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Some Preliminaries to Psycholinguistics

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The success of behavior theory in describing certain relatively simple correlations between stimulation and response has encouraged experimental psychologists to extend and test their theories in more complicated situations. The most challenging and potentially the most important of these extensions, of course, is into the realm of linguistic behavior. Consequently, in recent years we have seen several attempts to characterize human language in terms derived from behavioristic investigations of conditioning and learning in animals. These proposals are well known, so I will make no attempt to summarize them here. I will merely say that, in my opinion, their results thus far have been disappointing.

If one begins the study of a new realm of behavior armed with nothing but hypotheses and generalizations based on experience in some quite different area, one's theoretical

preconceptions can be badly misleading. Trivial features may be unduly emphasized, while crucially important aspects may be postponed, neglected, or even overlooked entirely. These hazards are particularly dangerous when we generalize across species, or from nonverbal to verbal behavior.

The impulse to broaden the range of phenomena to which our concepts can be applied is commendable. But when this enthusiasm is not guided by a valid conception of the new phenomena to be explained, much intelligent enterprise can end in frustration and discouragement. Human language is a subtle and complex thing; there are many aspects that, if not actually unique, are at least highly distinctive of our species, and whose nature could scarcely be suspected, much less extrapolated from the analysis of nonverbal behavior.

It was with such thoughts in mind that I decided to take this opportunity to summarize briefly seven aspects of human language that should be clearly understood by any psychologist who plans to embark on explanatory ventures in psycholinguistics. The ideas are familiar to most people working in the field, who could no doubt easily double or treble their number. Nevertheless, the seven I have in mind are, in my opinion, important enough to bear repeating and as yet their importance does not seem to have been generally recognized by other psychologists.

Without further apologies, therefore, let me begin my catalogue of preliminary admonitions to anyone contemplating language as a potential subject for his psychological ratiocinations.

A Point of View

It is probably safe to say that no two utterances are identical in their physical (acoustic and physiological) characteristics. Nevertheless, we regularly treat them as if they were. For example, we ask a subject to repeat something we say, and we count his response as correct even though it would be a simple matter to demonstrate that there were many physical differences between his vocal response and the vocal stimulus we presented to him. Obviously, not all physical aspects of speech are significant for vocal communication.

The situation is more complicated than that, however. There are also many examples - homophones being the most obvious - where stimuli that are physically identical can have different significance. Not only are physically different utterances treated identically, but physically identical utterances can be treated differently. It may often happen that the difference in significance between two utterances cannot be found in any difference of a physical nature, but can only be appreciated on the basis of psychological factors underlying the physical signal.

The problem of identifying significant features of speech is complicated further by the fact that some physical features are highly predictable in nearly all speakers, yet have no communicative significance. For example, when a plosive consonant occurs initially, as in the word *pen*, American speakers pronounce it with aspiration; a puff of air accompanies the *p* (which you can feel if you will pronounce *pen* holding the back of your hand close to your lips). When *p* occurs as a nominal member of a consonant cluster, however, as in *spend*, this puff of air is reduced or absent. The same phoneme is aspirated in one position and unaspirated in the other. This physical feature, which is quite reliable in American speech, has no communicative significance, by which I mean that the rare person who does not conform is perfectly intelligible and suffers no handicap in communicating with his friends. Facts such as these, which are well known to linguists, pose interesting problems for

psychologists who approach the acquisition of language in terms of laboratory experiments on discrimination learning.

In order to discuss even the simplest problems in speech production and speech perception, it is necessary to be able to distinguish significant from nonsignificant aspects of speech. And there is no simple way to draw this distinction in terms of the physical parameters of the speech signal itself. Almost immediately, therefore, we are forced to consider aspects of language that extend beyond the acoustic or physiological properties of speech, that is to say, beyond the objective properties of "the stimulus."

Since the concept of significance is central and unavoidable, it is important to notice that it has two very different senses, which for convenience, I shall call "reference" and "meaning."

For example, in most contexts we can substitute the phrase "the first President of the United States" for "George Washington," since both of these utterances refer to the same historical figure. At least since Frege's time, however, it has been customary to assume that such phrases differ in meaning even though their referent is the same. Otherwise, there would be no point to such assertions of identity as "George Washington was the first President of the United States." If meaning and reference were identical, such an assertion would be as empty as "George Washington was George Washington." Since "George Washington was the first President of the United States" is not a pointless assertion, there must be some difference between the significance of the name "George Washington" and of the phrase "the first President of the United States," and, since this difference in significance is not a difference of referent, it must be a difference in something else - something else that, for want of a better name, we call its meaning.

This distinction between reference and meaning becomes particularly clear when we consider whole utterances. An utterance can be significant even though it might be extremely difficult to find anything it referred to in the sense that "table" refers to a four-legged, flat-topped piece of furniture, etc. Sentences are meaningful, but their meaning cannot be given by their referent, for they may have none.

