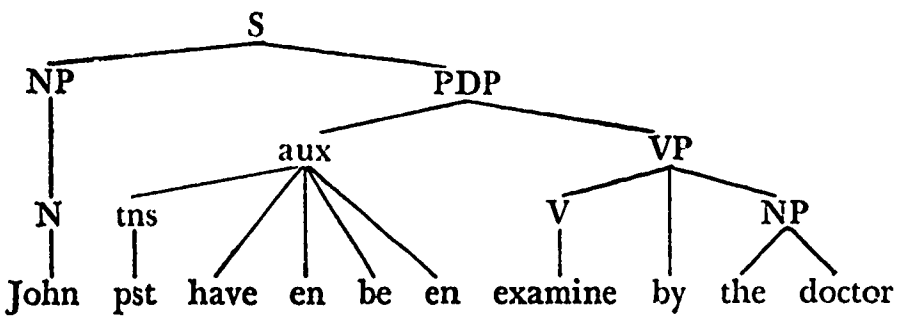
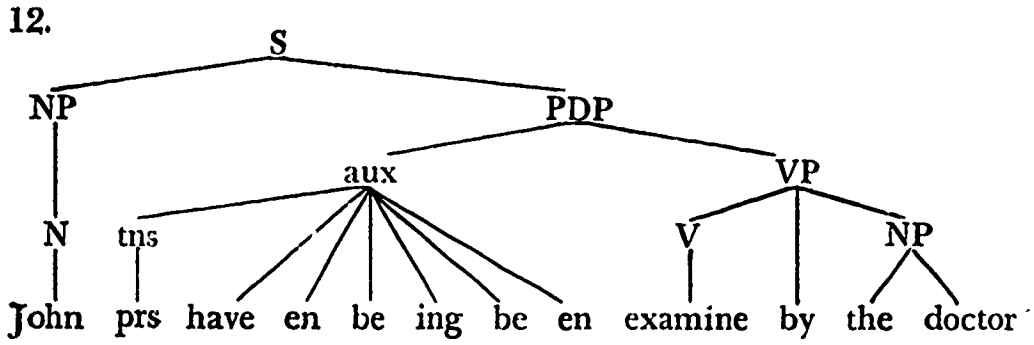


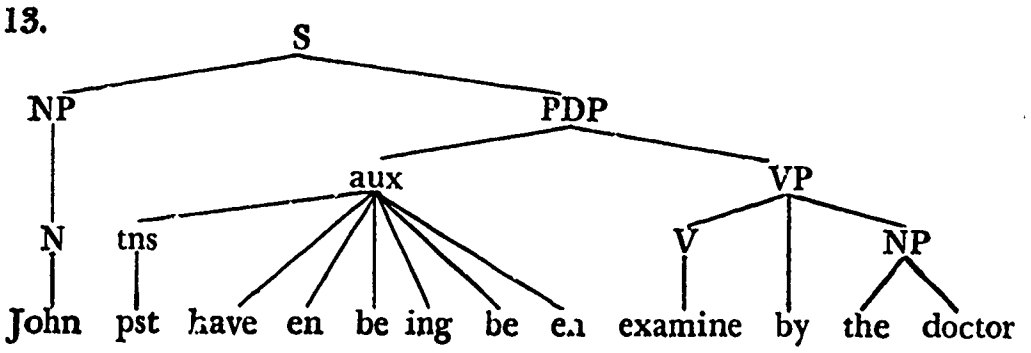
11.



12.



13.



Now, observe that the above structures can be derived from those in Diagram II-1 if we have a transformational rule which is optionally applied and which does the following:

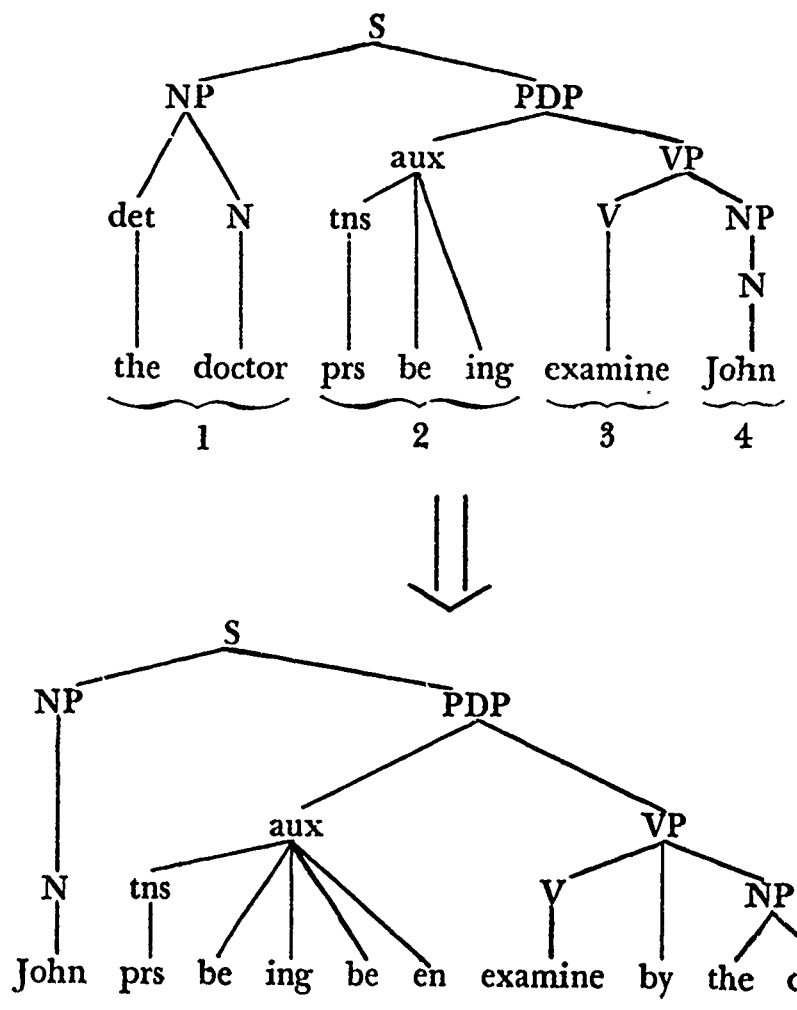
a) Moves the object noun phrase to the beginning of the sentence;
b) Moves the subject noun phrase to the position following the main verb and inserts *by* in front of it;
c) Inserts *be* + *en* immediately after the auxiliary.

Notice that if this rule applies before the Auxiliary reordering rule, just the desired results are attained. This rule may be formulated as follows:

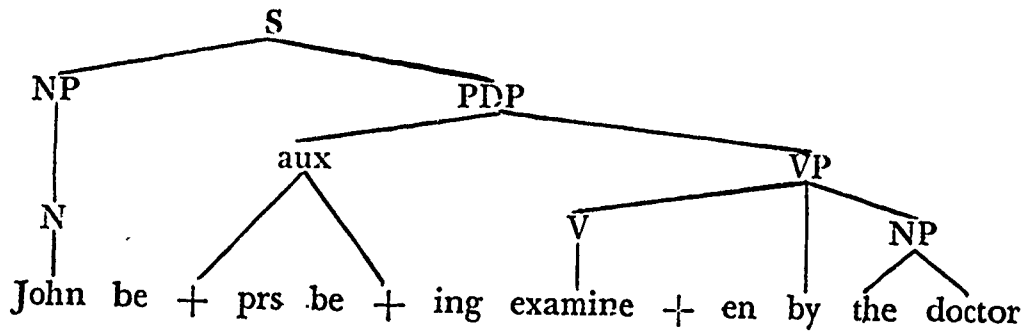
NP — Aux — V — NP
1 2 3 4 ⟹ 4 — 2 + be + en — 3 by + 1

That is, if the sentence is analyzed into four constituents as shown, they are reordered and new elements are inserted as shown by the rule. The following diagram (II-3) illustrates the application of this rule to the generation of (10).

Diagram II-3



The affix reordering transformation applies to this, yielding:



In order to cover passives in which the underlying subject is deleted (e.g., *John was examined.*) relatively minor modifications of the rule given above are necessary. Although this example is somewhat simplified, it does serve to exemplify the role played by transformational rules and by phrase structure rules; phrase structure rules generate deep structures, wherein grammatical relations such as subject of the sentence, object of the verb phrase, etc., are defined, and into which lexical items are inserted. The deep structures contain all the information necessary for a semantic interpretation; since, in this example, the deep structure underlying the active and the passive sentences are exactly the same, we are claiming that they do not differ in meaning, only in style.[5] Transformational rules operate on entire PMs, transposing some of their constituents, inserting or deleting other constituents.

Before summarizing the discussion of the structure of the syntactic component of the grammars of natural languages and turning to the survey of research in the child's acquisition of syntax, it is important for us to consider some more examples of syntactic constructions in English and how they are analyzed according to the transformational-generative theory of language. We present an analysis of simple negation and the formation of yes-no questions in the next few paragraphs. These constructions are focused on because several of the studies of language acquisition reported later in this chapter are centered on the child's learning of these syntactic devices.

Negative, declarative sentences. As examples of negation in

English, let us consider the negatives of some of the active sentences we have been considering:

(14) The doctor did not examine John.
(15) The doctor has not examined John.
(16) The doctor is not examining John.
(17) The doctor had not examined John.
(18) The doctor has not been examining John.
(19) The doctor had not been examining John.

