ON A CONCEPT OF DEGREE OF GRAMMATICALNESS

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The object of this paper is to clarify a concept of degree of grammaticalness that has appeared occasionally in the recent literature of generative grammar. I aim to make two points. First, the concept of degree of grammaticalness may be distinguished from any semantic concept of intelligibility. Second, it may be explicated in the light of a certain kind of confirmation-theory, the defining conditions for which turn out to explain the non-statistical character of generative grammars.

I

In his seminal work *Syntactic Structures* (p. 35 f.) Chomsky pointed out that a sentence like

John enjoyed and my friend liked the play

was «much less natural», as he called it than the alternative

John enjoyed the play and my friend liked it.

Sentences of the former kind are generally marked, he claimed, by special phonemic features such as extra long pauses, contrastive stress and intonation, failure to reduce vowels and drop final consonants in rapid speech, etc. These features normally mark the reading of non-grammatical strings. «The most reasonable way to describe this situation would seem to be by a description of the following kind: to form fully grammatical sentences by conjunction, it is necessary to conjoin single constituents; if we conjoin pairs of constituents, and these are major constituents (i.e. «high up» in the [phrase-structure derivation] diagram) the resulting sentences are semi-grammatical; the more completely we violate constituent structure by conjunction, the less grammatical is the resulting sentence.» Similarly, in a later chapter (p. 78) Chomsky remarked that any grammar which distinguished abstract from proper nouns would be subtle enough to characterise the difference between two groups of sentences he listed, and he claimed that there was a clear sense in which the sentences of one group were more grammatical than those of the other.

Subsequently many critics of Chomsky, e.g. Jakobson (1), remarked that sentences which he regarded at best as semigrammatical could in fact be given a meaning. The famous string.

Colourless green ideas sleep furiously

was even incorporated into a poem. Also Hill's results (2) suggested the unprofitableness of any attempt to construct, or appraise, a scale of grammaticalness on the basis of informants' idiosyncratic acceptances or non-acceptances of individual strings of words. To these critics Chomsky replied (3) by granting them their premisses and denying their conclusion. Certainly, when given a grammatically deviant utterance we attempt to impose an interpretation on it, exploiting whatever features of grammatical structure it preserves and whatever analogies we can construct with perfectly well-formed utterances. But we must distinguish, said Chomsky, between a class of utterances that need no analogic or imposed interpretation and others that can receive an interpretation by virtue of their relations to properly selected members of this class. And Chomsky then proceeded to outline a measure of degrees of grammaticalness in terms of a hierarchy of the categories appearing in the rules of a generative grammar (4).

Katz (5) now claims that this measure is unsatisfactory. He points out that there are some pairs of strings [X, Y] such that Y is much more intelligible than X even though according to Chomsky's example of an *n*-level hierarchy of categories X would have a higher degree of grammaticalness than Y. E.g. for X we may take

(1) The beef cut sincerity

and for Y

If there is any truth in what he says, it would be to insist foolish.

(1) R. Jacobson, "Boas's View of Grammatical Meaning", *American Anthropologist* lxi (1959) memoir no. 89 of Am. Anth. Assoc.

(2) A. A. Hill, "Grammaticality", *Word* xvii (1961) p. 1ff.

(3) N. Chomsky, "Some Methodological Remarks on Generative Grammar", *Word* xvii (1961) p. 219 ff.

(4) *Ibid.*, p. 236ff.

(5) J. J. Katz, "Semi-sentences" in *The Structure of Language*, ed. J. A. Fodor & J. J. Katz (1964) p. 400 ff.

And Katz argues that indefinitely many counter-examples of this kind could be constructed, since for Chomsky a string fails to receive a representation at level *i* (and at all higher levels) if it violates even a single restriction holding between a pair of categories at this level. If of two strings, S and S', S violates just one restriction which prevents it from reaching *i*-level grammaticalness, while S' succeeds in reaching *i*-level grammaticalness but nevertheless has a great deal of structural distortion, then S may well be more intelligible than S'.