Of course, one might argue that psycholinguists should confine their attention to the significance of isolated words and avoid the complexities of sentences altogether. Such an approach would be marvellously convenient if it would work, but it would work only if words were autonomous units that combined in a particularly simple way. If the meaning of a sentence could in some sense be regarded as the weighted sum of the meanings of the words that comprise it, then once we knew how to characterize the meanings of individual words, it would be a simple matter to determine the meaning of any combination of words. Unfortunately, however, language is not so simple; a Venetian blind is not the same as a blind Venetian.

Perhaps the most obvious thing we can say about the significance of a sentence is that it is not given as the linear sum of the significance of the words that comprise it. The pen in "fountain pen" and the pen in "play pen" are very different pens, even though they are phonologically and orthographically identical. The words in a sentence interact.

In isolation most words can have many different meanings; which meaning they take in a particular sentence will depend on the context in which they occur. That is to say, their meaning will depend both on the other words and on their grammatical role in the sentence. The meanings to be assigned to word combinations can be characterized in an orderly way, of course, but not by some simple rule for linear addition. What is required is an elaborate description of the various ways in which words can interact in combination.

As soon as we begin to look carefully at the relations among words in sentences, it becomes obvious that their interactions depend on the way they are grouped. For example, in sentences like, "They are hunting dogs," one meaning results if we group "are hunting" together as the verb, but another meaning results if we group "hunting dogs" together as a noun phrase. We cannot assign meanings to words in a sentence without knowing how the words are grouped, which implies that we must take into account the syntactic structure of the sentence.

Moreover, when we consider the psychology of the sentence, the problem of productivity becomes unavoidable. There is no limit to the number of different sentences that can be produced in English by combining words in various grammatical fashions, which means that it is impossible to describe English by simply listing all its grammatical sentences. This fairly obvious fact has several important implications. It means that the sentences of English must be described in terms of *rules* that can generate them.

For psychologists, the implication of this generative approach to language is that we must consider hypothetical constructs capable of combining verbal elements into grammatical sentences, and in order to account for our ability to deal with an unlimited variety of possible sentences, these hypothetical constructs must have the character of linguistic rules.

Language is the prime example of rule-governed behavior, and there are several types of rule to consider. Not only must we consider syntactic rules for generating and grouping words in sentences; we must also consider semantic rules for interpreting word combinations. Perhaps we may even need pragmatic rules to characterize our unlimited variety of belief systems. Only on the assumption that a language user knows a generative system of rules for producing and interpreting sentences can we hope to account for the unlimited combinatorial productivity of natural languages.

Rules are not laws, however. They can be broken, and in ordinary conversation they frequently are. Still, even when we break them, we usually are capable of recognizing (under appropriate conditions) that we have made a mistake; from this fact we infer that the rules are known implicitly, even though they cannot be stated explicitly.

A description of the rules we know when we know a language is different from a description of the psychological mechanisms involved in our use of those rules. It is important, therefore, to distinguish here, as elsewhere, between knowledge and performance; the psychologist's task is to propose and test performance models for a language user, but he must rely on the linguist to give him a precise specification of what it is a language user is trying to use.

Finally, it is important to remember that there is a large innate component to our language-using ability. Not just any self-consistent set of rules that we might be able to invent for communicative purposes could serve as a natural language. All human societies possess language, and all of these languages have features in common — features that are called "language universals," but are in fact pre-linguistic in character. It is difficult to imagine how children could acquire language so rapidly from parents who understand it so poorly unless they were already tuned by evolution to select just those aspects that are universally significant. There is, in short, a large biological component that shapes our human languages.

These are the seven ideas I wished to call to your attention. Let me recapitulate them in order, this time attempting to say what I believe their implications to be for psycholinguistic research.

Some Implications for Research

1 *Not all physical features of speech are significant for vocal communication, and not all significant features of speech have a physical representation.* I take this to imply that the perception of speech involves grouping and interpreting its elements and so cannot be simply predicted from studies of our ability to discriminate among arbitrary acoustic stimuli. Such studies can be useful only in conjunction with linguistic information as to which distinctions are significant. Linguists seem generally agreed that the absolute physical characteristics of a particular phone are less important than the binary contrasts into which it enters in a given language. It is noteworthy that after many decades of acoustic phonetics, we are still uncertain as to how to specify all the physical dimensions of the significant features of speech, particularly those that depend on syntactic or semantic aspects of the utterance.

2 *The meaning of an utterance should not be confused with its reference.* I take this to imply that the acquisition of meaning cannot be identified with the simple acquisition of a conditioned vocalization in the presence of a particular environmental stimulus. It may be possible to talk about reference in terms of conditioning, but meaning is a much more complicated phenomenon that depends on the relations of a symbol to other symbols in the language.