Let us first take note of the way in which these sentences differ from their positive counterparts, (1) and (3)-(7): Sentence (14) contains an inflected form of the stem *do,* followed by the tense marker; *do* and the tense marker precede *not,* which in turn precedes the verb stem. In fact, in all of the sentences (14)-(19), the stem immediately preceding *not* always has the tense marker suffixed to it. If we examine what is always immediately to the right of *not,* we see that it is either *been* or the verb stem, where the latter sometimes has a suffix. If we suppose that the rule or rules governing the formation of English negative sentences precedes the auxiliary reordering rule, it turns out that the following structures will yield sentences (14)-(19) after application of the affix reordering rule:

(14a) The doctor *pst* not examine John.
(15a) The doctor *pres have* not *en* examine John.
(16a) The doctor *pres be* not *ing* examine John.
(17a) The doctor *pst have* not *en* examine John.
(18a) The doctor *pres have* not *en be ing* examine John.
(19a) The doctor *pst have* not *en be ing* examine John.

The hypothesis that the negation rules precede the Affix-reordering rule provides us with the insight that *not* always follows the second element of the auxiliary, if the auxiliary contains more than one element. If the auxiliary only contains the single element *tns,* then *not* follows the auxiliary.

How do we account for the occurrence of the form of *do,* to which the tense suffix is attached (yielding *did* in 14)? In proposing the Affix-reordering rule, we stated that the affix is transposed to the position following the next element, if that element is a verb stem, *be* or *have;* when the *not* follows a tense element

(as a result of the negation rule given below), the Affix-reordering rule does not apply and *tns* is left unattached to a stem. Therefore, we need a rule following the Affix-reordering rule which inserts the stem *do* into the position immediately preceding any unattached affix. As we shall see below, the *do* insertion rule is motivated by several syntactic constructions in addition to negation; support is thus given to this analysis, since a number of syntactic constructions which are superficially dissimilar rely on the same set of rules for their derivations.

Returning now to the formulation of the negation transformation, it should be mentioned that there are syntactically based arguments to the effect that the deep structure of negative sentences must contain a marker indicating that they are negative sentences (Katz and Postal, 1964; Klima, 1964). Obviously, however, phrase structure rules can not simply account for the proper placement of the negative element, since its position depends on what options are chosen in the expansion of *aux;* if *have* + *en* is chosen, *not* ends up between these two; if the latter is not chosen, and *be* + *ing* is chosen, *not* ends up between these two; if neither option is chosen, *not* ends up after (or at the end of) the entire auxiliary. This, then, is an example of a situation tailor-made for T-rules. If we modify our first phrase structure rule as follows:

(PS-1) S $\longrightarrow$ (not) NP + PDP

so that it contains a negative marker (not) optionally present at the beginning of the deep structure of every sentence, the needed transformational rule can be stated as follows:

$$\begin{array}{cccccc} \text{not} - \text{NP} - \text{tns} & \left(\left\{ \begin{array}{c} \text{have} \\ \text{be} \end{array} \right\} \right) & \text{X} \\ 1 \quad 2 \quad 3 & (4) & 5 \end{array} \Longrightarrow 2\ 3\ (4)\ 1\ 5.$$

The braces mean "any one of the enclosed elements may appear in this position." X means "any symbol or string of symbols." This rule has the following interpretation: Transpose the negative element to the position following *have* (when *have* appears in an environment within a structure as indicated in the rule

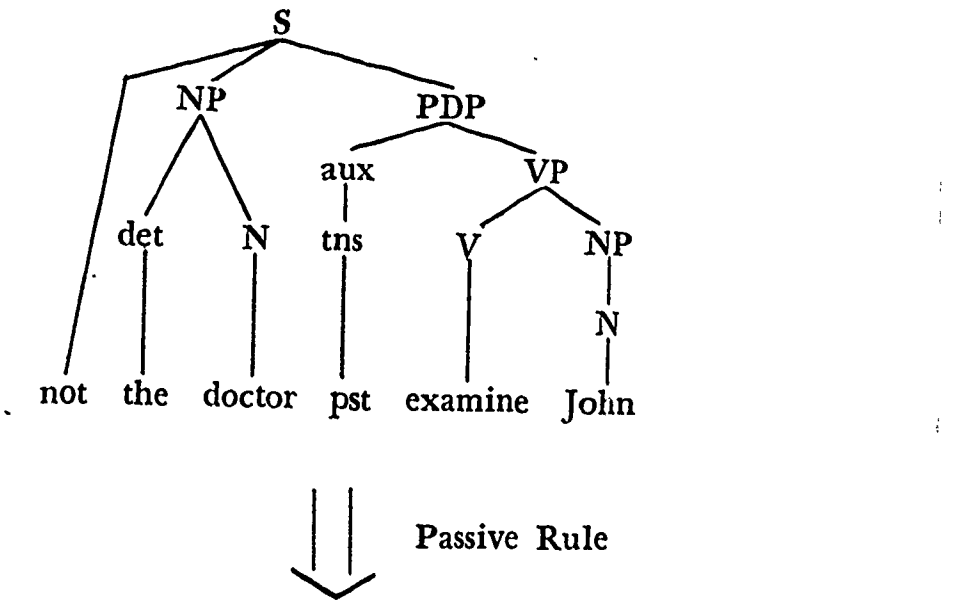
given above) or to the position following *be* (when *be* is the element immediately following *tns*). If neither *have* or *be* is present (i.e., if 4 is null), then place the negative element immediately after *tns*—the possibility of 4's being null is provided by the parentheses around the braces. If this rule is followed by the Affix-reordering rule modified as specified above and by the *do*-insertion rule given below, the sentences (14)-(19) can be generated by the deep structures which differ from those which underlie (1)-(7) only in that they have *not* preceded the rest of the sentence.

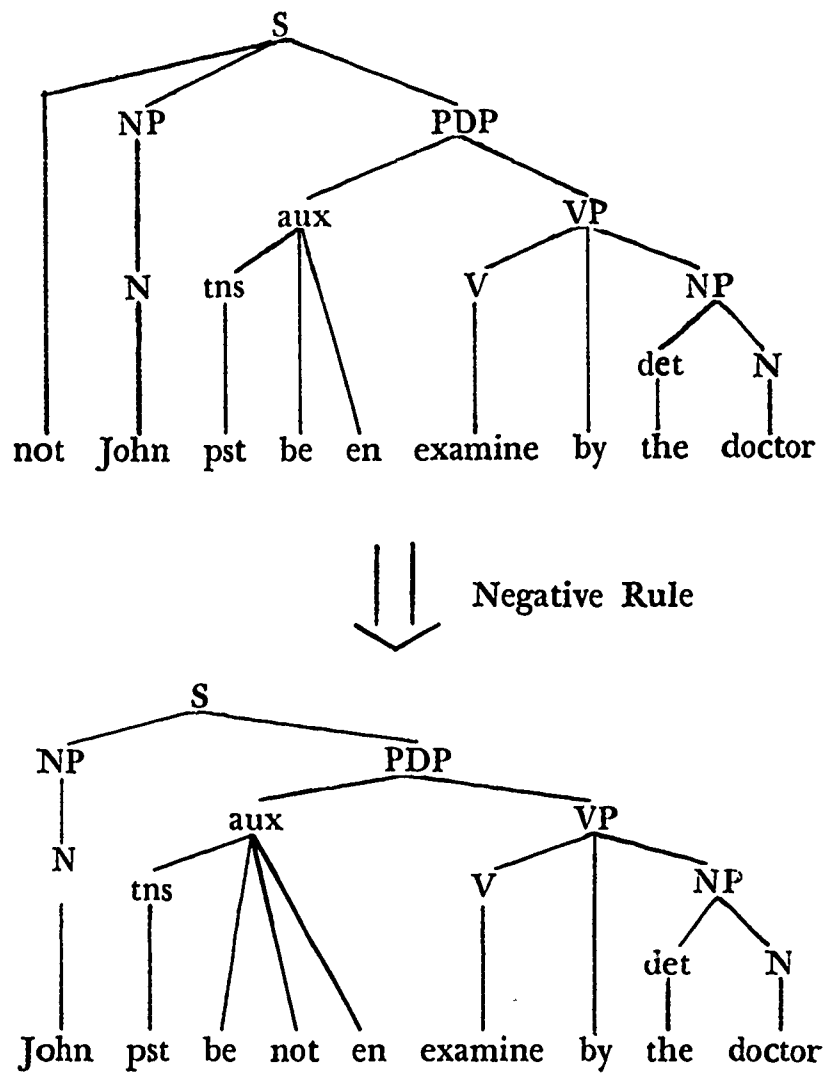
Let us now turn to an examination of the formation of negative passives—if the above analyses of passives and of negatives are correct, we would expect no additional rules to be necessary to generate negative passives. That is indeed the case—only a trivial adjustment of the passive rule is necessary. As an example, let us examine the passive conjoiner of (14):

(20) John was not examined by the doctor.

We assume, of course, that the deep structure of this sentence is precisely the one given immediately above; it differs from (14) only in that the passive rule was optionally chosen to apply. If we assume that the passive rule precedes the negative rule, we obtain the following derivation:

Diagram II-4





After the application of the Affix-reordering rule (the *do*-insertion rule does not apply), the correct sequence of elements appears. Phonological rules provide the correct "spelling" in terms of speech sounds.

Yes-No questions. As our final example of English syntax, we now turn to the formation of yes-no questions; we will first deal only with the following types of questions:

(21) Did the doctor examine John?
(22) Does the doctor examine John?
(23) Has the doctor examined John?
(24) Is the doctor examining John?

(25) Had the doctor examined John?
(26) Has the doctor been examining John?
(27) Had the doctor been examining John?

These are the question forms most similar to sentences (1)-(7). As a summary to this section, we provide derivations of several sentences which represent combinations of negatives, passives and questions. Sentences illustrating these combinations of rules are particularly important prerequisites to a full appreciation of some of the studies of language acquisition in young children reported in the second section of this chapter because the way in which the child learns to combine different syntactic rules in the production of sentences yields important insights into how children learn language.

