

LINGUISTICS AND PSYCHOLINGUISTICS TWELVE YEARS AFTER CHOMSKY'S REVIEW OF SKINNER'S *VERBAL BEHAVIOR*

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In 1959 Noam Chomsky wrote his now-famous review of B. F. Skinner's *Verbal Behavior*. An unfortunate result of that otherwise excellent article was that many linguists and psychologists have not spoken to each other since—except in emotion-charged polemics from time to time. There exists, however, a small (but growing) band of psychologists who have embraced Chomskian linguistics and who employ the techniques and philosophy of experimental psychology in their attempts to discover how a human being uses his native language. The activities of these psychologists—whom we shall call “cognitive psycholinguists”—are not clear to many of their colleagues whose exposure to linguistics begins and ends with Chomsky's review of Skinner.

The purpose of the present paper is to explain to interested colleagues just what it is that cognitive psycholinguists do: what are our philosophical orientations, our theoretical goals, and our experimental strategies. There will be no polemics here. Theoretical positions will be reported, not argued. One word of caution before we begin: The field of cognitive psycholinguistics, being in its infancy, is in a state of flux and it would probably be impossible to find any two psycholinguists who agree on all theoretical and procedural details. This paper may—because of its brevity—give a false illusion of homogeneity among cognitive psycholinguists.

In order to understand cognitive psycholinguistics, one must first have a feel for the direction taken by linguistics since about 1957. At the end of the 50's American linguistics underwent a true scientific revolution (Kuhn, 1962). Prior to that period, American linguists had accepted the thesis that all the essential properties of human languages could be described by characterizing sentences as serially ordered strings of discrete units. The task of the linguist was that of discovering and cataloguing—for each individual language—those discrete units (Wells, 1947). The theoretical principles of most interest to linguists were the procedures by which they were to go about discovering the basic linguistic units and the criteria to be applied to be sure that their lists were correct. Linguists

believed that human languages could vary infinitely and obeyed no universal constraints. These investigators went about their science producing brilliant taxonomies of the linguistic units (allophones, phonemes, morphemes) of the languages of the world.

The generative transformational linguists, led by Chomsky, differed from the taxonomists in their most basic beliefs about what constitutes a language (Chomsky, 1964). External, observable linguistic events (such as sentences uttered or written) are regarded as the end product of the operation of a system of very complex rules of grammar (Chomsky, 1965). The task of the linguist who is trying to describe a language, then, is to come up with a set of rules which produces, generates, or describes all and only the sentences which a naive native speaker would agree are sentences of his language. If the linguist's rules did not generate all the sentences which would be so judged, then he would be failing to describe some of the linguistic processes of the language. If, on the other hand, the rules generated some sentence types which the native speaker would judge as not possible sentences of his language, then the theory would be in the position of making false predictions.

The model of linguistic description which has emerged from the investigations undertaken since the revolutionary developments of the late fifties is as follows: Basic to every language is a set of "phrase structure rules"—which may be universal for all languages—which generate the 'deep structure' of sentences. The deep structure of sentences specifies all that is necessary to determine the meaning of a sentence as well as its superficial shape, or 'surface structure.' The 'surface structure' is produced by applying "transformational rules" to deep structures. That it is necessary to distinguish between deep structure and surface structure representations of sentences can be seen from the following examples:

(1) He expected the doctor to examine John.

(2) He persuaded the doctor to examine John.

Superficially, these sentences seem to have the same surface structure. In both cases, a superficial syntactic analysis—essentially like that we learned to perform in grade school—would show 'the doctor' to be the object of the main verbs 'expect' and 'persuade.' The following two sentences show, however, that the deep structure of any sentence containing 'expect' must be different from the deep structure of any sentence containing 'persuade':

(3) John expected to be examined by the doctor.

(4) *John persuaded to be examined by the doctor.

Any native speaker of English would immediately recognize (4) as not being a sentence of English—this is symbolized by the "*" before

the sentence. These cases show that the syntactic patternings of 'expect' and 'persuade' are different. A mere superficial analysis of these sentences is not adequate for explaining this difference; the concept of deep structure is necessary for properly characterizing the syntactic patterning which accounts for the grammaticality of (1), (2), and (3), but the ungrammaticality of (4). Again, phrase structure rules produce (or generate) deep structures, which are then transformed into surface structures by transformational rules. Note that transformational rules do not generate new structures, nor do phrase structure rules transform structures produced by other rules.