But the trouble is that Chomsky applied non-semantic criteria (e.g. phonemic features) in establishing the data about the greater or less grammaticalness that were to be explained by this theory of degrees of grammaticalness. Katz, on the other hand, is constructing his counter-exemples with the aid of a semantic criterion — greater or less intelligibility. On the face of it, therefore, Chomsky's problem was not Katz's, and Katz's criticisms of Chomsky appear at first sight to arise from *ignoratio elenchi*. Perhaps it will be objected that Chomsky's problem ought to have been Katz's, and Katz's criticisms are thus justifiable. But I shall now argue that Katz's solution of his own problem shows up the difficulty of identifying degree of grammaticalness with degree of intelligibility.

Katz sets out to explicate the concept of a semi-sentence, where a string is said to be a semi-sentence of the language L if and only if it is not generated by an optimal grammar of L and has sufficient structure to be understood by the speakers of L. He claims that a speaker knows (in the sense in which he knows the rules of the grammar of his language) a system of rules — *transfer rules* — that enables him to associate a non-null set — *comprehension set* — of grammatical sentences with each semi-sentence. This association is performed on the basis of the structure that the semi-sentence has; and the speaker's understanding of the semi-sentence is nothing other than his understanding of the sentence in the set with which the semi-sentence is associated. So that a semi-sentence is ambiguous *n* ways if and only if its comprehension set includes at least one subset of *n* sentences, none of which is a paraphrase of any other, and includes no subset of more than *n* such paraphrase-independent sentences. Katz concludes that a theory of semi-sentences cannot be solely a syntactic theory but must contain a semantic component rich enough to provide some means of deciding when two sentences are paraphrases of each other.

But what role does this measure of ambiguity have in Katz's theory

of semi-sentences ? Katz does not explicitly state that it is to be regarded as a measure for degree of grammaticalness. So let us suppose that it is not to be so regarded. Then Katz's theory suffers from two defects. First, it treats the concept of semi-sentencehood qualitatively, and not comparatively or quantitatively. It has no means of distinguishing between semi-sentences in respect of their degree of failure to be fully grammatical. Secondly, it introduces the concept of a comprehension-set with varying numbers of paraphrase-independent members, and yet assigns no relevant function to this variation other than as a measure of ambiguity.

Let us therefore suppose instead that this measure of a semi-sentence's ambiguity is regarded by Katz as a measure of its intellibility and thus, for him, of its degree of grammaticalness. But there are several difficulties here too.

First, there seem to be some direct counter-examples, e.g. our intuitions about semi-grammaticalness would normally lead us to suppose that

(2) Three men has left

and

(3) The men has left

have precisely the same degree of grammatical deviance, or conceivably we might suppose that (2) is worse than (3) because the error of putting a singular verb-from with a plural noun-form is made even more glaring by the presence of a plural numeral as well. Yet on the proposed interpretation of Katz's theory (3) is less grammatical than (2) because, while (3) is ambiguous between

The men have left

and

The man has left,

(2) is scarcely ambiguous at all.

Secondly, ambiguity exists even among fully grammatical strings. Indeed some fully grammatical strings are more ambiguous than some semi-sentences. E.g.

(4) He looked over his desk and set out his case

is more ambiguous than (3) and much more so than (2). It seems intuitively objectionable to select as a measure of semi-sentences' degree of grammaticalness a feature that some, but not all, semi-sentences share with some, but not all, full sentences.

Thirdly, even as a measure of intelligibility Katz's theory is not wholly satisfactory. The extent of a semi-sentence's ambiguity is equally affected, on his theory, by any difference of meaning whatever that prevents one sentence in the semi-sentence's comprehension-set from paraphrasing another. But it is easy to find examples that make this egalitarian attitude towards paraphrase-breakdowns seem implausible. E.g. take the semi-sentence

(5) Man bit dog

It has a comprehension-set that contains at least

The man bit the dog
A man bit a dog
The man bit a dog
A man bit the dog

Now, *pace* Katz ([6]), none of these sentences are exact paraphrases of one another. But the differences of meaning between them are so slight that some speakers of English might be tempted, like Katz, to treat them as paraphrases of one another. Consider, on the other hand, a semi-sentence like

(6) A man a dog bit

It is not unreasonable to assume in this context that the comprehension-set for (6) need contain no other sentences than

A man bit a dog
A dog bit a man.