Notice that there is a striking parallelism between the questions and the negatives: sentences (21) and (22) are the only ones which have a form of *do* among the questions, and sentence (14) was the only such among the negatives. In fact, just those elements of the auxiliary which precede *not* among the negatives are those which are transposed to the beginning of sentences in the formation of yes-no questions. This suggests that the question transformation rule is similar to the negative transformational rule in that it imposes the same organization on the auxiliary. For reasons not specified here, it is necessary to indicate the question status of sentences at the level of deep structure, as was the case for negatives. Since these reasons are purely syntactic, we have some independent justification for the idea that deep structures contain all the necessary information for semantic interpretation. The question transformation is roughly as follows:

$$\begin{array}{cccccc} Q - NP - tns - \left(\left\{\begin{array}{c} have \\ be \end{array}\right\}\right) & & & & X & \\ 1 \quad 2 \quad 3 & & & (4) & 5 & \Longrightarrow \emptyset\ 3\ (4)\ 2\ 5, \end{array}$$

where $\emptyset$ indicates that the first constituent, Q (the question marker which must be generated by a phrase structure rule in a manner similar to the generation of *not* in PS-1) has been deleted, and X stands for any arbitrary sequence of symbols. This

rule must be followed by the Affix-reordering rule, which in turn is followed by the *do*-insertion rule, accounting for *did* in both (14) and (21).

Let us now turn to the problem of ordering the negative, the passive and the question transformations with respect to each other.

If we first consider negative questions such as (28) and (29), we see that the negative rule should precede the question rule. This is so because there must be an optional rule which abbreviates the *not* and attaches it to the preceding stem; the question rule which moves the *have* to the front of the sentence in the examples below also moves suffixes to the *have* stem. Therefore, the *n't* must have already been suffixed to *have* by a rule which follows the negative rule. Clearly, then, the question rule follows the negation rule.

(28) Has the doctor not examined John?

(29) Hasn't the doctor examined John?

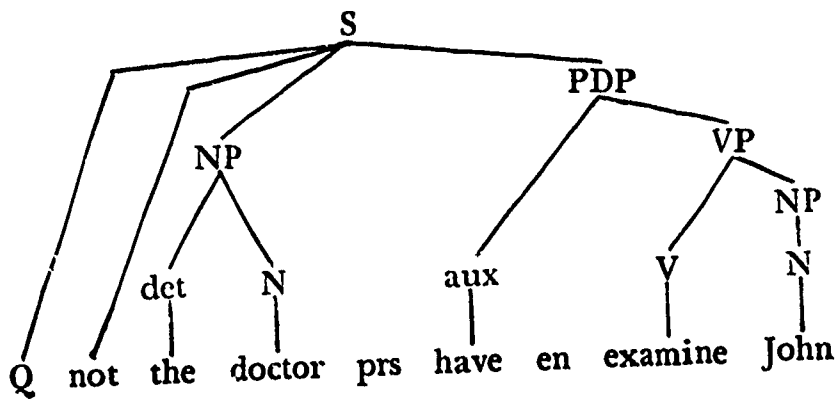
Consider the following example:

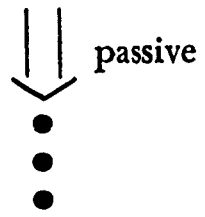
(30) Has John not been examined by the doctor?

We have already established the following order among the transformational rules:

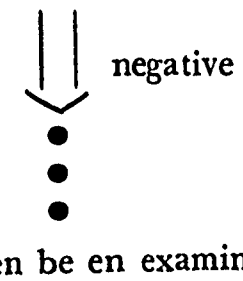
(i) Passive;
(ii) Negation;
(iii) Question;
(iv) Affix-reordering;
(v) Do-insertion.

To summarize the discussion we present the derivation of (30) through all of these rules:





Q not John prs have en be en examine by the doctor



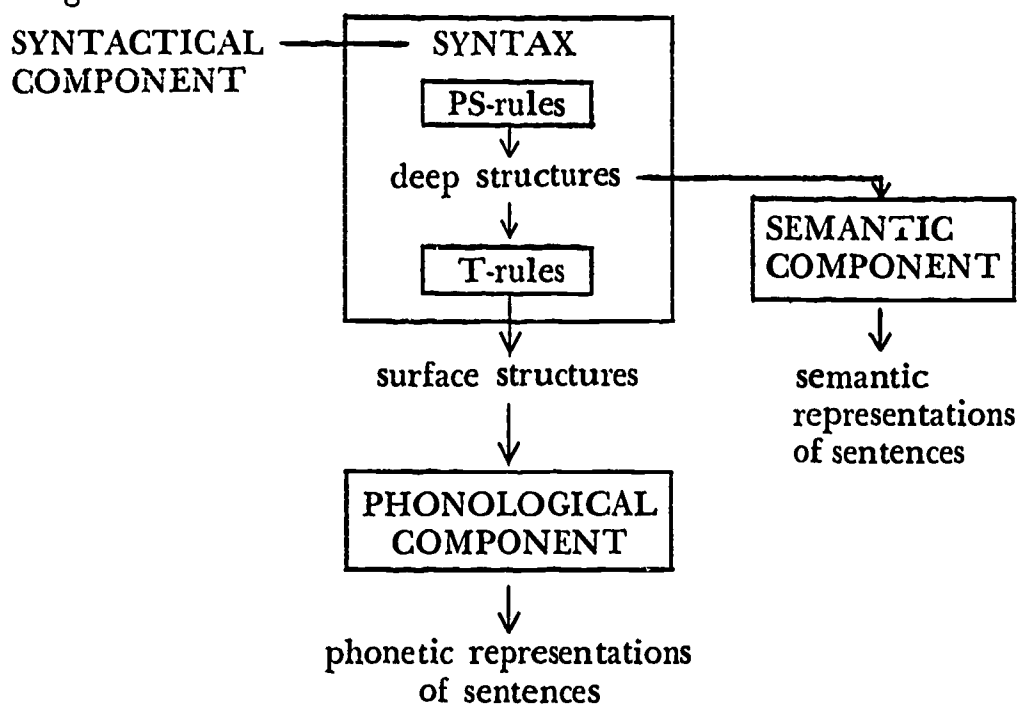
Q John prs have not en be en examine by the doctor

The organization of a generative grammar. It was stated above that a grammar is supposed to produce all and only the sentences of a language and a syntactic structure for each; we also require that a grammar provide a phonetic and a semantic characterization of each sentence. Thus, a generative grammar is composed of the following three components: syntactic, semantic and phonological. The syntactic component is considered the only component capable of generation; the other two components are merely interpretive. The semantic component receives the syntactic "deep structure" of a sentence and operates on it to provide a semantic reading (or set of readings if the sentence is semantically ambiguous) for the sentence in question. The phonological component, which is the best understood aspect of grammar, receives the "surface syntactic structure" of each sentence and operates on it to provide a detailed phonetic transcription of each sentence. We may think of this phonetic interpretation as the set of instructions to the articulatory organs appropriate to the production of the sentence in question.

See Diagram II-5.

With this tripartite conception a grammar can be thought of as defining a matching of phonetic, syntactic and semantic structures. Diagram II-5 represents a heuristic portrayal of the organization of a generative grammar. The syntactic component generates a deep structure and a surface structure for each sen-

Diagram II-5



tence of the language. (We will see below what these structures are and why it is necessary to provide for them in the theory of grammar.) The semantic component receives the deep structure and maps it into a set of semantic symbols, representing the "meaning" of the sentence. The deep structure simultaneously is operated on by the set of transformational rules, a subcomponent of the syntactic component; these rules map the deep structure into a surface structure. The surface structure representation of a sentence, which is roughly similar to the diagrams we drew when learning to parse sentences in high school, is mapped by the phonological component into a detailed phonetic transcription of a sentence.

The reader may well wonder how all this abstract organization can be justified. There is obviously no way of justifying the theory of grammar by direct observation. There are, however, several striking observations which give strong support to this theory. As far as the syntax itself is concerned, we have shown in this section that the distinction between deep and surface structure is motivated on purely syntactic grounds; furthermore, the examination of the grammatical relations among several sen-

tences and among parts of sentences of English (and other languages) gives rise to this conception of syntax.

But why do we conceive of the deep structure as the input to the semantic component? There are a number of purely syntactic considerations (Chomsky, 1965; Katz and Postal, 1964) which indicate that transformational rules do not add meaning to deep structures. Furthermore, deep structures contain an explicit representation of such syntactic relations as *subject of the sentence, object of the verb phrase,* etc., which are necessary for a semantic interpretation but which are distorted by transformational rules.

Turning now to the justification of the role of the phonological component, there is no evidence that deep structural factors are necessary for deriving a phonetic representation of a sentence; a great deal of research into the structure of phonology has, however, yielded much evidence that the information contained in the surface structure is necessary for the operation of the phonological component. The nature of the phonological component will be sketched in the next chapter, where research into the acquisition of phonology is surveyed.

It is evident that the syntactic component is central to the entire grammar. It is the syntactic component which possesses recursive properties; that is, the syntactic component is properly generative in that it defines (recursively) an infinite set of objects —all and only the sentences of natural languages and their structural descriptions. The other two components are interpretative.

Section 2. Acquisition of Syntax

Recent investigations into the child's acquisition of syntax are surveyed in this section. This survey is organized according to the sequence of empirically observed stages. The literature reveals that there are at least seven stages which are useful to keep distinct from each other. We will commence with a brief description of each of these stages. Finally, this chapter concludes with a discussion of the theoretical conclusions based on the material surveyed.

Seven developmental stages. The stages described here do not correspond exactly to the stages described by any one of the researchers whose work is surveyed; in fact, most of the investigators report only on fractions of the language acquisition process and do not usually present their results in relation to the entire process. The stages we discern are, then, abstracted from a number of independent studies. (McNeill, 1966; Klima and Bellugi, 1966; Brown and Hanlon, 1968).