One of the deep philosophical differences between the transformationalists and the taxonomists was not their method of data collection, but their differing conceptions of the relationship between theory and data. It is important to explore this issue for a moment, because it is just this philosophical stance which distinguishes the cognitive psycholinguist from his behavioristic colleagues. Recall that the only theoretical principle of the taxonomists was a set of discovery procedures, the application of which was guaranteed to yield a correct taxonomy of the language under analysis. Those procedures were defined over the superficial characteristics of the language being analyzed. The structure of the data (the sentences accepted as correct by native speakers) was to lead the linguist inexorably to the correct solution if he made no procedural errors. On the transformationalist view, however, the theory (or grammar or linguistic description) is not *determined* by the data in any direct way. The only requirement data places on theory, in fact, is that the theory correctly predict the data (e.g., sentence in the language). The linguistic description itself is subject to constraints of internal consistency and parsimony. Theories of individual languages are further constrained by linguistic metatheory, which specifies the formal characteristics of grammars of natural languages. Linguistic metatheory is alternatively referred to as universal linguistic theory, for it is a theory of the commonalities among the languages of the world.

The psychological claim of the linguist is that the grammar of a particular language is a formal characterization of the knowledge that a native speaker has about his language. This knowledge is frequently referred to as the linguistic competence of the native speaker (Fodor and Garrett, 1966). The demonstration by Chomskian linguists that language (and linguistic knowledge) cannot be conceptualized as a linear string of units leads to the proposition that linguistic performance (the production and comprehension of utterances) cannot be explained by response chains, no matter how se-

ductively they are presented as internal mediating variables (see, for instance, Mowrer, 1954). Response chains are composed of basic $s \rightarrow r$ units bound together (ultimately) by the Law of Effect. Linguistic theory claims, however, that every human being has at his command abstract structures which are unobservable, and, hence, in principle unreinforceable. If the mechanisms of language learning cannot be reinforced stimulus-response units, then it follows, of course, that adult linguistic behavior cannot be explained with reference to chains of mediated responses.

The Chomskian view of linguistic structures also precludes the existence of "laws" of linguistic performance which can be discovered by observing superficial relationships between observable aspects of language behavior. This is just to say that an analysis of observable linguistic behavior can no more lead ineluctably to a theory of linguistic performance than an analysis of the superficial linguistic units could lead the taxonomist to a correct description of a particular language. A theory of linguistic performance, like a theory of linguistic competence, must postulate abstract structures and processes *which are qualitatively different from observable ones* in order to predict (and thus explain) the data.

Let us return to the concept of linguistic competence. The theoretical claim is that the native speaker has at his disposal a formal grammar of his language. The existence of this underlying linguistic competence enables the native speaker to have certain intuitions about his language. Consider the now classical example of sentences (5) and (6):

(5) John is easy to please.

(6) John is eager to please.

Every native speaker of English knows that 'John' is the object of the verb 'to please' in (5), but the subject in (6). The grammar of English describes deep structures for (5) and (6) which attribute different underlying grammatical relations to the 'John,' i.e., 'object of the verb' in the structure underlying (5) and 'subject of the verb' in the structure underlying (6).

Judgments of ambiguity can also be explained with reference to deep structures. A sentence which has more than one meaning, such as (7), has as many deep structures associated with it as it has meanings.

(7) The elephant is ready to lift.

In the case of (7) there is one structure which specifies 'the elephant' as subject of the verb 'to lift' and another which specifies it as the object of that verb. The goal of a linguistic description is not only to produce all and only the sentences of a language judged

correct by a native speaker; a descriptively adequate grammar should also match the native speaker's intuitively based judgments of ambiguity, grammatical relationships, etc.

A person's linguistic competence is only one of a number of determinants of his actual linguistic performance, i.e., producing and understanding sentences. A great many psychological and physical factors (such as short term memory, long term memory, the auditory system—to name but a few) interact with the internalized grammar. That this must be so follows from the fact that no one speaks in perfectly formed sentences at all times—nor is comprehension infallible. Thus, cognitive psycholinguistic theory distinguishes between linguistic competence and linguistic performance, the former being the domain of the theoretical linguist, the latter being the domain of the psycholinguist.¹

The psycholinguist attempts to specify the psychological processes and structures necessary to explain linguistic performance. In addition, he expects to be able to specify in a complete psycholinguistic theory exactly how linguistic variables (i.e., variables defined in competence theory) interact with performance variables to produce linguistic behavior. In short, the task of the psycholinguist is to specify how the speaker-hearer uses his linguistic competence in everyday speech acts.

The basic experimental strategy of the psycholinguist is to select independent variables which are definable within linguistic theory, vary them systematically, and determine their effect upon various quantifiable dimensions of linguistic performance. The effects thus produced form the data which must be explained (or predicted) by performance theory. There is no expectation that a theory of linguistic performance will be induced from a knowledge of the systematic relationships between independent and dependent variables in the system. The theory is constrained, not determined, by the performance data.

