A Departure from Cognitivism: Implications of Chomsky's *Second* Revolution in Linguistics

Ted Schoneberger
California State University, Stanislaus and Applied Behavior Consultants, Inc.

In 1957 Noam Chomsky published *Syntactic Structures*, expressing views characterized as constituting a "revolution" in linguistics. Chomsky proposed that the proper subject matter of linguistics is not the utterances of speakers, but what speakers and listeners *know*. To that end, he theorized that what they know is a system of rules that underlie actual performance. This theory became known as *transformational grammar*. In subsequent versions of this theory, rules continued to play a dominant role. However, in 1980 Chomsky began a second revolution by proposing the elimination of rules in a new theory: the principles-and-parameters approach. Subsequent writings finalized the abandonment of rules. Given the centrality of rules to cognitivism, this paper argues that Chomsky's second revolution constitutes a departure from cognitivism.

"In Woody Allen's story 'The Whore of Mensa,' the patron asks, 'Suppose I wanted Noam Chomsky explained to me by two girls?' 'It'd cost you,' she replies" (Pinker, 1994, p. 126; see Allen, 1972, pp. 32–38).

Noam Chomsky's linguistics career spans half a century. The scholarly product of that career—papers, books, lectures—has been prodigious. Reviewing enough of this material to develop an easy familiarity with its central themes is a daunting task. Further, Chomsky's work is replete with formalisms and other technical expressions, making much of it unfathomable to those outside the field of linguistics. Because his views have changed frequently over time, any account of Chomskyan linguistics must carefully specify which works by Chomsky are being used as source material. And Chomsky's apparent penchant for historical revisionism—reinterpreting his past statements in a self-serving manner that often strains credulity (e.g., see Matthews, 1993, pp. 191–192)— makes it even more difficult to get a

clear understanding of his views. These impediments to understanding Chomskyan theory suggest the obvious question, "Why bother?"

There are a number of reasons why behavior analysts, particularly those with a keen interest in verbal behavior, should be knowledgeable about Chomskyan theory in its many incarnations. First, as a linguistics scholar and theoretician, Chomsky has enormous stature. The philosopher John Searle, though a frequent critic of Chomsky, has nonetheless praised his work as "one of the most remarkable intellectual achievements of the present era, comparable in scope and coherence to the work of Keynes or Freud" (1974, p. 31). Derek Bickerton (a prominent linguist himself) has declared Chomsky "arguably the Newton" of linguistics (1990, p. 5). This comparison to Newton is a particularly apt one, because Chomsky is often credited with changing linguistics from a science that merely classifies entities and processes into one that, like physics, also constructs and tests theories about them (Lees, 1974).

Second, Chomsky's influence extends beyond linguistics to other disciplines in which behavior analysis

Address correspondence to Ted Schoneberger, P.O. Box 157, Turlock, California 95381 (E-mail: TSberger@AOL.com).

also has a stake. One of them is education. Chomsky's work has inspired others to engage in patently wrongheaded applications, often with disastrous consequences. For example, to teach someone to speak and understand a second language, Chomsky (1970) has recommended that the instructor eschew "drills to form stimulus-response associations," and opt, instead, for creating "a rich linguistic environment for the intuitive heuristics that the normal human automatically possesses" (pp. 107–108). Drawing on supposed parallels between learning to speak and understand a language and learning to read, prominent pioneers of the whole language approach (e.g., Goodman, 1996; Smith, 1973) have adapted Chomsky's recommendation to the teaching of reading to first-language learners (Adams & Bruck, 1995; Liberman & Liberman, 1990).

For example, in chapter 1 of *Psycholinguistics and Reading,* Smith (1973) announced that "the major impetus" for the theoretical approach "which underlies the present volume . . . came from the school of 'generative transformational' linguistics associated primarily with the name of Noam Chomsky" (p. 3). Similarly, Goodman (1996) reported that Chomsky's views had supplied "a missing link in my understanding of reading," thereby inspiring Goodman (1967) to write "Reading: A Psycholinguistic Guessing Game." In this article Goodman asserted that efficient reading does not consist in accurately reading the words but, rather, in using just enough visual cues provided by the text, coupled with one's knowledge and beliefs, to make guesses about which words appear. As a result of the adoption of "guessing" and other whole language strategies by many school districts in the 1980s, it is arguably the case that millions of children have thereby failed to achieve adequate literacy (McPike, 1995). Although the influence of whole language is reportedly waning in some locales as phonics programs again find a receptive audience, it is perhaps in-

evitable that whole language's core tenets will be repackaged and will reappear under a new name. An effective theoretical critique of these whole language tenets—and the concomitant promotion of behaviorally derived reading programs—demand an understanding of Chomskyan theory.

Another discipline that has been influenced by Chomsky is philosophy. For Chomsky, there is no "sharp distinction" between science and philosophy (1988, p. 2). So, his contributions to the science of linguistics are (for him) in large measure also contributions to philosophy (and vice versa). For example, his argument that humans possess a universal grammar— an innate, tacit knowledge of the principles governing all languages— amounts to an argument for a Cartesian rationalist account of "mind" as against an empiricist one. Over the years Chomsky has had frequent exchanges about this and other topics with a number of prominent philosophers including, especially, W. V. Quine, John Searle, Hilary Putnam, and indirectly (i.e., by means of his contemporary interpreters) with Wittgenstein. Each has acknowledged Chomsky's philosophical contributions; for example, Putnam has proclaimed him, simply, "a major philosopher" (Putnam, 1989, p. 213). Further, Chomsky's influence on the humanities has not been limited to philosophy. Indeed, Pinker (1994) reported that "Chomsky is currently among the ten most-cited writers in all the humanities . . . and the only living member of the top ten" (p. 23).