The first stage *(Stage I)* is frequently referred to as that of holophrastic expression. Its most usual time period is from age 12 months to anywhere between 18 and 24 months. This period is characterized by one-word utterances which carry (for the child) the entire message to be communicated. Thus, each word —standing for a sentence—has a much broader and diffuse meaning for the child than it does for the adult; it follows, of course, that each word in the child's lexicon is highly ambiguous and can be disambiguated only by the situational context of the utterance. For example, a child might utter the word "Mommy" on a number of occasions; sometimes he might mean "Mommy, come here," at other times "Mommy, pick me up," and at others "Mommy, give that to me," and so on. During the holophrastic period, then, the child does not have any rules for joining words into sentences which have a meaning depending both on the meanings of the words contained and on the syntactic structure of the sentence. Instead, the child seems to be approaching language as a purely lexical problem; in short, the child is attempting to construct what amounts to a sentence dictionary. By the time he abandons this project and moves on to the second stage, he usually acquires about 200 words. The problem, of course, is that each of these 200 or so words does not have a precise meaning, but rather a long list of possible interpretations, each associated with a highly specific situational context. In order to reduce the load of semantic features associated with each word and to lend greater precision to linguistic communication, the child has to learn syntactic rules for construction of sentences whose meanings can be automatically derived from their structure and lexical content.

The second stage of language development *(Stage II)* is characterized by the presence of rudimentary syntactic rules. The child's lexicon seems to be roughly divided into two classes, the pivot and the open classes, according to recent terminology. Sentences consist of any one of the relatively few members of the pivot class followed or preceded by one or more members of the larger open class, which contain the vast majority of lexical entries (all nouns are open class members). The average utterance length is about 1.75 words/utterance. This period is relatively short, occurring at about 24 months of age. The child can form negatives by merely preposing a negative element (usually *not* for English-speaking children) to an otherwise unchanged positive declarative sentence. Questions are formed from declaratives by means only of rising intonation at the end of the utterance. As we shall see in greater detail, there is good syntactic evidence for interpreting the child's utterances at this and some later stages as an example of what in adult language is called "topic-comment" construction. An example of topic-comment construction in adult English is: "The wagon, I saw it in the yard." Other languages use this type of construction much more freely than does English. The significance of this observation regarding child language, and the evidence in support of this analysis will be discussed below.

The third developmental period of interest here *(Stage III)* occurs on the average at about 27 months. At this stage, the child's utterance length has increased to about 2.31 words per utterance. The pivot class mentioned in the preivous paragraph shows signs of differentiation. Negative sentences are produced by means of the words 'can't' and 'don't'; however, it is believed that these words are not interpreted by the child as a combination of 'not' with the respective forms 'can' and 'do' because the child does not typically produce the forms 'can' and 'do' until a later stage. Similarly, the child has learned to produce negative questions with the unanalyzed phrase 'why not' preposed to a negative sentence; this combination, of course, produces double negatives like "Why not cracker can't talk?" Also, the child produces negative imperatives by means of 'don't'.

The fourth period *(Stage IV)* is similar to the third, except that the pivot class shows signs of further differentiation. Also, the child now produces 'can' and 'do' independently of the negative, suggesting that the child's continued production of negatives of 'can't' in negative questions now reflects his acquisition of a grammatical rule joining 'not' and 'can.' This period occurs usually at about the age of 30 months.

Stage V, characteristically appearing at about three years of age, shows the child's development of a more complicated set of transformational rules—the previous four periods are, in the view of at least one investigator (McNeill, 1966), characterized by the operation *only* of phrase structure rules; that is, the child is believed to simply pronounce simple base structures without subjecting them first to transformational rules. The child no longer produces double negatives (although these reappear at the next stage!). Indefinite articles appear with negatives, and the child produces forms such as "I don't want some milk." That is, the child does not observe the rule which specifies that the indefinite article in negative sentences must be 'any' instead of 'some.' The auxiliary phrase shows much more development in this stage.

The sixth period *(Stage VI)* shows more development of transformational rules; the child produces negative articles in noun phrases in negative sentences, and has learned the essentials of the transformational rules described in the introduction to this chapter. He has not learned, however, to produce all combinations of them. An interesting aspect of his negative sentences at this point (at about three and a half years of age) is his production of double negatives due to the presence of a negative article in negative sentences. Thus, the child is apt to say such sentences as "I can't do nothing with no string." In the previous stage, when the child had not learned that there are special pronouns and articles which occur in negative sentences, he would probably have said, instead, "I can't do something with some string." He has now learned these special negative forms, but has still to learn to further differentiate them into those which do occur with a negative in the auxiliary ('anything' and 'any') and those

which do not ('nothing' and 'no')—something which many children never learn. Notice that these double negatives have a different basis from those of Stage III, which were the result of preposing 'not' to negative statements.

The final developmental period of interest, *Stage VII, is* characterized by the child's ability to combine transformations in the production of negative questions, truncated questions, negatives, and truncated negative questions (these terms will be defined below). This period occurs at about the age of four years, when the child has acquired virtually all of the essential aspects of the syntax of his language.

Stage I: The holophrastic period. It was stated before that children's earliest language may be characterized as a list of words, each of which "stands for" a complete sentence. Very little systematic knowledge is available concerning this stage. Most studies have concentrated on semantic characteristics of this period. In any case, this period does not seem to promise results from a syntactic study.

We may ask, however, why a child ever gives up his task of learning language by means of a holophrastic grammar. What compels the child to develop a highly complex set of rules for representing his knowledge of his language, when he has been getting along pretty well with a simple list of lexical items, each item with a rather broad set of semantic features? One motive that comes to mind immediately is that such a grammar does not provide any means for rendering more precise messages. In order to produce unambiguous messages, the child needs some regular means for joining his words together into sentences, where each sentence is syntactically structured in a way which assures relatively unambiguous interpretation.

The above is certainly one reason why the child needs to complicate his grammar beyond a simple list structure. Another probable cause was alluded to in the introductory discussion: that is, if the child continues to increase his lexical list, then not only must he increase its size each time a new word is learned, but he must also increase its size every time a new use of a familiar word is learned. If each word in the child's grammar is

coupled with an exhaustive list of the meanings of each sentence in which it is observed to occur, it follows, then, that the child must seek a more economical representation of his vocabulary. The only way he can do this is to abandon his holophrastic grammar in favor of a cognitively complex set of syntactic rules for combining lexical entries into novel constructions.

Stage II: Early open-pivot constructions. Somewhere between the ages of eighteen and twenty-four months, children begin to produce patterned speech which reflects the presence of syntactic rules. This speech has frequently been described as "telegraphic speech." That is, the child produces sentences which appear to be reduced versions of adult speech, with grammatical markers, articles, auxiliaries and other more or less predictable items deleted. Below is a sample of such sentences, reproduced from McNeill (1966):

two boot
a gas here
hear tractor
see truck Mommy
there go one
put truck window
Adam make tower

It is tempting to explain the child's speech as an attempt to reproduce adult speech, except that redundant and frequently unstressed (hence, relatively inaudible) items are left out. This, however, would be misleading; the evidence shows that the child possesses a simple grammar, the output of which seems to resemble a telegraphic reduction of adult speech.

McNeill argues that the best analysis of the typical two-word utterance is in terms of the pivot-open structure. According to McNeill's analysis, the child's speech at this stage is made up of a word from the pivot class in juxtaposition with a word from the open class; alternatively, the child may construct a sentence with words from the open class alone. The child never, however, constructs sentences with nothing but pivot class words. This analysis is similar to and supported by the findings and analyses of Braine (1963) and Brown (1964).

The pivot class contains many fewer members than the open class; the majority of newly acquired vocabulary items, moreover, become members of the open class. It seems, then, that the pivot class is somewhat superficially similar to the grammatical function words of adult language. Although this may be true, it should be noted that, from the point of view of adult grammar, the members of the child's pivot class are quite heterogeneous: it may consist of some articles, some adjectives, etc. Prior to the process of differentiation, all members of the class have identical privileges of occurrence; that is, each member can appear in the same sentential position as any other member. Differentiation refers to the process of splitting the heterogeneous pivot and open class into progressively more distinct classes, each with separate privileges of occurrence within utterances. Each child may make a unique decision as to which category will be differentiated at various stages, but the process of differentiation seems to take place in a similar manner for all children.

McNeill argues that further development of the child's grammar can be characterized, in part, by differentiation of the open and pivot classes.

Stages III and IV: Differentiation of the pivot class. As stated previously, this stage is characterized, in part, by further differentiation of the pivot class. McNeill presents these data in terms of a set of rules which he ascribes to the child. We present his data, but we do not reproduce his rules, because there seems to be good reason to be suspicious of his interpretations; this will be discussed in the theoretical conclusions to this chapter.

The data seem to indicate that there are about five major milestones in the differentiation of the pivot class, which occurs across Stages III and IV. The first point in this process (at the end of Stage II) is characterized by sentences where the pivot typically consists of words of any of the following types:

(i) articles (a, the)
(ii) demonstratives (that, this)
(iii) adjectives (big, red, green . . .)
(iv) possessive pronouns (my, mine, your . . .)
(v) quantifiers (other, one, more, all . . .)

Any one of these may appear in position before members of the open class.

The second milestone is characterized by a separation of the articles and demonstratives into distinct classes, each with unique privileges of occurrence within utterances. Thus, at this stage, utterances typically consist of members of the open class preceded by from one to three pivot class members. The utterance may commence with any one, two, or with all of the following pivot class members, in the order indicated:

(ii)-(i)-(iii), (iv) or (v)—open class members. Thus, the child is likely to say something like *that a my car,* but not ⊕ *that my a car.* Similarly, *that a horsie* is likely to occur, but ⊕ *a that horsie* is ruled out.

