

OPTICAL ILLUSIONS AND GRAMMAR BLINDNESS

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This paper is dated May 17, 1960; it was duplicated and circulated informally. Like the much better known Chomsky (1961b), it is a reply to the remarks of Hill (1961) on the notion of grammaticality. It does not appear to have been cited in any other publication, above ground or underground.

Suppose a chemist wished to study the effect of water on iron and that he prepared the following experiment to test the hypothesis that iron rusts in water. A number of small iron rods are prepared and given to a class of freshmen, acting as informants, to examine before and after placing them in glasses of water. The following experimental results are obtained:

- 1) Informant A reports no effect. He understands about rusting but finds no rusting after placing his rod in the glass.
- 2) Informant B reports that water causes iron rods to bend. He does not know about rusting and simply reports what he sees. He also is ignorant of refraction of light.
- 3) Informant C reports that water rusts iron. He

knows about rusting and also knows that it might take some time; he therefore allowed the rod to remain in the glass long enough to oxidize. He also knows about refraction of light, but he correctly judges that it is irrelevant to the chemical effect being studied.

- 4) Informant D reports no effect. By mistake he obtained an aluminum rod, performed the relevant observations, and found no rusting.
- 5) Informant E gave no report but asked whether atmospheric oxygen is to be admitted to the glass of water during the experiment.

The chemist himself, interpreting the results of his experiment, reports that the hypothesis is not confirmed by the data, for informants do not consistently identify rusting on iron rods placed in water.

The hypothesis had been advanced by a brash, young student of chemistry, who is quoted as having said: "Anyone familiar with iron and water knows that iron rusts when placed in water, for if he is asked to observe an iron rod in a glass of water, he will report that rust appears on the iron." The chemist claims to have refuted the student's hypothesis about iron and water with the results of his experiment.

It is not difficult to say exactly what is wrong in this ludicrous caricature of scientific research, but when the same mistakes are made in a subtler fashion in bona fide investigations, it is not always obvious how and why they invalidate the conclusions that some scholars would like to draw.

To begin with, the original hypothesis of the student was supported by a reference to every-day events or common knowledge--everyone knows, roughly speaking, that iron rusts in water, even if few laymen can say explicitly why or how. The chemist sought to invalidate the thesis by showing that the supporting evidence from daily life was not literally true as stated, for the results of his experiment showed that if people are asked to report what happens when iron rods are placed in water, a great variety of responses will be obtained, only some of which may be relevant to the question under investigation. This is very unconvincing evidence that rusting is not a commonly recognized feature of iron.

Next, the experiment itself was very poorly designed.

Optical Illusions and Grammar Blindness

Informants A and D might have given the desired response but for the interference of extraneous, uncontrolled factors, namely, time of oxidation process and identity of the metal in the rod used. Informant B paid attention to the wrong features of the apparatus.

Taking account of these mistakes in laboratory procedure and experimental design, we might try to account for responses like that of Informant E, assuming that one could obtain others of this kind with further experimentation. This response shows that, far from refuting the literally taken evidence of rusting as offered by the student, experiments confirm that people, or at least some people, have even more and deeper knowledge of the properties of iron than were claimed; Informant E indicated that he not only knew iron rusts in water, but also that he knew something about why. It is not necessary, incidentally, to assume that he had learned this in school. The experiments to show the relevance of atmospheric oxygen to the phenomenon of rusting are very easy to perform.

The chemist is also known to have charged the student with incredible naivete on the following grounds. In predicting the results of such an inquiry about rusting of rods he must have paid attention only to the outward appearance of metal rods as the only evidence the experimental subjects might be expected to use to identify them as consisting of iron rather than, say, aluminum. The chemist assumes, in other words, that the only relevant question to be put to the subjects is; "Does this bar rust?" However, after the experiment, Informant D remarked, "I wonder what that rod was made of, it sure was light for iron!" Thus, he knew the relevance of the material of which the rod was supposed to consist, and he might well have reported correctly the difference in the behavior of aluminum and iron in water had the chemist supplied him with both.

By now our anecdotal analogy has been stretched far enough, and it is time to say explicitly what light it is supposed to shed on linguistics or linguistic theory. I shall be blunt.

Chomsky wrote that speakers of a language know the difference between grammatical and ungrammatical strings of words, and he supported this view by mentioning some differences in behavior they might exhibit when asked about some instances. Hill (1961), mistaking these and similar assertions as a proposal to establish a theory of grammar upon some behavioral or empirical tests for grammaticalness, sought to refute the statements by performing an experiment. He offered to some experimental subjects a list of such

strings and asked that they accept or reject them and also, if possible, grade them into a sequence of acceptable to unacceptable.