Chomsky has also made major contributions to psychology, the field that, besides linguistics, has been most influenced by him. Chomsky's best known contribution is doubtless his review of Skinner's (1957) *Verbal Behavior* (Chomsky, 1959). The arguments offered by Chomsky against Skinner's book have been viewed within nonbehaviorist circles as "the basic refutation of behaviorist psychology" (Newmeyer, 1986a, p. 52). Indeed, it is this publication that was most respon-

sible for Chomsky's early fame. Unfortunately for behavior analysis, Chomsky's arguments were unintentionally bolstered by Skinner himself. By failing to mount a timely counterargument, Skinner inadvertently enhanced the effectiveness of Chomsky's critique. As MacCorquodale (1970) observed, the failure to provide a systematic reply to Chomsky's review became "the basis for an apparently wide-spread conclusion that it is in fact unanswerable, and that its criticisms are therefore essentially valid" (p. 83). For example, Gardner (1985) asserted that Skinner's lack of a response "signaled" to language researchers the "theoretical bankruptcy" of the Skinnerian account of language (p. 193). Although Skinner (1972) justified his failure to respond on the grounds that (a) he found the "tone" of Chomsky's review "distasteful" and that (b) Chomsky misconstrued his position, Skinner acknowledged "No doubt I was shirking a responsibility in not replying to Chomsky" (p. 346).

Skinner's lack of response to Chomsky's critique was later partially corrected by MacCorquodale (1970). Although MacCorquodale's retort was well reasoned and comprehensive, it met with only modest success. Forty years after its publication, Chomsky's review is still considered by most linguists as a definitive refutation of a behavioral account of language. What, then, should behavior analysts do? Rhetorician Jeannine Czubaroff (1989) has offered some suggestions. In his response to Chomsky, MacCorquodale had suggested that the two paradigms need not take an adversarial stance. According to Czubaroff, this "tolerant, pluralistic attitude, while admirable, fails to take fully into account the politics of science. Given limited financial resources and a limited pool of researchers, advocates of different paradigms inevitably vie for resources and personnel" (p. 45). In place of tolerance and pluralism, Czubaroff has recommended instead nothing less than a "full refutation" of Chomsky's review.

Such a refutation, of course, requires an adequate knowledge of Chomskyan theory. This then leads to a third reason for studying Chomsky. Without a knowledge of Chomsky, behavior analysts can never hope to pick up where MacCorquodale left off and effectively counteract, once and for all, the devastating effects of Chomsky's review.

Fourth, although Chomsky has been subjected to relentless attacks over the decades—Newmeyer (1996, p. 30) has called him "the most attacked linguist in history"—his theory remains relevant and deserving of study. Indeed, far from being passe and of historical interest only, his views remain influential and, therefore, demand attention. For instance, many of his views have remained largely intact in the work of younger psycholinguists, thus winning over many who have never actually read Chomsky in the original. An example is Pinker's (1994) *The Language Instinct.* In that highly popular book, Pinker acknowledged that his views have been "deeply influenced" (p. 24) by the works of Chomsky. Indeed, Pinker noted that "the most famous argument that language is like an instinct comes from Noam Chomsky" (p. 21). Now, it is true that the popularity of Chomskyan theory indeed waned in the 1970s. However, it is also true that Chomsky's more recent theoretical musings have rekindled an interest in his work and have won him new converts. For example, Newmeyer (1996) has described as "explosive" the 1981 publication of Chomsky's *Lectures on Government and Binding.* As a result of the publication of this book, "for the first time in over fifteen years, the majority of people doing syntax were working within the framework currently being developed by Chomsky" (Newmeyer, 1996, p. 63). The reverberations of that "explosion" have continued to exert considerable influence into the 1990s. As Newmeyer put it, "since around 1981 we have been in the Government-Binding period, in which the model of Chomsky 1981 has

inspired a high percentage of the research in syntactic theory" (p. 171).

And now the fifth and final reason for studying Chomsky: Although Chomsky's recent theoretical revisions continue to have a considerable impact, a discussion of these revisions remains largely absent in the writings of behavior analysts. For example, in his discussion of psycholinguistics—a discipline that many credit Chomsky with starting—Catania (1998) devoted a section to the subject of transformational grammar. However, in an otherwise excellent discussion, Catania does not mention that the most famous proponent of transformational grammar (Chomsky) had jettisoned the theory over 10 years earlier (Chomsky, 1986). Similarly, in her "historiographic account" of the fate of *Verbal Behavior* (Skinner, 1957) and Chomsky's (1959) review of it, Andresen (1991) also provided no mention of this and other critical changes in Chomskyan theory. This omission seems particularly puzzling, given the fact that Andresen cited the book (Chomsky, 1986) in which these changes first received wide circulation. Such omissions occur throughout the behavioral literature (e.g., Reese, 1991; Vasta, Haith, & Miller, 1992). Thus, behavior analysts need to familiarize themselves with current Chomskyan theory if their public discussions of it are to accurately reflect its present status. This is critical if behavior analysts ever hope to effectively mount the aforementioned counterattack to Chomsky.

In this article I first examine the centrality of rules as explicanda within Chomskyan theory. I then show how, beginning in the 1980s, Chomsky came to abandon rule-based accounts of language. Next, I argue that, given the primacy of rules within traditional cognitivism, Chomsky's abandonment of rules constitutes a departure from traditional cognitivism. Finally, I offer some closing comments concerning Chomsky's current place within contemporary cognitive scientific thinking.