3 *The meaning of an utterance is not a linear sum of the meanings of the words that comprise it.* I take this to imply that studies of the meanings of isolated words are of limited value, and that attempts to predict the meaning of word compounds by weighted averages of the meanings of their components — an analogy with the laws of color mixture — cannot be successful in general. In Gestalt terminology, the whole is greater than (or at least, different from) the sum of its parts.

4 *The syntactic structure of a sentence imposes groupings that govern the interactions between the meanings of the words in that sentence.* I take this to imply that sentences are hierarchically organized, and that simple theories phrased in terms of chaining successive responses cannot provide an adequate account of linguistic behavior. Exactly how concepts are combined to produce organized groupings of linguistic elements that can be uttered and understood is a central problem for psycholinguistics.

5 *There is no limit to the number of sentences or the number of meanings that can be expressed.* I take this to imply that our knowledge of a language must be described in terms of a system of semantic and syntactic rules adequate to generate the infinite number of admissible utterances. Since the variety of admissible word combinations is so great, no child could learn them all. Instead of learning specific combinations of words, he learns the rules for generating admissible combinations. If knowledge of these rules is to be described in our performance models as the language user's "habits," it is necessary to keep in mind that they are generative habits of a more hypothetical and less abstract nature than have generally been studied in animal learning experiments.

6 *A description of a language and a description of a language user must be kept distinct.* I take this to imply that psycholinguists should try to formulate performance models that will incorporate, in addition to a generative knowledge of the rules, hypothetical information-storage and information-processing components that can simulate the actual behavior of language users. In general, limitations of short-term memory seem to impose the most severe constraints on our capacity to follow our own rules.

7 *There is a large biological component to the human capacity for articulate speech.* I take this to imply that attempts to teach other animals to speak a human language are doomed to failure. As Lennberg has emphasized, the ability to acquire and use a human language does not depend on being intelligent or having a large brain. It depends on being human.

In science, at least half the battle is won when we start to ask the right questions. It is my belief that an understanding of these seven general propositions and their implications can help to guide us toward the right questions and might even forestall ill-considered forays into psycholinguistics by psychologists armed only with theories and techniques developed for the study of nonverbal behavior.

A Critique

I have now stated twice my seven preliminary admissions. In order to make sure that I am being clear, I want to repeat it all once more, this time in the form of a critical analysis of the way many experimental psychologists write about language in the context of current learning theory.

For the purposes of exposition, I have chosen a sentence that is part of the introduction to the topic of language in a well-known and widely used textbook on the psychology of learning. After remarking that, "language seems to develop in the same way as other instrumental acts," the author says:

Certain combinations of words and intonations of voice are strengthened through reward and are gradually made to occur in appropriate situations by the process of discrimination learning.

This, I believe is fairly representative of what can be found in many other texts. I have chosen it, not because I bear any malice toward the author, but simply because I think that all seven of my admissions are ignored in only 27 words. Let me spell them out one by one.

First, since infants are not born with a preconception of what words are, they could hardly be expected to begin acquiring language by uttering combinations of words. Perhaps the author was not thinking of infants when he wrote this sentence. If he had been, he would probably have written instead that, "Certain combinations of *sounds* and intonations of voice are strengthened through reward and made to occur by the process of discrimination learning." In either case, however, he ignores my first admission that not all physical features of speech are significant and not all significant features are physical.

A child does not begin with sounds or words and learn to combine them. Rather, he begins by learning which features are significant, and progressively differentiates his utterances as he learns. It is conceivable, though not necessary, that he might acquire those significant distinctions that have some physical basis "by the process of discrimination learning," but it would require an extensive revision of what we ordinarily mean by discrimination learning in order to explain how he acquires significant distinctions that are not represented in the physical signal, or why he acquires those features (such as aspiration only on initial plosives) that are not significant and are not systematically rewarded or extinguished.

Second, as I have already admitted (too generously, perhaps), it is possible to argue that a referential relation might be established between a visual input and a vocalization "by the

process of discrimination learning." I deny, however, that it is reasonable to speak of acquiring meaning in this way.

Exactly what should be included in the meaning of a word is open to debate, but any interpretation will have to say something about the relation of this word's meaning to the meanings of other words and to the contexts in which it occurs – and these are complicated, systemic interrelations requiring a great deal more cognitive machinery than is necessary for simple discrimination. Since the author says specifically that *words* are acquired by discrimination learning, and since words have meaning as well as reference, I can only assume that he has ignored my admission not to confuse reference and meaning. Perhaps a more accurate interpretation, suggested by the phrase "occur in appropriate situations," would be that he has not really confused reference and meaning, but has simply ignored meaning entirely. In either case, however, it will not do as a basis for psycholinguistics.