Yet the difference of meaning between these two sentences seems intuitively greater than that between any of the sentences contained in the comprehension-set for (5). Correspondingly one would suppose (6) to be less intelligible than (5), though Katz's theory implies the op-

([6]) *Ibid.*, p. 411.

posite. It looks as though any measure of semi-sentences' intelligibility that appealed to a comprehension-set would have to pay regard to the semantic distance, as it were, between the paraphrase-independent members of this set as well as merely to the number of these members.

Perhaps, however, it will be urged that semi-sentences' degree of grammaticalness might still be identifiable with their degree of intelligibility, provided that the latter be measured in some way that avoids the difficulties encountered by Katz's measure. Even Chomsky (7), it may be pointed out, intended his procedure for projecting a hierarchy of categories from a grammar to be construed as part of the explanation of how speakers acquire the ability to comprehend deviant strings. If such a projection-procedure is a component in a language-learning device, then according to Chomsky that device acquires the automatic ability to comprehend deviant strings — deviant in the sense determined by the hierarchy of categories — when it learns the grammar of a language. But Chomsky intended his procedure only as a *part of* the explanation of how speakers acquire the ability to comprehend deviant strings, and certainly one can at least conceive that lexical considerations, as well as grammatical ones, may affect degree of intelligibility. Indeed the conventional thing to say about (1) is not that it is ungrammatical but that the normal meanings of the words don't allow the sentence to make sense.

No doubt there is another way of looking at (1). We can suppose our grammar so detailed in the distinctions it makes between different categories of nouns, adjectives, etc. that it is capable of producing rules which show (1) to be grammatically (rather than lexically) deviant. But it has yet to be shown exactly what theoretical or technological purposes are best served by such an extension of grammar far beyond its conventional field of study: the explanation of native language learning by normal children ? the education of mentally retarded children ? the teaching of foreign languages ? the treatment of aphasia ? machine translation ? Until we are sure that there is no purpose for which conventional limitations on the scope of grammatical enquiry are appropriate, we should do well not to close the door on the possibility that the relative unintelligibility of certain strings may best be given a lexical rather than a grammatical explanation and these explanations may be of very different kinds.

(7) *Ibid.*, p. 404.

It seems to me that any proposal to measure degree of grammaticalness by degree of intelligibility does seek to close this door. It assumes relative intelligibility to be explicable solely by reference to grammatical structure (8), and postulates an ordering of the latter that is identifiable with an ordering of the former. But what we need instead are at least two scales, not one. We need one or more non-semantically calibrated scales of grammaticalness, and, independently, one or more scales of intelligibility. We might then be able to assess the extent to which degree of intelligibility is a function of degree of grammaticalness, according to one or more ways of measuring these degrees. And we might thereby be helped to estimate the utility of extending our grammatical analyses right up to the level at which we show (1) to be grammatically deviant. For example, suppose degree of intelligibility were found to correlate with degree of grammaticalness up to a certain level of detail in grammatical analysis, and suppose this correlation began to alter when rules were added to the grammar that imposed yet further restrictions on the generation of grammatical sentences. One might wish to take this as an indication that in some fields (dependent in part on the measures of grammaticalness and intelligibility employed) the likelihood of intelligibility is maximised by transferring the balance of attention at a certain point from grammar to lexis. I would be inclined to conjecture that this may often occur in learning to speak, or translate from, a foreign language which belongs to the same general culture as one's own. In learning the lexical equivalences *the/le, beef/bœuf, cut/couper, sincerity/sincérité*, a Frenchman has already learnt enough to know that (1) is relatively unintelligible. If there are grammatical rules of Engish that are responsible for this unintelligibility he has learnt them implicitly through learning the lexical equivalences. But if no special grammatical rules are needed here — whether for the purposes of pedagogy or of translation-programming — then in this context at least the unintelligibility of (1) is not to be traced to grammatical deviance (9).