THE ROLE OF RULES WITHIN CHOMSKYAN THEORY: AN HISTORICAL OVERVIEW

The First Revolution: Transformational Grammar

> Throughout the history of the study of man there has been a fundamental opposition between those who believe that progress is to be made by a rigorous observation of man's actual behavior and those who believe that such observations are interesting only in so far as they reveal to us hidden and possibly fairly mysterious underlying laws that only partially and in distorted form reveal themselves to us in behavior.
>
> . . .
>   Noam Chomsky is unashamedly with the searchers after hidden laws. (Searle, 1974, p. 2)

The syntactic structures theory. Based on comments by Miller (1979), Newell and Simon (1972), and others, Gardner (1985) has identified September 11, 1956, as the "birth date" of cognitive science. A principal reason for Gardner's claim is that on that date Noam Chomsky delivered a paper entitled "Three Models of Language" at a symposium at the Massachusetts Institute of Technology. A year later a more elaborate version of Chomsky's paper appeared as the monograph *Syntactic Structures* (Chomsky, 1957). Along with Skinner's (1957) *Verbal Behavior,* Chomsky's monograph was one of two seminal works on language to appear that year. The views expressed in that monograph soon came to be characterized by many as constituting a "revolution" in linguistics (Matthews, 1993, p. 28).

Syntactic structures theory comprised "part of an attempt to construct a formalized generalized theory of linguistic structure" (Chomsky, 1957, p. 5). Conceptualizing grammar as a formal "device" (p. 11) or "machine" (p. 19) for generating sentences, Chomsky's monograph centered on this question: What are the critical features of a grammar capable of generating "all and only" the well-formed sentences of a language? In confronting this

question, Chomsky examined three theoretical models, evaluating the success of each as an answer to this question. However, before turning to Chomsky's discussion of these proposed answers, it is necessary to clarify the terms *grammar* and *generate*. First, consider the term *grammar*. For many contemporary linguists, the grammar of a language is jointly comprised of its phonology, syntax, and semantics. Others define it more narrowly, treating it as synonymous with syntax (Aitchison, 1992, p. 8). The early Chomsky (1957) took a middle position, including syntax and phonology in his definition of grammar but excluding semantics. However, in syntactic structures theory, his focus is on the syntactical component only. Thus, unless otherwise stated, in this discussion on syntactic structures theory, I shall use the term *grammar* in this restricted sense.

At the time Chomsky wrote *Syntactic Structures*, post-Bloomfieldian structuralism (also known as American descriptivism) was the dominant view among linguists in America. Characterized as "behaviorist" in orientation, American structuralism advocated "rigorous observation of man's actual behavior" (Searle, 1974, p. 2), as the defining feature of linguistics research activity. After collecting data of actual speech (the "corpus"), the linguist would then employ *discovery procedures* (a) to classify the component elements (e.g., phonemes, words, sentence types) and (b) to determine their distribution within utterances. These discovery procedures were designed to "extract a grammar from raw linguistic data" (Newmeyer, 1986b, p. 66). Frequently described as "mechanical" in nature, they comprise a detailed, objective algorithm that, when followed, yields the grammar; for example, an algorithm based on statistical analyses of word usage.

For Chomsky (1957), however, the grammar of a language is not the product of data-based discovery procedures. Rather, the grammar of language L is a *theory* of L. As such, it cannot

be extracted "directly from the raw data" (p. 52) but, rather, arrived at "by intuition, guess-work, all sorts of partial methodological hints, reliance on past experience, etc." (p. 56). Chomsky did not deny that the linguist used data. Rather, he was saying that, in the end, it is the linguist's "intuition, guess-work"—not the data alone—that produce the grammar. Chomsky draws on the typical theory construction activities in the natural sciences (principally physics) as his model of how to go about the construction of the grammar of L. In syntactic structures theory, then, Chomsky used *grammar* to refer to a theory of the syntax of a given language. Further, he took the additional step of reifying the grammar, characterizing the speaker's and hearer's knowledge of L as a "machine" or "device" for generating all and only well-formed sentences of L.

This raised two additional issues requiring clarification. First, is Chomsky saying that such a device actually exists, residing, somehow, *inside* the speaker-listener? No, at this point in Chomsky's theorizing, his positing of a grammar machine is in keeping with the popularity in the 1950s of explanations employing automata theory. Second, what does Chomsky mean by *generate*? As Lyons (1970) has pointed out, Chomsky's use of the term *generate* here is misleading. This term suggests (incorrectly) that grammar is defined in terms of the speaker alone when, in fact, it is meant to explain both speaking and listening. More importantly, the term is misleading because its usage mistakenly suggests that the grammar actually *produces* speech. This error on the part of readers of Chomsky is understandable, because Chomsky (1957) carelessly used *produce* and *generate* somewhat interchangeably. However, as Botha (1989) has put it, "to conflate, carelessly, 'generate' with 'produce' " is to commit what Botha has called "the generative gaffe" (p. 3). Chomsky has maintained over the years that this gaffe has been committed by those

who have misunderstood him. According to Chomsky, syntactic structures theory is not a theory of actual speech production. In short, the generative rules do not produce speech; rather they are "put to use" (Chomsky, 1965, p. 4) in speech production. In what other sense, then, is Chomsky using the term *generate* when he asserts that the grammar generates sentences?

To better understand Chomsky's "quasi-mathematical use" (Haley & Lundsford, 1994, p. 30) of *generate*, consider this analogy offered by Haley and Lundsford. A person talking out loud in one room is overheard by someone in another room. The eavesdropper only hears pieces of what the other person is saying: "8, 10, . . ., 14, 16, . . ., 20, 22, . . ." If asked by a third person to hypothesize about the speaker's behavior, the listener could say that the speaker seems to be counting by twos. If pressed to express her hypothesis formally, the listener could write the algorithm $Y = X + 2$. If the listener's hypothesis is correct, she has used a *limited* sample of numbers to construct an algorithm which generates *all* of the spoken numbers. Further, given the conditions of the initial number being even and positive, this algorithm also *generates* the complete, infinite set of positive even numbers. However, although its power to generate an infinite set of numbers is granted, this algorithm does not actually *produce* one of those numbers. It describes what a person knows who can count by twos. It could also be used by a person who has never counted by twos to so count. But the algorithm itself does not produce one spoken number.