The third milestone is characterized by the differentiation of the class of adjectives (iii) from the pivot class. Thus, adjectives can appear before or after nouns, whereas all other pivot class members must appear before nouns. Furthermore, the child now distinguishes possessive pronouns from the demonstratives and articles. At this stage, then, the child does not produce an article in the same phrase as a possessive pronoun (e.g., *a my cup* is no longer produced).

Stage V: Development of T-rules. The main characteristic of Stage V is the growth of transformational rules. It will be recalled from the previous section that an adequate description of the syntax of any language must include two types of rules: phrase structure rules (which generate the deep structures, represented by branching diagrams) and transformational rules (which operate on the deep structures and transform them ultimately into surface structure representations of sentences, derived constituent structures). Now, it seems that all of the utterances which are produced by children in Stages I-IV can be described by phrase structure rules. This observation has led McNeill (1966) to conjecture that children do not have any transformational rules until this stage and "speak in base." This theoretical question will be discussed more fully in the conclusion to this chapter; we are now concerned with the child's developing capacity to deal with sentences, the structure of which

necessitates positing transformational rules in the child's grammar.

Just prior to this period, the child produced negative declarative utterances simply by preposing 'not' to the declarative sentence, and producing the entire utterance with a single intonational contour; that is, with no intonational dip after the 'no.' Thus, Bellugi (1964) gives such examples as the following:

no wipe fingers
not fit
no singing song
no drop mitten

The fact that these are not 'telegraphic' versions of the adult analogue "no, I'm not wiping my fingers," of "no, I'm not singing a song" is indicated by the fact that children do not have the pause and intonational dip after the 'no' which is characteristic of the adult construction. It appears, then, that these constructions of the child are his own creation, and are not patterned directly on an adult model.

Furthermore, at the earlier, pretransformational stage, the child produces questions by simply superimposing a rising intonation onto a declarative construction. We are thus led to consider that negative and interrogative sentences consist of the appropriate positive, declarative sentence with a single *Neg* (negative marker) or *Int* (interrogative marker) affixed to the entire sentence. The crucial point here is that there is no reason to impute transformational rules to the child at this stage. The reader will recall that, in order to characterize negative and interrogative sentences in adult English it is necessary to use transformational rules which analyze the auxiliary, as well as other constituents. Furthermore, the deep structures which underlie the negatives and interrogatives are differentiated from the analogous positive, declarative sentences only by the presence of a sentence-initial *Neg* or *Int* morpheme. It is striking that the child's productions are so similar to the deep structures of adult English.

A further aspect of negative and interrogative sentences men-

tioned above is the analysis of the auxiliary. It is unlikely, if our syntactic analysis is correct, that the child would produce negatives and interrogatives like adult versions if they had not yet developed the necessary machinery for producing an analyzable auxiliary. One would further expect that the capacity to produce and analyze a complicated auxiliary is a necessary prior condition for producing adult versions of negatives and interrogatives. Indeed, at this stage the child does not have free use of auxiliaries such as modals.

Before the child develops the transformations, he typically will produce sentences with such contracted negatives as 'can't' and 'don't.' However, since the child does not have 'can' and 'do' there is good reason to believe that these forms are not analyzed by the child and functions as a variety of negative marker. Thus, after the child has mastered negatives such as those described above, he may begin to produce sentences such as the following examples presented by Bellugi (1965):

I can't see you.
I don't sit on Cromer coffee.
Why not cracker can't talk?
Why not you looking right place?

In order to explain the first two examples, we are forced to say that the child produces 'can't' or 'don't' as unanalyzed negative markers, but that they occur in a different place within the sentence from that of the original *Neg*. Whether it gets moved around by a transformational rule, or whether the child produces it by means of a more complicated set of phrase structure rules is not the essential point; from his failure to produce declarative affirmatives with 'can' and 'do' we know that the child does not produce them as adults do, because he does not have the auxiliary to analyze.

Notice that the last two examples illustrate the appearance of double negatives. McNeill argues cogently, on essentially the same grounds that were presented for the analysis of 'can't' and 'don't', that 'why not' also functions as an unanalyzed unit, indicating negative questions. In the case of the third example

above, 'why not' was prefixed to a negative sentence containing 'can't', whereas in the last example it is prefixed to a sentence consisting simply of a positive declarative sentence.

Shortly after the period described above—at the beginning of our Stage V—Bellugi's subjects began to produce sentences such as the following:

No, it isn't.
No, I don't have a book.
I can't see it.
I don't want cover on it.
That not a clown.
I am not a doctor.
I not crying.
That not turning.
Why I didn't see something?
Why he didn't know how to pretend?
You don't want some supper?
I didn't see something.
Don't touch the fish.
Don't put the two wings on.

In addition to the preceding types of negatives, the child now produces sentences with a modal in positive, declaratives: e.g., "I can do it." Thus, we are led to assert that the child has developed an analyzable auxiliary, and the above negatives and negative questions are produced by means of a transformation essentially similar to that which we described for adult English. Consider, for example, the two negative questions. They do not contain double negatives, as in the period immediately preceding them, and the *why* and the *not* are separated, as we would predict if the child had a negative transformation which moved the *Neg* to the second position of the auxiliary, to be followed by the 'do-insertion' transformation. Thus, double negatives which arose from the child's failure to analyze the auxiliary and thus his failure to develop a negative transformation, have now disappeared from the child's production.

Stage VI: Development of pronouns. Notice that in the last set of examples there are occurrences of negative sentences with

indeterminate pronouns *(some, something)*. Klima (1964) has shown that the appearance of indeterminate pronouns, the indefinite pronouns *(any, anything)*, and the negative indeterminate pronouns *(no, nothing)* are governed by transformational rules which depend on negation. Sentences such as the following illustrate the operation of these rules in adult English:

I want some milk.
I don't want any milk.
I want no milk.

All three are grammatically acceptable sentences in adult English, although the last is stylistically odd. An indeterminate pronoun is automatically converted into an indefinite pronoun in a negative sentence (with certain restrictions discussed by Klima). This indefinite pronoun can optionally incorporate the *Neg*, yielding the last example sentence. Although we will not attempt to justify this analysis of pronouns in adult English, the generation of the last sentence proceeds something like this:

Neg — I — aux — want — some — milk
Neg — I — aux — want — any — milk
I — aux — want — *Neg* + any — milk

Neg + any will be converted by phonological rules into *no*. This derivation differs from the derivation of the second example by one rule; instead of a rule which incorporates the *Neg* into the pronoun, the *Neg* is transposed into the *aux*, providing the environment for the operation of the *do*-insertion rule illustrated in the first section of this chapter.

It is evident, then, that children who produce sentences such as *I don't want some milk* have not yet developed either of the two rules illustrated in the derivation above. If we were to expect that the order of the child's acquisition were to follow the order in which rules apply in adult English, we would expect that the first step on the way to developing these rules would be characterized by the presence of sentences such as *I don't want any milk*, to be followed by the optional *I want no milk*. This, however, is not the case; children characteristically produce such sentences as *I don't want no milk* before they master the correct adult forms. The developments of such negative sen-

tences characterize the beginning of our Stage VI; in Stage V we witnessed the development of transformational rules which required analyzing the auxiliary and rearranging elements of the deep structure. What is involved here is essentially agreement or dependence. The child shows evidence of attempting to capture the dependence of the pronominal features on the presence of the *Neg* in the same sentence (i.e., the fact that the *Neg* in the sentence governs the indefiniteness of the pronominal). In attempting to do this, however, the child produces agreement instead; that is, instead of having the *Neg* govern indefiniteness in the pronoun, the child has the *Neg* govern the appearance of a feature of negation in the pronoun. Perhaps one might speculate from this that agreement is cognitively simpler than government; whether or not that is the correct interpretation, it is nevertheless clear that the child does not go about developing transformations in the order in which they are going to end up ordered when he grows to adulthood. To the contrary, the child develops a set of rules, which he then must change here and there in order to approximate more closely adult English.

Stage VII: Rule combinations. In the first six periods we witnessed first a development of a classificatory system of basic elements (the pivot and open classes, and differentiations within the pivot class) and the development of rudimentary transformations of a variety of sorts. Stage VII is characterized by the child's development of the capacity to combine various transformations to produce such sentences as negative questions.

In a recent monograph, Brown and Hanlon (1968) studied the order in which three children acquired simple active affirmative declarative (SAAD) sentences, negatives, questions, truncated statements (e.g., *we did*), negative questions, truncated negatives (e.g., *we didn't*), truncated questions (e.g., *did we?*) and negative truncated questions (e.g., *didn't we?*). Although we have not described the generation of truncated sentences, the reader should know that the transformation for producing truncated sentences requires essentially the same organization of the auxiliary phrase as does the negative and question transforma-

tions. Thus, we would expect that simple truncation, question formation and negation would all commence at approximately the same time. This expectation is borne out by their investigations.

Brown and Hanlon establish a hierarchy of derivational complexity. They say that if two sentences differ only in that one is produced by all the rules of the other *plus* one or more rules, then the sentence with the greater number of rules is the more complex. Notice that this is different from establishing derivational complexity only on the number of rules involved in their derivation; it states that the derivations of the two sentences are identical, except that the more complex sentence involves some rule(s) which the less complex one does not. On this basis, negative questions are more complex than either negatives or questions; negative truncations are more complex than either negatives or simple truncations; truncated questions are more complex than simple truncations or questions; truncated negative questions are more complex than any of the other constructions; and SAAD sentences are the least complex of all. Their studies affirm that the order of the child's capacity to produce these constructions is essentially the same as th der of derivational complexity.

Thus, we see that Stage VII is characterized not so much by the development of new transformations, but primarily by the child's ability to combine previously acquired transformational rules in the production of syntactically more complex sentences.