Consider the theory put forth by Fodor and Garrett (1967). That theory assumes that when a person hears a sentence his Language Comprehension Device (LCD)—given only the surface structure of the utterance—must recover the deep structure of the utterance in order to complete its meaning. The comprehension difficulty of a sentence, then, will vary systematically with the number of clues to its deep structure which are present in its surface structure. One

¹The theoretical relationship between competence and performance is the focus for some discussion among psycholinguists. Bever (1970), in particular, has argued that the demarcation between competence and performance cannot and should not be so sharply drawn.

such clue is the existence of a relative pronoun, such as 'whom' in sentence (8):

(8) The girl whom the boy hit ran home.

The relative pronoun immediately signals the LCD that 'the girl' is the subject of one deep structure sentence and the object of another, the subject of which is 'the boy.' The Fodor and Garrett theory, therefore, predicts that a sentence such as (9):

(9) The girl the boy hit ran home,

will be more difficult to understand than (8). A number of different experiments (Fodor and Garrett, 1967; Hakes and Cairns, 1970) have systematically varied the presence *vs.* absence of relative pronouns in stimulus sentences. Those sentences which have undergone relative pronoun deletion (which, incidentally, is a transformational rule in the grammar of English) have, in fact, been shown to be more difficult on a number of different dependent measures.

It should also follow from the Fodor-Garrett theory that if a surface structure contains ambiguous cues—that is, if the information contained in surface structure is compatible with more than one deep structure—then comprehension complexity should increase accordingly. Such local ambiguity is associated with a particular sort of verb and leads to what Fodor, Garrett, and Bever (1968) have referred to as the "verb complexity hypothesis." There are verbs which are 'pure transitive' verbs—that is, they can be followed only by a direct object. 'Hit' is such a verb, illustrated in sentence (10). Other 'complex verbs' can be followed by either a direct object [as in sentence (11)] or by a complement sentence (which appears in surface structure as a clause) as in (12). 'See' is a complex verb. Note that (13) is ungrammatical just because 'hit' is a pure transitive.

(10) The man hit the ball.

(11) The man saw the ball.

(12) The man saw that the ball was red.

(13) *The man hit that the ball was red.

Let us further assume that as it receives an utterance, the LCD considers all possible structural hypotheses compatible with the surface structure of the sentence. We would then predict that comprehension complexity would be positively related to the number of structures potentially associated with the main verb. Thus, complex verbs such as 'see' should induce the LCD to form more structural hypotheses than a pure transitive verb such as 'hit.' In a series of experiments designed to test this hypothesis, Fodor, *et al.* (1968) used invariant sentence frames (each containing a direct object), varying the type of verb (either pure transitive or complex). Using

paraphrasing accuracy as the dependent measure, the authors demonstrated that sentences containing complex verbs were more difficult to process and the "verb complexity hypothesis" was confirmed.

Further support for the theory that the LCD considers all possible structural hypotheses as it receives a sentence comes from a group of experiments investigating the processing of structurally ambiguous sentences, such as (7) ('The elephant is ready to lift.'). (Foss, Bever and Silver, 1968; Cairns, 1971.) These experiments indicate that not only are both structures of the ambiguous sentence available to the comprehension device at some point in the processing of the sentence, but it is possible, under certain conditions, for the device to have access to both structures for a brief period of time.

The LCD, then, is seen as a complex processor which takes information available in a surface structure and uses that information to project hypotheses about the deep structure of the sentence. The unit of analysis adopted by the LCD is thought to be the underlying sentence (which usually appears as a clause in surface structure). A number of experiments which are reviewed and interpreted in Bever, Lackner and Kirk (1969) support the hypothesis that the underlying sentence is in fact the primary unit of speech perception and comprehension analysis. Using a technique originated by Broadbent and Ladefoged (Broadbent, 1958), audible clicks were introduced onto tape recorded sentences. The subject's task was simply to report the point in the sentence at which he perceived the click to have been located. Subjects reported that the clicks occurred nearer the clause boundaries than they objectively occurred. That is, the extraneous noise was subjectively displaced to the end of the clause boundaries. A click occurring in 'rains' in sentence (14) would, for instance, be reported as occurring between 'rains' and 'we.'

(14) If it rains, we will get wet.

This subjective displacement of the clicks was interpreted as being the result of attention oscillation to preserve the integrity of the perceptual unit, the clause.

In 1965, George Miller published his "Preliminaries to Psycholinguistics," telling everyone who cared to listen that it would not be an easy task to figure out how people use language. The hypothetical constructs which have been developed and the processes which have been postulated during these intervening six years have presented more new questions than answers to old ones. This is, of course, as it should be. The one indispensable prerequisite to doing good science is, after all, asking the right questions. Six years of research have, however, lent greater credence to Miller's words: "Language is just that—complex, arbitrary, improbable, mentalistic—and no amount of

wishful theorizing will make it anything else. In a word what I am trying to say . . . is simply this: Language is exceedingly complicated."

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