The purpose of this analogy is to explain how *generate* is used by Chomsky. Obviously, knowledge of language is more complex than knowledge of counting. However, just as in our counting example, limited exposure to a sample of utterances by native speakers (the corpus) allows the grammar to enumerate a collection of rules for generating a presumably infinite set of sentences (the language). Of course,

a critic might ask, "If these mathematically generative rules cannot really tell us anything about how language is *actually produced* [italics added], . . . what good are they?" (Haley & Lundsford, 1994, p. 35). Consider the counting analogy again. Although the algorithm may not be directly relevant to the actual production of even numbers (one can count by twos without ever being given this algorithm) it is relevant for Chomsky to the *study* of such production. Specifically, it tells us the general law to which such production must conform (Haley & Lundsford, 1994, p. 36).

Now we are ready to turn, finally, to a discussion of Chomsky's proposed model of linguistic structure—the syntactic structures version of transformational grammar—and thereby, the topic of rules. In syntactic structures theory, Chomsky asserted that a grammar generates well-formed sentences by applying two types of language-particular syntactic rules: (a) phase structure rules and (b) transformational rules. Consider phase structure rules first. When the sentence *The man hit the ball* is analyzed in terms of its phrase structure, it consists of the noun phrase (NP) *the man* and the verb phrase (VP) *hit the ball*. Further, the NP *the man* consists of the article (T) *the* and the noun (N) *man*, and the VP *hit the ball* consists of the verb (V) *hit* and the NP *the ball*. Lastly, the NP *the ball* consists of the T *the* and the N *ball*. Chomsky (1957, p. 26) offered the following set of rules (a simple "phrase structure" grammar) for generating this sentence:

Rule 1: Sentence → NP + VP
Rule 2: NP → T + N
Rule 3: VP → V + NP
Rule 4: T → the
Rule 5: N → (man, ball, etc.)
Rule 6: V → hit, took

Each of these rules has the form X → Y where X is a single element, the arrow stands for "rewrite," and Y is a string of one or more elements. Consider an example of how these rules are

applied to derive the sentence *The man hit the ball.*

> Applying Rule 1 yields the string NP + VP.
> Applying Rule 2 yields T + N + VP.
> Applying Rule 3 yields T + N + V + NP.
> Applying Rule 4 yields the + N + V + NP.
> Applying Rule 5 yields the + man + V + NP.
> Applying Rule 6 yields the + man + hit + NP.
> Applying Rule 2 yields the + man + hit + T + N.
> Applying Rule 4 yields the + man + hit + the + N.
> Applying Rule 5 yields the + man + hit + the + ball.

The phrase structure grammar outlined above can be extended and elaborated, making it capable of generating more English sentences. However, for Chomsky, a phrase structure grammar has deficiencies that make an alternative grammar more attractive. Consider the following active and passive English sentences: *The man hit the ball* and *The ball was hit by the man.* As shown above, the active sentence *The man hit the ball* can be generated by a phrase structure grammar. If additional phase structure rules were added, this grammar could also generate passive sentences. However, what cannot be accounted for with this grammar is the fact that native English speakers "feel" that these two sentences are closely related and, in fact, have virtually the same meaning. Accounting for the close relationship between such pairs of active and passive sentences requires a transformational grammar (Lyons, 1970, p. 68).

Thus, in addition to phase structure rules, a transformational grammar also contains (as its name suggests) transformational rules. The latter have the form $b + c \rightarrow c + b$. A phrase structure rule takes a single element and rewrites it as a string of elements, but a transformational rule takes a string of elements and rewrites it as a different string of elements. For example, in transforming *The man hit the ball* into *The ball was hit by the man*, the active-passive transformational rule requires that the two noun phrases change plac-

es, a change in verb from *hit* to *was hit*, and the insertion of *by* prior to the last noun phrase. In addition to the passive voice transformation, there are other types of sentences that result from performing transformations on simple declarative sentences. For example, applying the negative transformation yields *The man did not hit the ball*; applying the interrogative yields *Did the man hit the ball?* Furthermore, multiple transformations can be applied. For instance, applying both the passive and negative transformations yields *The ball was not hit by the man.*

In addition to providing an account of the aforementioned intuitions of the native speaker (e.g., that some sentences "feel" closely related), Chomsky's transformational grammar is (according to him) also more powerful than a phrase structure grammar in accounting for specific types of structural ambiguities. For instance, consider the sentence *Flying planes can be dangerous.* This sentence is ambiguous because it could mean that *Planes that are flying can be dangerous* or it could mean that *To fly planes is dangerous.* In a phrase structure grammar, each version has the same immediate constituent analysis. However, the transformational grammar identifies two different underlying strings to this derived string (Lyons, 1970).

As previously noted, the appearance of syntactic structures theory has been deemed by many a "revolution" within linguistics. However, Chomsky has eschewed the term *revolution* as a label for the brash theoretical approach presented in *Syntactic Structures* (Chomsky, 1957). Instead, his theory represents what he later (e.g., 1986) has called a "conceptual shift" in 20th century linguistic theory. More specifically, this theory consisted of a shift in focus "from the study of language regarded as an externalized object to the study of the system of knowledge of language attained and internally represented in the mind/brain" (Chomsky, 1986, p. 24). As we shall see, this con-

ceptual shift faced numerous revisions in the ensuing decades.

The standard theory. Rules continued to play a central role in subsequent versions of transformational grammar. After syntactic structures theory, the next major version was presented in *Aspects of the Theory of Syntax* (Chomsky, 1965) and became subsequently known as the standard theory. Here Chomsky introduced the technical term *generative grammar*, defining it as "a system of *rules* [italics added] that . . . assigns structural descriptions to sentences" (p. 8). Likewise, in his account of language acquisition, he asserted that "a child who has learned a language has developed an internal representation of a system of *rules* [italics added] that determine how sentences are to be formed" (p. 25).