(8) In his concluding remarks (*ibid.*, p. 416) Katz seems to recognize some of the risks inherent in this assumption.

(9) So far as this is so there is something to be said for the familiar philosophical thesis that conceptual principles, or rules of logical grammar, may be distinguished from rules of linguistic syntax by their greater invariance under translation. The extent to which grammatical rules are actually needed (as distinct from being theoretically possible) in the analysis of a language also tends to be reflected in the extent to which grammatical

II

Perhaps a defender of Katz's approach would rejoin to my criticisms that our intuitions in regard to semi-sentences' degrees of grammaticalness cannot in practice be distinguished over a sufficiently wide range of variation from our intuitions in regard to intelligibility. «The project of constructing a wholly non-semantic measure of grammaticalness», he might argue, «is a vain one because it corresponds to no clearly distinguishable reality in the total linguistic situation. Construct a Chomsky-type hierarchy of categories, if you like. But, in the face of Katz's semantically based counter-examples, what reason is there for taking such a hierarchy to measure anything of importance at all, let alone to measure degree of grammaticalness?»

I want to argue that there is a good reason. The reason is that the Chomsky-type degree of grammaticalness of a string, *qua* possessing a certain structure, may be identified with the highest degree of confirmation, i.e. evidential support, that is obtainable, on a suitable selection of evidence, for the statement that this string, *qua* possessing this structure, is fully grammatical. In order to show that such an identification should be acceptable I shall first examine some of the properties of confirmation-functors that can measure degree of evidential support for theses of generative grammar, and then indicate how such functors can come to measure degree of grammaticalness.

We often talk of the extent to which a child has learned certain parts of its native grammar or the extent to which a student has learned certain parts of a foreign grammar. Of course there is no universally accepted system of marking or grading examination scripts in schools and universities. But every school and university has some such system, and certain features are common to most systems. In particular, in testing grammatical knowledge we normally judge an examinee's merit by the variety of non-deviant sentences uttered. The examinee who makes two different kinds of grammatical mistake in a prose composition suggests that he knows less grammar than the

category-names are readily freed from semantic implications: contrast the terms *transitive/intransitive* with *animate/inanimate*. Note also that even in formal-logical theory "x is both square and not-square" is normally not regarded as ill-formed, though it is L-false. Presumably therefore "x is both square and round" and "x is both square and shapeless" are equally to be regarded as well-formed.

examinee who merely makes two mistakes of the same kind, and the former would normally be marked or regarded lower than the latter if the three kinds of mistake are all equally serious. Similarly the recent literature of linguistics has contained many comparative judgements about the merits of different generative grammars produced by investigators of various languages, and these merits are alleged to be shown at least in part (though other factors, such as relative simplicity, or suitability as a foundation for semantics, may also be taken into account) by the variety of hazards that the proposed rules surmount in avoiding the generation of grammatically dubious sentences. What seems to be implicitly employed in these judgments is a two-place functor c[H, E], where H is a hypothesis asserting that any string generated by such-and-such a set of rules (the rules implicitly employed by a student or explicitly stated by a linguistic investigator) is a grammatical sentence, and E reports one or more intuitions about the grammaticalness of individual strings thus generated. We may assume these functors to denote real numbers $\geqslant 0$, so that we can either assign numerical values, in the from $c[H, E] = n$, or at least draw comparisons of the form $c[H, E] > c[H', E]$, which assert that H is better supported by E than H′ is.