The experimental subjects failed to sort the strings into two classes, grammatical and ungrammatical, and they also differed widely on their judgments of acceptability. Hill took this as a refutation of Chomsky's claim and even implied that the negative results could be viewed as a failure of Chomsky's theory of language to give correct experimental predictions.

Since it is not well represented in our story of the chemist, we shall ignore the implications of (1) Hill's own ability correctly to formulate both grammatical and ungrammatical sequences of words to match those he cited from Chomsky, and (2) Hill's own correct surprise at which of these sequences were sometimes accepted on various grounds by the subjects (namely, the ones Hill knew were ungrammatical).

In exact analogy with our anecdote above, I view the results of Hill's experiment not as a refutation of Chomsky's claim, but rather as an excellent confirmation of an even stronger hypothesis than that advanced by Chomsky. The responses showed, of course, that one cannot test for grammaticalness by asking informants about the acceptability or unacceptability of sentences, since there are many irrelevant and uncontrolled factors; sequences of words can be accepted or rejected for a great variety of reasons, each having greater or lesser relevance to the formal, or syntactic, features of sentences, that is, their grammaticalness. There is little reason to believe, in fact, that there is an empirical test for grammaticalness.

The comments made by the subjects show, however, that speakers of English not only know the difference between bona fide English sentences and ungrammatical strings of words, but that in some cases they even know why certain sequences are ungrammatical. First of all, a response like "That would make good modern poetry!" is very revealing; no one thought any of the ungrammatical examples would have made good classic poetry or good ordinary prose. But everyone knows that one of the formal devices used by the modern poets to achieve startling effects is distortion of syntactic structure. But this in turn implies that there must be an underlying "correct" form to distort; and Chomsky suggests simply that one minimal aim of linguistic science be an exact characterization of this underlying "correctness".

Second, one informant responded to the example: *I saw a fragile of*. with the question, "What's an of?" (or, perhaps, "What's an Of?"). This datum shows pretty clearly

Optical Illusions and Grammar Blindness

that the subject not only identified correctly the ungrammaticalness of the sequence in question, but he even knew what was wrong with it. And we can be quite sure that the same result would have been obtained had the example been presented in spoken form instead of written. In other words, Chomsky is not naive in calling the sequence ungrammatical because it is so only in this written form (with *of* instead of *Of* or perhaps *uhv*); rather, we see that the "naive" speaker not only identifies grammaticalness, but he even correctly analyzes the difference between the two contrasted sentences, one with the preposition, the other with an unfamiliar noun.

Hill strongly implies that he considers "grammaticalness" unacceptable as a technical term in linguistic science because so far no one has formulated an empirical test for it. The statements by Chomsky that Hill has attempted to refute are simply part of Chomsky's proposal that linguistics must seek to explain the indubitable ability of speakers of a language to distinguish, both when talking and when listening, between bona fide sentences of their language and various distortions of them.

Suppose, now, that there were a simple mechanical, empirical test for sentence-hood in English, and as example let us take a typical proposal often found at the beginning of linguistic studies: "A sentence is any sequence of words ending in one of two terminal contours, where the words may be chosen from a (long) finite list." (Of course, this is a quaint oversimplification of the proposals that have actually been made, but it permits a good illustration of the important point.)

If the above "operational definition" of sentence in English were correct, then the grammar of English would consist of two simple rules followed by as many lexical rules as there are words in the English lexicon (a finite number, of course). It might have the following form:

$$(1) \quad S \longrightarrow W \left\{ \begin{array}{c} \# \\ / \end{array} \right\}$$

$$(2) \quad S \longrightarrow WS$$

$$(3) \quad W \longrightarrow A$$

$$(4) \quad W \longrightarrow B$$

etc.

where # and / are terminal contour symbols, and A, B, C, ... are the individual words. Rule (1) generates all one-word sentences, and Rule (2) generates by recursion all other sentences from the latter. The grammatical study of English is now a closed subject!

It has not been very fruitful to seek an "operational definition" of the notion "sentence". Rather, traditional grammatical study has been, for the most part, aimed at formulating a characterization of sentences by means of grammatical rules. The fact that this study has been difficult and involved can be viewed as evidence that the notion of "sentence of language L" is not a trivial or simple one. Furthermore, since the grammatical or formal features of sentences are intimately related in many and various unknown or partially unknown ways to the use of sentences and to the meanings of sentences, it seems at least most unlikely that an operational test for sentence-hood will ever be found based on the acceptability or unacceptability of strings of words. Our best prospect at the present time is undoubtedly to seek a characterization of the most impeccably grammatical sentences by means of so-called generative grammars and then to attempt various extensions of that theory to cover other kinds of utterances.

Our major point, then, is that it is simply a misapprehension about the nature of scientific research and results to insist that grammaticalness or sentence-hood cannot be explicated or characterized by means of generative grammars unless there is a mechanical or empirical test for grammaticalness.