In explicating syntactic structures theory, Chomsky claimed that exposure to a relatively small, finite set of utterances (the corpus) allows a generative grammar to project an infinite set of possible, well-formed utterances (the language). In making this claim, Chomsky distinguished between actual utterances produced or understood by a speaker-hearer versus the knowledge a speaker-hearer has of a language. In standard theory, Chomsky (1965) elaborated on this distinction by making a fundamental distinction between competence and performance. *Competence* is defined as the speaker-hearer's knowledge of a particular language. More specifically, what is known is a generative grammar defined as "a system of *rules* [italics added] that in some explicit and well-defined way assigns structural descriptions to sentences" (p. 8). On the other hand, *performance* is "the actual use of language in concrete situations." During language acquisition, the child's task is to acquire, from exposure to utterances, the "underlying system of rules" that are "put to use" by a competent speaker-hearer in actual performance (Chomsky, 1965, p. 4).

Does performance ever directly reflect competence? Yes, says Chomsky, but only as an "idealization." For Chomsky, linguistic theory has as its primary focus an ideal speaker-listener who belongs to "a completely homogeneous speech-community." This hypothetical entity "knows its language perfectly and is unaffected by such grammatically irrelevant conditions as memory limitations, distractions, shifts of attention and interest, and errors . . . in applying his knowledge of the language in actual performance" (1965, p. 3). Of course, acknowledged Chomsky, actual utterances by a real (not ideal) speaker "could not directly reflect competence" because natural speech displays "numerous false starts, deviations from rules, changes of plan in mid-course, and so on" (p. 4). Nonetheless, the knowledge of language is "put to use" during performance and "underlies" it.

For Chomsky (1965), linguistic theory is mentalistic in the sense that it is concerned with "discovering the mental reality underlying actual behavior." Chomsky grants that actual instances of language behavior, as well as dispositions to so behave, are also useful in that they "provide evidence as to the nature of this mental reality." However, if linguistics is to be a "serious discipline," language behavior "surely cannot constitute the actual subject matter of linguistics." Rather, its subject matter is a language community's competence viewed as a system of linguistic rules known by its members. A grammar, then, is a description of the intrinsic competence of a speaker-listener. Further, if this grammar is explicit, it is a generative grammar (p. 4).

Traditional, taxonomic grammars provide a wealth of data regarding the structural descriptions of uttered sentences. Yet these structuralist grammars fail to identify many of the basic regularities of a language. More specifically, with respect to syntax, these traditional grammars restrict themselves to classification while failing to provide generative rules that participate in "the regular and productive syntactic processes." This is a "defect

of principle, not . . . empirical detail or logical preciseness." In identifying these regularities, Beattie (1788) stated, "Those things, that all languages have in common, or that are necessary to every language, are treated of in a science, which some have called *Universal* or *Philosophical* grammar" (quoted by Chomsky, 1965, p. 5).

The extended standard model. Syntactic structures theory has been criticized for excluding semantics from the study of language. This criticism is incorrect. In *Syntactic Structures*, Chomsky (1957) acknowledged the "importance of semantic . . . studies of language" (p. 17) and even provided a chapter on the syntax-semantics relationship (Haley & Lundsford, 1994, pp. 110–111). However, this criticism is at least accurate to the extent that this early model clearly focused on syntax. More specifically, although the importance of semantics was acknowledged, semantic rules were excluded from the discussion. Similarly, although the standard theory also acknowledged the importance of semantics, its discussion of the role of linguistic rules is largely restricted to an explication of the "system of rules" that "assigns structural descriptions to sentences" (Chomsky, 1965, p. 8). Again, the focus is on syntactic rules.

In the years subsequent to the publication of the standard theory, Chomsky (1971, 1972) and his colleagues (e.g., Jackendoff, 1972) offered elaborations that are now known, collectively, as the extended standard model. As part of that effort, Chomsky refined and elaborated on the role of rules; in particular, the extended standard model specifically included a discussion of the role of rules in semantics. For example, the extended standard model continued to define generative grammar as a system of rules for generating an infinite set of structural descriptions, but it also stated that the "formal properties and configurations" possessed by these structures "serve to mediate the relation between sound and meaning" (Chomsky, 1972, p. 104). Thus,

part of what it means to "know a language" is to master "a system of rules that assigns sound and meaning in a definite way for an infinite class of possible sentences" (p. 103).

The revised extended standard model. Although this modification (e.g., Chomsky, 1973, 1977; Chomsky & Lasnik, 1977) remained faithful to transformational grammar's commitment to rules, "the whole clanking transformational apparatus of earlier years" (Trask, 1993, p. 241) was reduced to a single rule. Further, this version of transformational grammar devoted more attention to developing constraints on rules instead of focusing on the rules themselves. In the 1980s, additional modifications to the revised extended standard model led to its being supplanted by government binding theory, a radical departure that represented the beginning of a second revolution and the demise of rules as explicanda (Trask, 1993, p. 241).

The Second Revolution: The Principles-and-Parameters Approach

Government binding theory. The onset of the 1980s signaled (a) the beginning of the end for rules as explicanda, and consequently (b) the eventual demise of transformational grammar as well, within Chomskyan linguistics. As previously stated, in transformational grammar the grammar contains two distinct classes of syntactic rules. However, in *Lectures on Government and Binding*, Chomsky (1981) took the radical step of proposing a grammar in which one of these two rule classes is eliminated and the other is severely reduced. Although previous works published by Chomsky (e.g., 1973, 1980) presaged these and other changes, the publication of *Lectures on Government and Binding* is generally credited (e.g., Cook & Newsom, 1996) with beginning what has come to be called the second Chomskyan revolution (or, in Chomskyan parlance, the second "conceptual shift") in linguistics. This new

revolution has been named the "principles-and-parameters" approach. Government binding theory is the first version of this new approach. To understand why Chomsky felt the need to make this radical break with the past, we need to consider a serious problem encountered with the theories comprising the first revolution or conceptual shift.