In sketching these seven stages, we have surveyed the development of the child's syntax from approximately 12 months of age to about four years. At the age of four, the child has acquired a rich set of phrase structure rules and transformational rules, which he can use in a variety of combinations. He has, in fact, acquired all of the basic machinery of syntax, and needs only to perfect details of agreement, government, and the like. Little is known about these further developments, except that they are usually rather long-lived and present little of interest as far as an understanding of language acquisition is concerned.

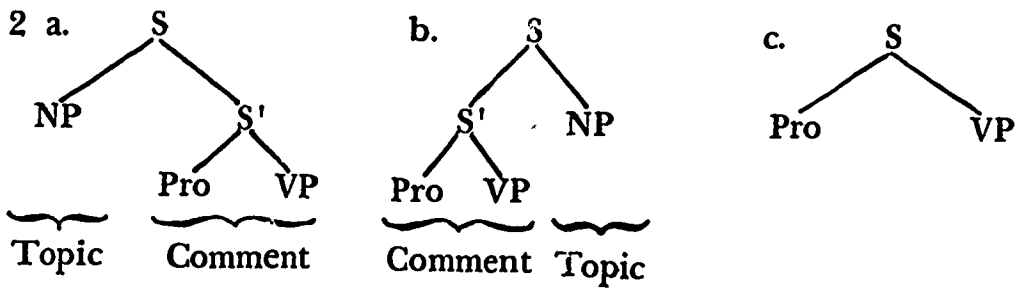
Section 3. Summary and Conclusions

A basic assumption shared by students of language acquisition is that the linguistic universals discovered by theoretical linguists are a direct result of genetic factors which are unique to humans. What is meant by 'a direct result' is subject to a great deal of question at this point in child language research. Some scholars feel, rather pragmatically, that linguistic universals can be regarded as 'given' or 'innate', as a starting point for a theory of language acquisition. Another point of view is that linguistic universals are the product of a universal set of strategies used by children and that the manner in which a child goes about developing linguistic universals is a promising field of study in and of itself. Such a study should give us insight into the developing cognitive processes of the human organism, just as a study of linguistic universals should give us insight into the mature cognitive processes of adult language users.

The asumption that certain commonalities exist among the grammars internalized by all humans does not lead us ineluctably to the assumption that every human child arrives with these commonalities 'wired in.' It is just as reasonable, *a priori,* to assume that there are certain cognitive processes which are common to children and which insure that each child will eventually develop an internalized grammar which embodies all linguistic universals. Good candidates for such cognitive determinants are, among others, modes of perception; strategies for hypothesis formation and testing; and the ability to selectively attend relevant portions of the linguistic environment. Following Fodor (1966) we shall refer to these two assumptions as innate vs. intrinsic, the former referring to the concept of the 'wired in' universal, the latter to the concept of the deterministically developed universal.

We have reserved until this section discussion of the research carried out by Jeffrey S. Gruber because his study provides a theoretical basis for drawing conclusions from the material presented in the preceding section. Gruber (1967) has studied a period roughly analagous to our Stage IV, just following Mc-

Neill's stage of complete differentiation of the pivot class. He analyzes child speech in terms of topic-comment constructs, such as 2 a. and 2 b. below, as well as the traditional NP-VP (in this case Pro-VP) of 2 c. The latter can appear either independently or as an expansion of S'.



A number of elements, such as nouns and case-marked pronouns (e.g., *him, her*), can appear as the topic NP, while the *Pro* of the embedded comment S' and of 2 c. is restricted to unmarked pronouns (e.g., *he, she, it,* and also probably *there* and *that*). It is the child's topic NP which is the precursor of the adult's subject NP. The *Pro* of S' is regarded as a kind of inflection of the Verb in the comment S' and drops out at later stages (which will be discussed below) to yield the adult NP-VP (subject-predicate) trees.

While, as Gruber points out, McNeill's theory that children at this stage possess only phrase structure rules can account (at least superficially) for the same sets of strings as Gruber's rules, there are several important differences in the two analyses. In the first place, McNeill assumes the existence of a universal base, as well as the innateness of grammatical relations. Therefore, he must beg the question concerning word order in such a universal base. What he actually does is assume English word order in the base. There is no way to get sentences with the 'subject' NP appearing to the right of the PDP. Gruber points out that there is very nearly equal distribution of the NP before and after the PDP (or VP). This is because the NP is not yet a subject, but a topic, which can appear before or after a comment S'. Another important difference between the two analyses is the role played by the unmarked pronouns, which alone can serve as 'subjects' of comment S'. Gruber can thus explain the occur-

rence of the following two paradoxical question constructions:

3 a. Where went the wheel?
b. Where it went?

3-a. is formed from a topic-comment construction, with "where went" comprising the comment S' and "the wheel" as topic NP. That is, the *Int* element, which generates 'where,' is in the comment S'. Note that 'it' could never appear in such a construction because 'it' could never appear as a topic NP, so the non-occurrence of "Where went it?" is explained by the grammar. There is only one, ordinary S element in 3-b., which carries *Int* and has 'it' as Pro and 'went' as VP. The analysis makes the interesting prediction that the also non-occurring "The wheel where went?" is grammatical at this period and could be expected to appear in a larger corpus. Notice that the *Int* marker is incorporated into an S, either S or S', and no transformation is postulated (such as an inversion transformation in adult grammar) to obtain the output.

We now consider the form of the transformational rules necessary for a description of the child's grammar at this point. In order to approach this question, we first ask: Into what 'chunks' must the transformational rules analyze the deep structures? In Gruber's analysis the child's transformational rules do not analyze strings below the level of S. That is, the rules can apply to an entire S or to a comment S', in which case (and only in that case) it separates the comment from the topic NP. McNeill's analysis is unable to give any principled reason to exclude "Where went it?" while producing "Where went the wheel?" because there is no distinction made between the behavior of pronouns and nouns in his analysis.

Gruber's analysis makes the appearance of the copula (which is introduced transformationally) dependent upon the existence of an unmarked pronoun. Therefore, the analysis makes the very strong empirical claim that nouns (which only appear as topics) will never appear with a copula during (or prior to) the period discussed by Gruber. It follows that nouns will only appear in copular constructions after the topic-comment period has passed, that is, after the topic NP has become a subject NP,

and after the pronominal element in the comment S' has dropped out. Therefore, there should be a high correlation between the time of the appearance of Noun + Copula constructions and the yielding of topic-comment constructions to adult subject-predicate constructions. Since 'topic NP' is a generic which includes both objects and subjects, when the topic-comment constructions disappear, the distribution of subjects and objects around the verbal element must conform to the subject, verb, object order of the child's native language. As the grammatical relations 'subject of' and 'object of' evolve, there can no longer be equal distribution of nouns around the verbal element as was observed during the period Gruber discussed. So he must predict that constructions such as "All broken wheel" will disappear at the same time that 'the wheel is X' appears.

So far, according to Gruber, the following assumptions are made about the linguistic competence and intrinsic processes of the child:

(1) The most primitive unit which can appear in the structural description of a transformational rule is S at early periods of language development. There are rules of the form S ——→ Pro— VP and also rules of the form S ——→ Np — S' or S ——→ S' — NP, which produce topic-comment constructions.

(2) As language development progresses, the *Pro* element of S' drops out and S' is incorporated into S. At this time the topic NP's are differentiated into subject and object NP's.

(3) For the processes of (2) to take place, S' must be analyzed by the transformational rules into smaller units. For instance, some analysis is required to incorporate the object NP into its proper position relative to (in English, to the right of-) the V node of S'. In topic-comment constructions there was little formal interdependence between the topic NP and the V of S'. When the pronominal element of S' drops out, however, and S' is incorporated into S, it seems reasonable to expect that V will be more extensively analyzed, and this analysis will exhibit itself in various forms of linguistic behavior.

An unanswerable question at this time is "which comes first, the incorporation of S' into S or the finer-grained analysis of

topic NP and comment S'?" Gruber suggests that the topic-comment construction reflects the 'basic psychological reality' of the subject-predicate relationship. This may well be true, if one considers 'psychological reality' as roughly equivalent to some sort of 'semantic reality'. However, the units into which a child analyzes his inputs seem to provide more promising clues to the cognitive reality of a given developmental period.

While comprehension is known to precede production, Klima and Bellugi (1966) point out that it does not precede production by a very long period of time. In general, a child understands adult speech via his own grammar. For instance, there is a significant period of time during which children who do not yet produce passive sentences can not understand passive sentences, either. Thus, the child is constantly filtering his linguistic input through his own grammar. He breaks the linguistic chaos around him into manageable pieces, which become smaller with time, as he learns to handle the larger ones.

It seems likely that increasingly complex cognitive structures and increasingly finer analyses of linguistic elements will eventually be found to occur prior to increasingly differentiated structures in the child's grammar. That is, we speculate that first the child learns to further analyze, for instance, the verbal element in S' and finds that in order to handle the new elements which result he must incorporate S' into S. This is purely speculative, of course, at this time, and all one can hope to do now is show how several independent pieces of evidence support the claim that the verbal element is restructured at about the same time that, according to Gruber, the subject-predicate relationship is evolving out of the earlier topic-comment constructions. This evidence concerns the development of the auxiliary and the handling of the *Neg* element, to which we now turn.