What other assumptions are plausible ? Presumably (call it the *Equivalence Condition*) if H is logically equivalent to H′ and E to E′ then $c[H, E] = c[H', E']$. Presumably also (call it the *Instantial Comparability Condition*) if S is a substitution-instance of the hypothesis H (asserting the grammaticalness of a particular string if generated by the rules described in H), and if S does not mention any element of H's domain — i.e. any string — that is mentioned in E, and if S′ is analogously related to H′ and E′, then $c[H, E] > c[H', E']$ if and only if $c[S, E] > c[S', E']$. I.e. the relative weight of evidential support for an individual sentence's grammaticalness, in virtue of its having such-or-such a structure, varies directly with that for the relevant rule or rules and *vice versa*. For example, Chomsky ([10]) in effect agrees with Hill ([11]) that in generative grammar the grammaticalness of a string is to be judged only in the light of its supposed method of generation. A string is otherwise insufficiently identified for its grammaticalness to be judged. Conversely support for a string so identified is also support for the generative rules that help to identify it.

([10]) *Loc.cit.*, p. 228f.
([11]) *Loc.cit.*, p. 9.

Now it can be demonstrated ([12]) from these two conditions that (*Instantial Conjunction Condition*), where S^1, S^2, ...S^n are all substitution-instances of H mentioning no element of H's domain — i.e. no string — that is mentioned in E, then, so long as we may assume that at least *n* applications of the rules described in H have in fact been made, $c[S^1, E] = c[S^1 \,\&\, S^2 \ldots \,\&\, S^n, E]$. I.e. two or more applications of a set of generative rules are normally just as well supported by relevant evidence as a single application. The importance of this Instantial Conjunction Condition lies in the fact that, where we can have $c[X \,\&\, Y, E] = c[X, E]$, there $c[X, E]$ cannot, except in certain limiting cases, be either a probability or a function of probabilities. This is obvious enough in the case of simple probabilities, but it can also be demonstrated ([13]) for any function of probabilities. The resistance to statistical support that Chomsky has observed ([14]) in regard to assessments of grammaticalness is thus a necessary feature of any confirmation-functor that satisfies two formal or quasi-formal conditions, viz. the Equivalence and Instantial Comparability Conditions. For these conditions determine certain properties of $c[S, E]$ irrespective of the subject-matter with which S and E are concerned. Of course, the Instantial Comparability Condition is only of permanent interest in relation to universal hypotheses with an infinite domain. For, if the domain of H were finite, there might come a time when we had so much evidence available about the elements of that domain that, if we were to cite all available evidence in E, (in accordance with what Carnap ([15]) called the Requirement of Total Evidence), we could no longer find a substitution-instance, S, of H satisfying the requirement that S does not mention any element of H's domain which is mentioned in E. But this does not constitute a reason for not applying the Instantial Comparability Condition to the special case of generative grammars, since the rules of a generative grammar are supposed to be capable of generating an infinite number of sentences.

([12]) The demonstration is given in L. Jonathan COHEN, "A Logic for Evidential Support" forthcoming in *British Journal for the Philosophy of Science*. An earlier version of this article was delivered in the form of two lectures to the University of Liege and the Centre National Belge de Recherches de Logique on March 26 and 27, respectively. Cf. also L. Jonathan COHEN, "What has Confirmation to do with Probabilities?" forthcoming in *Mind*.

([13]) "What has Confirmation to do with Probabilities?", forthcoming in *Mind*.

([14]) *Syntactic Structures*, p. 16f.

([15]) R. CARNAP, *Logical Foundations of Probability* (1950) p. 211.

A more general result is also available, if three other conditions may be assumed.

First, if a syntactical theory generates indisputably ungrammatical sentences it needs to be rejected and replaced by a theory that differs from it in some respects. Hence if the evidence for a hypothesis of the kind we have been considering includes mention of a clear counter-instance the evidence gives no support to the hypothesis as it stands. Contrapositively, if the hypothesis is supported, its negation is not. We therefore assume (Negation Condition) that if $c[H, E] > o$, then $c[\sim H, E] = o$. Our confirmation-functors thus measure degree of support only, not degree of undermining also: we do not have, e.g., $c[H, E] = 1 - c[\sim H, E]$. We are out to weigh just the typical build-up by eliminative induction — the accumulation of varied unsuccessful attempts to falsify a universal hypothesis.