According to Chomsky (1986, p. 3), the arrival of the first conceptual shift occasioned the asking of three basic questions: (a) What constitutes knowledge of language? (b) how is knowledge of language acquired? and (c) how is knowledge of language put to use? Let us consider the last question first. Chomsky has not attempted to answer the question of how knowledge of language is put to use in performance. Rather, he has taken the position that his theory is one of linguistic competence, not performance, and that "The question of how we talk remains in the domain of mysteries" (Chomsky, 1980, p. 77). Yet, as we have seen, Chomsky has spent considerable time on the other two questions. And it is here that a serious problem has arisen. He answered the first question by arguing that anyone who knows a particular language has knowledge of a system of rules that constitutes the generative grammar of that language. He answered the second question by giving an account of universal grammar, the latter constituting a "theory of the 'initial state' of the language faculty, prior to any linguistic experience" (Chomsky, 1986, pp. 3–4). Given this universal grammar and the "triggering" effect of a linguistic environment, knowledge of a particular language "grows" in the mind. For Chomsky, each answer, by itself, seems on target. However, a serious problem arises when each answer is considered against the backdrop of the other.

Chomsky (1965) stipulated that a grammar meets the condition of *descriptive adequacy* "to the extent that it correctly describes the intrinsic competence of the idealized native speak-er" (p. 24). Thus, in answering the first question—what constitutes knowledge of language?—one's goal should be to provide a descriptively adequate answer. If the proposed grammar allows one to do such tasks as assigning structural descriptions to sentences and distinguishing between well-formed and deviant expressions in a manner that corresponds to the native speaker's linguistic intuitions, then that grammar has descriptive adequacy.

In addition, Chomsky (1965) further stipulated that a linguistic theory meets the condition of *explanatory adequacy* to the degree that it "succeeds in selecting a descriptively adequate grammar on the basis of primary linguistic data" (p. 25). In other words, a linguistic theory has explanatory adequacy if it explains why, given the linguistic data available to a child, one particular grammar is selected over others. Such a theory has to "account for the fact that a specific language is fixed by the evidence" (1986, p. 83). Thus, the problem of explanatory adequacy "is essentially the problem of constructing a theory of language acquisition" (1965, p. 27). Solving the problem of explanatory adequacy constitutes an answer, then, to the second question regarding how knowledge of language is acquired.

Chomsky has acknowledged "if not a contradiction, at least a tension" between the twin pursuits of descriptive and explanatory adequacy (quoted in Haley & Lundsford, 1994, p. 134). According to Chomsky, to assert that a grammar has descriptive adequacy one has to show that the descriptive devices of the associated universal grammar theory are sufficiently rich to account for "the attested variety of languages" as well as "their possible variety" (1986, p. 51). However, "the richer the mechanisms, the harder it is to explain how anybody knows it" (quoted in Haley & Lundsford, 1994, p. 134). Hence, these same descriptive devices of the universal grammar have to be "meager enough" such that "only a few languages, or just one, are determined by

the given data" (1986, pp. 51–52) (Botha, 1989, pp. 169–170). This tension between the requisite richness of the descriptive devices, on the one hand, and their requisite meagerness, on the other, makes the attainment of both descriptive and explanatory adequacy a very difficult task.

As we have seen, Chomsky's pursuit of descriptive adequacy over the decades has resulted in a complex system of rules for generating expressions. Chomsky's earliest accounts provided a rule system with two types of syntactic rules: phrase structure rules and transformational rules. Unfortunately, "Both types of rules allow a wide range of options . . . and the availability of these options makes it extremely difficult to account for the fact that a specific language is fixed by the available evidence" (1986, p. 83). In other words, positing phrase structure rules and transformational rules makes it very difficult to attain explanatory adequacy. As Chomsky and Lasnik (1995) later bluntly admitted, "To achieve descriptive adequacy, it seemed necessary to enrich the format of permissible systems, but in doing so *we lose the property of feasibility* [italics added]" (p. 24). This difficulty has led Chomsky to "efforts to reduce the variety of possible rule systems." As a consequence of those efforts, Chomsky concluded that the existence of phrase structure rules is "particularly suspect." He has reasoned that these rules can be eliminated from the grammar "insofar as they merely restate, in another form, the essential content of lexical entries." In short, "it seems . . . that there are no rules of this type in language" (1986, p. 83).

Regarding transformational rules, Chomsky (1986) initially found no similar reason for questioning their existence. However, he stated that "the variety of these rules can be significantly reduced" (p. 83). Specifically, he suggested the rules may be reduced to either the "move alpha" or "affect alpha" principles accompanied by some parametric variation. Roughly

translated, the "move alpha" principle means move anything anywhere, whereas the broader "affect alpha" principle means "do anything to anything" (Chomsky quoted in Haley & Lundsford, 1994, p. 146). Abandoning his earlier rule-based account, Chomsky (1986) stated that "What we know is not a rule system in the conventional sense. In fact, it might be that the notion of rule in this sense . . . has no status in linguistic theory" (p. 151). As a result of this new model, a radically new view of language has emerged.