The recent longitudinal study of child language by Brown and Hanlon (1968) reports the development of transformations in the grammar of three children. Brown reports that the first four transformations to manifest themselves are the Question, Negative, Truncation and Do-Support. It seems to be the case that, although different children acquire these transformations

at different chronological ages, the four transformations emerge together for each individual child. Brown points out that all of these transformations require the analysis of VP into Aux ± Verb and the element *Aux* behaves similarly—and independent of Verb—in all four transformations. Aux, at this stage, is said to be composed of Tense + (Modal) + (Be). Below are the essential structural descriptions and changes given by Brown:

T-Question:

$$Q - NP - Aux - X \Longrightarrow Q - Aux - NP - X$$

T-Negative:

$$Neg - X - NP - Aux - Y \Longrightarrow X - NP - Aux - Neg - Y$$

T-Truncation:

$$NP - Aux - X \Longrightarrow NP - Aux$$

Do-Support:

$$\left\langle \left\{ \begin{matrix} \text{Tense} \\ \text{ing} \end{matrix} \right\} \right\rangle_{\text{Aux}} - X \Longrightarrow Do + \text{Tense} - X$$

It is clear that these transformations can emerge only when Aux has assumed the status of an independent element in the child's linguistic inventory. If we assume that prior to the emergence of these transformations many of the child's utterances were of the topic-comment variety, then we can see that the advent of these transformations brings the topic NP and the comment S' into much more intimate structural contact. In T-Question Aux is moved from S' out to S; in T-Negation, *Neg* is moved from S into S'; in T-truncation, topic and part of S' are left to stand alone together. It is also the case that topic must differentiate into subject and object NP's, properly placed, before the advent of these transformations; otherwise the structural descriptions would only be satisfied about half the time.

An urgent, virtually un-addressed (Fodor, 1966, is a notable exception) question in the field of language acquisition research

is: How are we to characterize the hypotheses formed by the child? It seems reasonable to assume that for some period of time prior to the acquisition of a new linguistic mechanism (e.g., a particular type of transformation) or a new structural element (e.g., Aux) the child will be formulating hypotheses specifically about that new process or element. This should mean that he will be perceiving his linguistic environment differently during that period. It is possibly just during this period of hypothesis formation and testing that comprehension precedes production. First, there is a cognitive shift in his ability to perceive, analyze and understand his linguistic inputs. Then there is a period of hypothesis formation which represents his attempt to integrate his new perceptions into his own linguistic behavior. Following is the behavioral evidence of the new mechanism or element in the child's own output. Brown and Hanlon discovered the interesting fact that when a new transformation emerges the child is infatuated with it at first, and uses the new construction at 4-8 times adult frequency. Gradually, the frequency decreases to normal usage.

Crucial to research based on this characterization of language development is knowing in advance what one expects the child to be trying to learn next. Longitudinal studies are of paramount importance, of course, even though there is a great deal of inter-child variation. If we assume that linguistic universals are the result of intrinsic, deterministically acting processes, then we have another set of good clues to the hypotheses the child is forming. A prominent goal of language acquisition theory should be to characterize just those universal strategies and processes which culminate in the internalization of linguistic universals.

Chapter 3

The Child's Acquisition of Phonology

This chapter is divided into two sections. In the first we illustrate the nature of phonology in a grammar and report on the findings and opinions of researchers concerning the child's acquisition of phonology. Unfortunately, there are few developmental studies to report, since few ambitious investigations have been undertaken in this area. In the second section we discuss conclusions based on the material of Section 1.

Section 1. What is Phonology?

The structure of phonology. The set of rules illustrated in Section 1 of the previous chapter provides a surface structure representation of each sentence. We now turn to the problem of accounting for the fine-grained phonetic details of sentences. This problem is compounded when we realize that some important aspects of phonetic representations of sentences—such as stress and intonation—are dependent on the syntactic structure of the sentence.

The phonological component of a generative grammar is envisaged as a set of rules which bridges the gap between syntactic surface structures and phonetic representations. We shall first illustrate the general nature of these rules and their operation by an analysis of regular past tense forms of English verbs. This analysis serves as a basis for a discussion of the child's acquisition of phonology which follows.

Below are some typical examples of the formation of the past tense in regular (weak) English verbs:

-t		-d		-*id*
peep-peeped		sob-sobbed		hate-hated
peek-peeked		drag-dragged		load-loaded
laugh-laughed		live-lived		
watch-watched		comb-combed		
race-raced		lean-leaned		
lash-lashed		boil-boiled		
rush-rushed		care-cared		

Now, if we consider that the surface structure representation of these can be schematized by VERB STEM + PAST TENSE (PST) SUFFIX, then the task of the phonological rules can be seen to be that of mapping the PST into the appropriate phonetic forms. These rules can be given the following rough description:

(1) Rewrite PST by *id* if the noun stem ends in either *t* or *d*.

(2) Rewrite PST by *t* if the noun stem ends in any one of the following consonants: p, k, f, c, s.

(3) Rewrite PST by *d* if the noun stem ends in any vowel, liquid (*l* or *r*), nasal, or any of the following consonants: b, g, v, ð, z.

These rules are unordered with respect to each other; that is, they will produce the same results no matter in what order they are applied. If, however, we were to allow the rules to be ordered, it is apparent that significant simplifications result. If the second rule were constrained to follow the first, then it is only necessary to specify that PST is *t* when the verb stem ends in a voiceless consonant; this is so because, those stem-final voiceless consonants which take *id* have already caused PST to be rewritten as *id*. Thus, there is no longer the symbol PST suffixed to those verbs, and Rule 2 cannot incorrectly produce such a form as | lowdt | for *loaded*.

Phonetic features. This example, as well as a wealth of other evidence, indicates that phonological rules must be ordered in order to give an economical description of the phonological

component of a grammar. This example can also serve to illustrate the necessity of a further aspect of phonological theory: the substitution of phonetic features as the basic units of phonological theory, rather than phonemes.

Consider the fact that the first rule of the English example refers to a class of speech sounds all of which share—in fact, share uniquely—certain phonetic characteristics. Furthermore, *t* and *d* are all and only the sounds of English which have the three characteristics of (1) being produced with the blade or corona of the tongue (hence, they are called "coronal"): (2) involve a total stoppage of the air stream (hence, they are called "noncontinuants"); and , (3) have a point of articulation anterior to the palato-alveolar area (hence, they are called "anterior"). Furthermore, the second rule refers simply to all the voiceless sounds of English, and the third rule need not refer to any features in the context of the rule. These rules now take the following form:

PST ⟶ *id*; when following a stem with a final anterior, coronal stop.
PST ⟶ *t*; when following a stem with a final voiceless phoneme.
PST ⟶ *d*

We see that far fewer phonological units need be referred to if they are stated in terms of rules that are ordered and make use of features.

The concept of "natural class." It is universally true that the more general is the statement of a phonological rule—i.e., the broader is the range of environments in which the phonological rule applies—the fewer features must be used to state it; the opposite is true if phonemes are used instead of features. A succinct proof of this is found in Halle (1964). The question we now face is: Do the features we use to describe the phonology of any given language, e.g., English, also apply maximally well to the description of any other language? That is, is it necessary to invoke the phonetic features of "coronal," "anterior," and "voiceless" in describing phonological phenomena in other languages? Or, do we have to discover (or invent) an entirely new set of phonetic features for each new language we confront? Empirical studies

of many languages have revealed that the answer to the former question is "yes," and the latter question receives a negative answer. That is, it seems that the overwhelming majority of the phonological rules of the world's languages require the formulation of classes of segments which can be described in terms of a relatively small set of universal phonetic features. These classes are called natural classes, because they are formulated by means of a small set of features drawn from the stock of universal features.

The universality and psychological reality of phonetic features. During the 1930's there arose in Prague a circle of linguists whose basic theoretical tenets (at least as concerned phonology) included the characterization of phonological systems in terms of their feature content. One of the leading members of this school, Nikolai Trubetzkoy, began a study of universal laws governing the content of phonological systems. Beginning in 1929 until his death in 1938 he published several articles and monographs reporting on the results of his investigations. These results indicate that there is a set of universal laws to the effect that the presence of certain features in a language implies the presence of certain others, and, perhaps, the absence of yet others. For example, no language may contain a feature contrasting a rounded back vowel (e.g., *u*) and an unrounded back vowel (*ɨ*), or constrasting a rounded front vowel (*ü*) and an unrounded front vowel (*i*), unless that language also contains a feature which distinguished high vowels (such as those already illustrated) from low vowels, usually *a*.

Following Trubetzkoy, Roman Jakobson (also a leading exponent of the Prague School) attempted to explain these universals in terms of the acoustical and perceptual characteristics of the features; certain features distinguished sounds which were easier to discriminate perceptually than others, and some features were held to attenuate the more highly discriminable distinctions. For example, Jakobson argued on acoustic grounds that the distinction between high front vowels and high back vowels is enhanced by rounding the lips during the production of the back vowel and leaving the lips unrounded during the

production of the front vowel. Thus, we typically find languages with an *i* and a *u*, and, rarely, if ever, a language with *i* and *ɨ*, and with no *u* (or *o*). Since Jakobson based his arguments on acoustic grounds, then it appears that Jakobson discovered a physical basis for explaining some of the universals discovered by Trubetzkoy. In fact, Jakobson proposed a set of about twelve features, which, together with their physical descriptions and a "natural" hierarchy among them, attempt to explain many of Trubetzkoy's discovered universals.

The reader may well wonder at this point what all this has to do with the child's acquisition of phonology. It will be recalled from the first chapter that universals have to be explained on the basis of biological characteristics of *homo sapiens* which place constraints on the form of any human language. These constraints are discoverable from, among other studies, the study of a vast number of the world's languages. One would expect that universals would in some way be reflected in the child's acquisition process. If it is true that linguistic universals reflect biological constraints on the form of language, then obviously children must obey these contraints at every step of their language learning process. If these universals state that a certain feature—feature A, say—may not occur in a language unless another given feature—feature B, say—then we would expect that a child would incorporate feature B in his phonology before he would acquire feature A.

To look at the same question from a slightly different angle, Jakobson argues logically that if there were universal ordering relations regulating the acquisition of features into a child's developing phonology, then these ordering relations would account for the universal implicational laws which place constraints on feature inventories in all adult languages. Thus, if a child never acquires feature A until he has first acquired feature B, then there will be no language which has feature A unless it also has feature B. Clearly, these two ways of looking at the question are equivalent.