There is unfortunate ambiguity in the phrase, "Certain combinations of words and intonations of voice." I am not sure whether the author meant that each word was learned with several intonations, or that we learn several intonations for word combinations, or that we learn both to combine words and to modulate the pitch of our voice. Consequently, I have been forced to cheat on you by examining the context. What I found was no help, however, because all the formal propositions referred simply to "words," whereas all the examples that were cited involved combinations of words.

Perhaps I am being unfair, but I think that this author, at least when he is writing on learning theory, is not deeply concerned about the difference between words and sentences. If this distinction, which seems crucial to me, is really of no importance to him, then he must be ignoring my third admission that the meaning of words are affected by the sentences in which they occur.

My fourth admission – that the syntactic structure of a sentence imposes groupings that govern the interactions between the meanings of its words – is also ignored. No matter how I interpret the ambiguous phrase about, "Certain combinations of words and intonations of voice," it must be wrong. If I read it one way, he has ignored the problem of syntax entirely and is concerned only with the conditioning of isolated word responses. Or, if I put a more generous interpretation on it and assume he meant that combinations of words are strengthened and made to occur by discrimination learning, then he seems to be saying that every word and every acceptable combination of words is learned separately.

By a rough but conservative calculation, there are at least 10²⁰ sentences 20 words long, and if a child were to learn only these it would take him something on the order of 1,000 times the estimated age of the earth just to listen to them. Perhaps this is what the word "gradually" means? In this interpretation he has clearly violated my fifth admission, that there is no limit to the number of sentences to be learned, and so has wandered petulantly close to absurdity. Any attempt to account for language acquisition that does not have a generative character will encounter this difficulty.

Sixth, from the reference to responses being "strengthened" I infer that each word-object connection is to be characterized by an intervening variable, along the lines of habit strength in Hull's system. This is a rather simple model, too simple to serve as a performance model for a language user, but it is all our author has to offer. As for keeping his performance model distinct from his competence model, as I advise in my sixth admission, he will have none of it. He says – and here I resort to the context once more – that language "is a complex set of responses [and] also a set of stimuli." It may be defensible to talk about speech as a set of responses and stimuli, but what a language user knows about his language cannot be described in these performance terms.

A language includes all the denumerable infinitude of grammatical sentences, only a tiny sample of which ever have occurred or ever will occur as actual responses or stimuli. The author would blush crimson if we caught him confusing the notions of sample and population in his statistical work, yet an analogous distinction between speech and language is completely overlooked.

Finally, we need to make the point that the kind of reinforcement schedule a child is on when he learns language is very different from what we have used in experiments on discrimination learning. No one needs to monitor a child's vocal output continually and to administer "good" and "bad" as rewards and punishments. When a child says something intelligible, his reward is both improbable and indirect. In short, a child learns language by using it, not by a precise schedule of rewards for grammatical vocalizations "in appropriate situations." An experimenter who used such casual and unreliable procedures in a discrimination experiment would teach an animal nothing at all.

The child's exposure to language should not be called "teaching." He learns the language, but no one, least of all an average mother, knows how to teach it to him. He learns the language because he is shaped by nature to pay attention to it, to notice and remember and use significant aspects of it. In suggesting that language can be taught "by the process of discrimination learning," therefore, our author has ignored my final admonition to remember the large innate capacity humans have for acquiring articulate speech.

In summary, if this sentence is taken to be a description of the fundamental processes involved in language acquisition, it is both incomplete and misleading. At best, we might regard it as a hypothesis about the acquisition of certain clichés or expressive embellishments. But as a hypothesis from which to derive an account of the most obvious and most characteristic properties of human language, it is totally inadequate.

This completes the third and final run through my list of preliminaries to psycholinguistics. If I sounded a bit too contentious, I am sorry, but I did not want to leave any doubt as to why I am saying these things or what their practical implications for psycholinguistic research might be.

My real interest, however, is not in deploring this waste of our intellectual resources, but in the positive program that is possible if we are willing to accept a more realistic conception of what language is.

If we accept a realistic statement of the problem, I believe we will also be forced to accept a more cognitive approach to it: to talk about hypothesis testing instead of discrimination learning, about the evaluation of hypotheses instead of the reinforcement of responses, about rules instead of habits, about productivity instead of generalization, about innate and universal human capacities instead of special methods of teaching vocal responses, about symbols instead of conditioned stimuli, about sentences instead of words or vocal noises, about linguistic structure instead of chains of responses — in short, about language instead of learning theory.

The task of devising a cognitive production model for language users is difficult enough without wearing blinders that prevent us from seeing what the task really is. If the hypothetical constructs that are needed seem too complex and arbitrary, too improbable and mentalistic, then you had better forgo the study of language. For 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, what all my preliminary admonitions boil down to, is simply this: Language is exceedingly complicated. Forgive me for taking so long to say such a simple and obvious thing.

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