In written works, lectures, and interviews subsequent to government binding theory, Chomsky has been more forceful and far-reaching in his rejection of rules as explicanda. Instead of simply reducing the number of transformational rules, he has now eliminated them. For example, in a 1989 interview Chomsky stated "there aren't any rules. That picture of language . . . just happens to be wrong. . . . There's no rule . . . of question formation or anything like that. There are just very general principles which are not particular to specific constructions" (Chomsky quoted in Haley & Lundsford, 1994, pp. 135–136). To reiterate, Chomsky's second conceptual shift, as it has matured, has clearly rejected rules as explicanda. According to this new theory—the principles-and-parameters approach—the initial state of a newborn's language faculty consists of a small number of principles and open parameters. These principles and open parameters constitute the universal grammar. A child acquires a particular language by the process of setting the values of the parameters (Cook, 1988, p. 57). This process of parameter setting occurs as a result of the child's exposure to linguistic data from the environment. When all the parameters are fixed, the language faculty achieves the steady state typical of a competent adult member of a language community.

Consider an example. A principle of universal grammar states that for any particular human language, all phrases

(e.g., noun, verb, preposition, and adjective phrases) are comprised of "heads" of a related type and possible "complements." For example, in the verb phrase *kick the ball*, the verb *kick* is the head and *the ball* is the complement; in the prepositional phrase *on the ground*, the preposition *on* is the head and *the ground* is its complement. As previously noted, this principle maintains that the heads are of a related type. Specifically, the head parameter allows two types: head first or head last. All the heads of phrases for a particular language are related by being either head first or head last. The value of the head parameter for the learner of a particular language is fixed by his or her experiences with that language. English is called a head-first language because the verb in a verb phrase occurs first in the phrase (*kick the ball*), the preposition in a prepositional phrase occurs first, and the like. Japanese, on the other hand, is a head-last language, (e.g., *I Japanese am*) (Cook, 1988, pp. 7–8). The English child and the Japanese child have different settings for the head parameter because they have different linguistic input from the environment.

Chomsky has attempted to make more salient the major features of this new model of the universal grammar by comparing it to a complex network containing a "switch box" with a finite number of switches. Parameter setting occurs when these switches are set:

> We can think of the initial state of the faculty of language as a fixed network connected to a switch box; the network is constituted of the principles of language, while the switches are the options to be determined by experience. When the switches are set one way, we have Bantu; when they are set another way, we have Japanese. Each possible human language is identified as a particular setting of the switches—a setting of parameters, in technical terminology. (Chomsky, 1997, p. 7)

The minimalist program. After government binding theory, Chomsky offered a second version of principles and parameters called the "minimalist program." Though not, according to

Chomsky, a separate theory, the minimalist program is nonetheless an adjunct of the principles-and-parameters approach and encompasses modifications in government binding theory. In the minimalist program, Chomsky has again argued that "There are . . . no language-particular rules" (Chomsky, 1995, p. 6), thereby sounding the death knell for rules—and therefore, for transformational grammar as well—within contemporary Chomskyan linguistic theory. In place of language-particular rules, Chomsky has now posited universal principles whose parameters are fixed by exposure to a particular language. In sum, then, the status of current Chomskyan linguistic theory is that it offers, in place of transformational grammar, the principles-and-parameters theory. In so doing, Chomsky has repudiated rules as explicanda of linguistic structure. Furthermore, given the centrality of rules within cognitivism, Chomsky's rejection of rules as explicanda constitutes a departure from that doctrine.

Rules and Cognitivism

As I have attempted to show, rules have occupied a central position in numerous versions of early (i.e., prior to the second conceptual shift) Chomskyan linguistic theory. The importance of rules to early Chomsky is also made apparent by noting the amount of space he has devoted in a number of his published works to a defense of a rule-based account. For example, in *Rules and Representations*, Chomsky (1980) devoted an entire chapter, as well as numerous other passages, to such a defense. Similarly, in *Knowledge of Language*, Chomsky (1986) again devoted a chapter to this task. Particularly noteworthy in that chapter is his detailed response to Kripke's (1982) version of a Wittgensteinian critique of rules. Also noteworthy is the fact that this defense of rules is offered in the same book wherein he announces his abandonment of rules. Such apparent ambivalence suggests the diffi-

culty Chomsky faced in jettisoning what was clearly a central part of his long-held theoretical views.

Speaking more generally, rules have also played a prominent role in numerous other explanations of human knowledge centering on the internal states and processes of the knower. In such accounts, the internal states and processes are typically described as providing the basis for, and being evidenced by, the knower's behavior. In short, rules and other internal states and processes are the primary subject matter; behavior plays the secondary role of being based on, and providing the outer evidence for, the inner contents of the mind. For example, in *Plans and the Structure of Behavior,* Miller, Galanter, and Pribram (1960) proposed a theory that asserted that all skilled behavior is based on a plan consisting of a set of rules (Reed, 1997). Similarly, in a book on the information-processing approach to cognitive psychology, Lachman, Lachman, and Butterfield (1979) asserted that "Language is an abstract system, governed by rules," and that "the child who learns his language must learn not only words and their meanings, but also the rules that govern their combinations" (p. 83).

Serving to buttress these theoretical accounts of rules with experimental data, researchers have also developed rule-based computer simulations of human cognitive activity. For example, rules occupied an important position in Newell and Simon's (1972) program General Problem Solver, and in Winograd's (1972) program SHRDLU (an application of Chomsky's rule-based theory to computer-simulated language comprehension). The fundamental assumption of these computer-based approaches is that a physical symbol system (Newell & Simon, 1976)—for example, a computer or a human mind—assembles symbols into expressions, and that rules then "create, modify, reproduce, or destroy" these symbolic expressions (Dror & Dascal, 1997, p. 218).

In the 1970s the term *cognitive science* first made its appearance (Gardner, 1985). The term refers to the contemporary activities of a number of individuals whose primary subject matter is the mind. More specifically, these individuals are concerned with cognition—with the "hows" and "whys" of knowledge. Eschewing mind–body dualism, they conceptualize talking about the mind as a way of talking about the design features of the brain at a level of abstraction considerably removed from actual brain structures. Drawn from a number of diverse disciplines, the cognitive scientists couch their accounts of cognition in terms of mental representations. Again, rules typically play a critical role in these accounts.