Jakobson, then, synthesized a vast collection of the literature written up to 1941 (when he published *Kindersprache, Aphasie,*

und allgemeine Lautgesetze) about the child's acquisition of phonology and extracted some laws regulating the order in which phonological features are acquired. The laws are consistent with the universal laws discovered by Trubetzkoy and are explicable, according to Jakobson, on acoustic grounds.

Although more recent studies which have carried Trubetzkoy's investigations further have revealed a greater complexity and variety of universals—some of which cannot be explained on acoustic-perceptual grounds—Jakobson's insights still stand. The only further modifications to Jakobson's theory which appear essential at this stage of our knowledge is that considerations of articulatory complexity may play an important role, in addition to perceptual distinctiveness.

Jakobson describes the child's gradual development of a phonological system as a regular sequence of selections of speech sounds from the repertoire of sounds which the child is capable of producing, where the selected sounds are manipulated according to the child's nascent linguistic system. More precisely, the child selects oppositions between sounds—i.e., functional distinctions between sounds—as the child acquires the phonological system of his mother tongue. This view was a natural result of the more general tenet of Prague phonology that the phonological value of a speech sound is determinable only by taking into consideration the role of the sound in the total system of phonological oppositions; by the same token, the child makes linguistic use of a speech sound only when it is an element of such a system.

Jakobson distinguished between two stages of development prior to a stage which could be called linguistic: The first stage, the babbling stage, is characterized by the child's production of a wide diversity of sounds, some but not all of which are found in the various languages of the world; at this stage, there seems to be a minimum of vocal tract control, and the child produces, according to Jakobson, all sounds within the constraints imposed by the acoustic properties of the vocal tract.

The second pre-linguistic stage represents the child's acquisition of control over the output of his vocal tract; in this stage

the child restricts the inventory of sounds he produces to those which are common to languages of the world. Jakobson described this stage as one of human speech in general. Although the child produces all the sounds which can be found in the languages of the world, he does not restrict his inventory to the sounds which are particular to any given language; the first linguistic stage, in which he limits his sound to those which are in his own language, comes later. We can view this prelinguistic stage as one in which children are learning vocal tract control, an obvious prerequisite to learning to talk. Since children are adept at parroting sounds at this stage, they appear to be learning to match articulatory motor patterns with auditory goals or images.

In the earliest stages of actual language, children seem to lose a great number of sounds from their repertoire (at least in their efforts at speaking). In fact, the child even loses mastery over sounds which are in the adult language, where one might think that the presence of such a model would reinforce the child's ability to produce these sounds. There is no reason to suppose that the child has experienced a set-back in his motor skills, however, as Jakobson points out, children at this stage can successfully mimic sounds which they do not produce spontaneously in their own attempts to communicate orally.

This aspect of Jakobson's theory of the child's acquisition of phonology can be restated in terms of a generative theory by saying that, although the child can successfully pair articulatory motor patterns with a large number of auditory goals, he cannot yet generate these goals by means of rules of grammar. Phonological oppositions can be said to become "stabilized" when the child has learned the phonological rules of his language; it is only by means of these rules that he can produce auditory images —which serve as goal specifications for exercising feedback control over his vocal tract—which correspond to representations of morphemes in the child's permanent memory. Again, this assumes that the child's acquistion of the vocal tract skills by means of which he fulfills these goals is a prerequisite of learning the phonological rules.

Section 2. The Acquisition of Phonology

In the preceding pages we have devoted the discussion primarily to a theoretical treatment of how children acquire an inventory of distinctive features; we have not gone into a concrete description of the order of the features acquired. This would require an extensive technical discussion which is beyond the scope of this presentation. It is appropriate at this point, however, to consider some points concerned with the acquisition of phonological rules. The example of the acquisition of past tense formations in verbs lies at the basis of the discussion which follows.

In addition to the regular past tense formations discussed previously, there are, as is well known, many verbs which form the past tense irregularly. These are traditionally called "strong" verbs, and the regular verbs are "weak." For example, English has the following strong verbs:

sit-sat
drive-drove
go-went
come-came
bring-brought

Ervin (1964) studied the acquisition of past tense forms in English. She showed that at the earliest stage children do not have any past tense formations at all—they produced such forms as *he go* whether the child is referring to an event in the past or the present.

The next stage of interest involves the first use of past tense forms. Ervin shows that at this stage children use correct adult forms for the past tense of strong verbs! As is well known, children go through a rather long period—sometimes lasting well into grade school—during which they consistently "regularize" the strong past tense forms, and produce such sentences as:

he sitted
he drived
he goed

he comed
he bringed

Obviously, at this stage, the child has acquired rules such as those illustrated in Section 1 of this chapter—he simply applies them to every verb. How do we account for his earlier correct usage of strong verbs? Not only do the children at the earlier stage use correct strong verb forms, but their total stock of verbs consists largely of strong verbs. In fact, many of the most common verbs in English are strong verbs. It seems reasonable to assume that the child, in acquiring his first stock of verbs, simply has two lists of forms, present tense forms and past tense forms. That is, he has stored in his lexicon two distinct morphemes for each verb, one for the present and one for the past. This is radically different from the later stage, where the child can get by with just one list of verb stems and a general rule for forming the past tense. The latter situation is obviously the more economical, since it cuts down on the number of items to be remembered permanently by a factor of almost two.

Thus, children keep increasing their verb vocabulary by two items every time they learn a new verb until they get to a point where they have a large enough number of regular verb stems that they have enough data to discover the rule for forming the regular past tense in English. At this point they wipe out *all* of their special list of past tense forms, and represent verbs in their permanent memory in a form from which both the present and the past tense forms can be generated by the appropriate rules.

We must now ask: Why do children at this point overgeneralize the rule and incorrectly "regularize" the strong verbs? This question can only be answered speculatively. It seems to follow, however, that the child is more concerned with the economy of the internal representation of his grammar than he is with faithful reproduction of adult forms.

This explanation provides, then, a natural account of why children first go through a stage where they produce strong verb forms correctly, then seem to slip back and produce incorrect past tense forms of the strong verbs. In reality, they do not slip

back at all—they are instead representing generalities of their phonology in terms of rules which they apply universally instead of long lists of disparate items. It is not until comparatively much later that they learn to differentiate among their sets of verbs according to phonological classes such as strong and weak verbs and learn the correct strong verb forms again.

Section 3. Summary and Conclusions

Perhaps the main conclusion which follows from the preceding discussion can be stated in negative terms: it is clear that such factors as mimicry, drill, and even overt instruction are of minimal importance in the child's acquisition of phonology. It has been proposed that "expansion" by the parents of a child's speech facilitates language learning. "Expansion" is simply the adult practice of repeating what the child has just said, "correcting" what the adult considers the "errors" made by the child in the preceding utterance. A study by Cazden (1965) compared the linguistic improvement of several groups of children. One was given consistent expansions; in another group the children were given normal responses which were not expansions. Of the several groups studied, the children in the normal response group showed the greatest linguistic improvement over time. An appropriate linguistic environment is obviously a necessary condition for the child to learn the phonology (and syntax) of his language, but the child seems to be constrained to follow a developmental program of his own, regardless of what teachers, therapists, or parents may wish to do about it. This observation is of paramount importance to anyone who deals pedagogically with children's language.

Thus, a child has to follow a fixed sequence in learning the set of phonetic features used by his language to distinguish meaningful items. If a language instructor were to attempt to teach a child to make distinctive use of a phonetic feature which he is not ready for, the attempt would almost certainly end in failure. Thus, a child would be unable to learn to distinguish affricates (e.g., the initial sound in *chap*) unless he has already

learned to distinguish stops from fricatives. If a child does not yet make the latter distinction, his perceptual and/or articulatory apparatus is not sufficiently developed or trained to make the former.

The same observation is appropriate for the child's learning of phonological rules. Here again the child is constrained by presumably biologically based factors to follow a predetermined sequence of milestones. It would be hopeless to attempt to teach the child the correct form of the strong verbs when he has just begun to over-generalize the regular past tense formation rule. Such an attempt would fail because the child's Language Acquisition Device is concentrating on economy at that stage, and will avoid cluttering its vocabulary and phonological rules with extra categories such as strong verbs. Only at a later stage, when the child has begun to learn strong verb forms, could direct instruction in this area serve any purpose, and even at that time the child may prove to be rather recalcitrant to language instruction.

NOTES

1. The transformational-generative movement came to the forefront in linguistics after 1957, after the publication of *Syntactic Structures,* by Noam Chomsky, professor of Linguistics at the Massachusetts Institute of Technology. Since that time, the principle theoretical linguists associated with this school of thought have included Chomsky, R. B. Lees, Morris Halle, and many others here and abroad.

2. The principle investigator in the area of biological factors in language acquisition, use, and structure is Eric H. Lenneberg, formerly of the Harvard Medical School, now with the University of Michigan. His recent book *Biological Foundations of Language* reviews the literature on this subject and reports on his own extensive observations; this book serves as a basis for the discussion in this section.

3. The apostrophe following the number of the rule indicates that the rule will be revised below.

4. A more complete analysis will obviously require, at least, that the NP in PS 2' be optional in order to provide for sentences with intransitive verbs such as *The doctor slept.*

5. Recent research has shown that it is necessary to indicate a difference between the deep structures of active and passive sentences. For reasons not enumerated here, a more complete analysis of English requires that the deep structure of passive sentences contains a constituent in the Verb Phrase which serves as a trigger for the operation of an obligatory passivizing transformational rule, rather

than having an optional passivizing transformational rule which operates on the same deep structures as underlie active sentences, as in this example. This does not alter the essential aspects of the point exemplified here.

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