Secondly, we must assume that any evidential support a universal theory has is passed on to its logical consequences. More specifically (*Consequence Condition*), for all E, H and H′, if H is logically deducible from H′, then $c[H, E] \geqslant c[H', E]$. There would be little point in scientific generalisations if the applications of a universal hypothesis H to particular cases were not at least as well supported as H itself by the evidence for H: our general knowledge would be useless. And scientific system-building — the axiomatisation of a body of universal hypotheses — would be equally useless if evidential support were not automatically passed on by a conjunction of universal statements to any other universal statement logically deducible from it.

Thirdly, any hierarchy of grammatical categories such as is described by Chomsky may be regarded as presenting a series of tests that are applicable to hypotheses about rules of generative grammar. At each level of the hierarchy we are presented, in ascending order of subtlety, with distinctions between two or more categories of expression (e.g. verb/noun, transitive verb/intransitive verb, animate noun/inanimate noun) by reference to which we may vary the circumstances of the test we apply. (E.g. where a rule is formulated in terms of any verb and any noun one test will consist in examining it in relation to one sentence that contains a transitive verb and an animate noun at the relevant points, another that contains an intransitive verb and an inanimate noun, and so on.) Thus there may be

assumed to be (*Evidential Ordering Condition*) a fixed serial order for the application of tests to hypotheses, so that if C is the class of tests to which one hypothesis has been subjected and C′ is the class to which another has been subjected, either C is included in C′ or C′ in C.

Now from the Negation, Consequence and Evidential Ordering Conditions it is easily demonstrated that if $c[H', E] \geqslant c[H, E]$ then $c[H \,\&\, H', E] = c[H, E]$, where H and H′ are universal hypotheses. We thus have the anti-probabilistic situation, $c[X \,\&\, Y, E] = c[X, E]$, again. Confirmation-functors for generative grammars normally resist interpretation into the symbolism of the probability-calculus, whether they be concerned with the application (substitution-instances) of theories or with the theories themselves. ([16])

I wish now to argue that to the extent we can understand such a concept of degree of evidential support for generative grammar we must also be capable of understanding a wholly non-semantical concept of degree of grammaticalness. For to discover the degree of grammaticalness of a string, *qua* possessing a certain structure, we simply need to determine how well supported, on a legitimate selection of the available evidence, is the thesis that any string possessing this structure is grammatical. Of course at any level a test may produce a counter-instance which belongs essentially not to that level but to some higher one. Our test may appear to fail at the verb/noun level, e.g., not because of the verb formulation as such, but because we happen to have chosen an intransitive verb. If a formulation with some transitive verb is fully grammatical then the failure belongs not to the verb/noun level, where we can afford to neglect the counter-instance, but either to the transitive/intransitive level or to some yet higher one. In short, the higher up our categorial hierarchy we can go, i.e. the more refined the distinctions we can draw while still obtaining at least some indisputably grammatical sentences from our generative hypotheses, the better established is our thesis on the evidence thus far available, and, correspondingly, the more grammatical is the given string *qua* possessing the structure in question. Thus, since no-one can investigate generative syntax ra-

([16]) Instead, as it turns out, confirmation-functors of this kind are definable, and their logical properties formally provable, within a generalised modal logic, as is shown in "A Logic for Evidential Support" (forthcoming).

tionally without making some comparative (or even quantitative) estimates of such degrees of confirmation on the basis of purely qualitative intuitions about grammaticalness or non-grammaticalness in particular cases, we have a built-in guarantee that so far as syntactical studies are distinguishable from semantic ones we have intuitions that go to establish degrees of grammaticalness which are distinguishable from our intuitions in regard to greater or less intelligibility.

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