For example, in *The Mind's New Science,* an often-cited book that has served a canonical function within cognitive science, Gardner (1985) defines this approach to cognition as a

> contemporary, empirically based effort to answer long-standing epistemological questions. . . . Though the term *cognitive science* is sometimes extended to include all forms of knowledge—animate as well as inanimate, human as well as nonhuman—I apply the term chiefly to efforts to explain human knowledge. (p. 6)

According to Gardner, cognitive science is an explicitly multidisciplinary approach to the problem of explaining human knowledge. In particular, he has identified "philosophy, psychology, artificial intelligence, linguistics, anthropology, and neuroscience" (p. 7) as participating disciplines. In further describing cognitive science, he has identified as one of its "core assumptions" (p. 38) the view that talking about human cognitive processes necessitates discourse about *mental representations.* Elaborating, Gardner has asserted that this discourse also requires positing a level of mental analysis that is "wholly separate" from both the "biological or neurological" and the "sociological or cultural" levels (p. 6). Indeed, according to Gardner, the "major accomplishment of cognitive science has been the clear demonstration of the

validity of positing a level of mental representation," a level that is now "on essentially equal footing with these entrenched modes of discourse— with the neuronal level . . . and with the sociocultural level" (p. 383). As a result, "mental structures and operations" such as "schemas, images, *rules* [italics added], transformations" are "taken for granted and permeate the cognitive sciences" (p. 383).

In *The Language Instinct*, Pinker (1994) has offered an account of cognitive science that is nearly identical to that of Gardner's. Of course, given the subject matter of Pinker's book, the account is more narrowly focused. Like Gardner, Pinker's account focuses on human cognition—in the case of language, the focus is on what speaker-listeners know when they know a language. Pinker also views cognitive science as multidisciplinary; he identifies "psychology, computer science, linguistics, philosophy, and neurobiology" (p. 17) as the member disciplines. And, like Gardner, he sees mental structures and processes—principally, representations and rules—as playing an important role within cognitive science. "The representations that one posits in the mind" are comprised of "arrangements of symbols" (p. 78). These symbols represent "concepts and propositions in the brain in which ideas, including the meanings of words and sentences, are couched" (p. 478). To know a language, then, is to be able to translate these arrangements of symbols "into strings of words and vice versa" (p. 82). And to translate back and forth between arrangements of mental symbols and arrangements of words, we use a "set of rules" (p. 84).

To summarize, then, both Gardner and Pinker define cognitive science as an interdisciplinary approach to the study of mind that provides explanations of the latter in terms of mental representations and rules. Though doubtless accurate in its characterization, this definition can be critiqued on the grounds that it confuses the subject matter of cognitive science with the

dominant theoretical doctrine of cognitive science. As a way of disentangling subject matter and theory, Dreyfus (1995) has offered the following distinction. *Cognitive science* is "any theory about how the mind does what it does." On the other hand, *cognitivism* is the "special view" that "all mental phenomena" are comprised of the "manipulation of representations by *rules* [italics added]" (p. 72). Briefly expressed, Dreyfus' definition of cognitivism assumes much that is not stated.

Chomsky's abandonment of the use of rules within his theory represents a substantial departure from cognitivism. However, a fair question to ask is "Does it matter?" More specifically, one may inquire about the serious implications (if any) of this departure for Chomskyan theory. First, consider the issue of whether this departure implies that Chomsky's linguistic theory can no longer be counted as cognitivist in nature. Historically, Chomskyan theory has developed in a manner largely independent of established orthodoxy. For example, in writing *Syntactic Structures*, Chomsky (1957) rejected most of of what was then the dominant view of American linguistics; namely, post-Bloomfieldian structuralism. Similarly, Chomsky has developed the principles-and-parameters approach without any apparent concern for whether or not it represents a departure from cognitivism. Unlike many for whom the coherence of their theories depends on closely adhering to a school of thought, Chomsky's theorizing has often been at odds with those espousing cognitivism. For example, Chomsky has consistently embraced the "core assumption" (Gardner, 1985, p. 38) of mental representations, but he has also been consistently at odds with one of the other core assumptions identified by Gardner; namely, the view that the computer "serves as the most viable model of how the human mind functions" (Gardner, 1985, p. 6).

For example, Chomsky (1993) has characterized as a "dubious move" the

use of computer models to study phenomena such as rule following in humans. With human artifacts like computers, "There is no natural kind or normal case" (p. 43). So, determining whether any particular computer is "malfunctioning, following a rule, etc." (p. 43) cannot be determined by comparing it to computers in general. Rather, answering such questions about a particular computer requires answering questions about the designer of the computer or program. So, in determining whether a computer is, say, following a rule, one must consider the "designer's intent, standard use, mode of interpretation, and so on" (p. 43). According to Chomsky, "Such questions do not arise in the study of organic molecules, nematodes, the language faculty, or other natural objects, viewed . . . as what they are, not in a highly intricate and shifting space of human interests and concerns" (pp. 43–44).

For Chomsky, then, the validity of the principles-and-parameters approach, like Chomskyan theorizing in general, does not depend on its upholding the orthodox view—in this case, cognitivism *qua* a rule-based account. However, the validity of contemporary Chomskyan theory will certainly be evaluated on other grounds. Admittedly, it may be too early to accomplish this evaluation. The theory is relatively new and has undergone, and will mostly likely further undergo, revisions at a somewhat rapid pace. However, as its major premises become clear and established, Chomsky's theory will be evaluated in its answers to a number of questions. Chief among them are the following: How do the general principles of language with fixed parameters "do the work" previously assigned to rules operating on mental representations? What role, specifically, does linguistic experience play in the fixing of parameters? How, specifically, do principles with their parameters fixed interact to yield linguistic competence? A curious audience awaits Chomsky's replies to these and other questions.

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