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The Dialogue With Simplon*

Simplon: How does it come to pass, o Meander that there are lies and falsehoods in the speech of others? Does this not violate the basic order between man and nature, and among men themselves apart from nature?

Meander: That is indeed a worthy question. I think the best way to consider the import of such a problem is to review the arguments of the ancient two-headed philologist, McGorgon-on-the-Charles** that there are no false statements uttered by others, only ungrammatical statements, which do not exist by virtues of their ungrammaticality. But let us start with some fundamental investigations of what language is, for without that is it not impossible to define 'lie' or 'truth'?

Simplon: Yes. It would seem so.

Meander: Is it not the case that when a stranger addresses you in some language that you do not know, he has said nothing to you at all?

Simplon: What? That seems most surprising. How could that be? Surely my understanding of what a stranger says does not determine whether he in fact said something. What do you mean by that Meander?

*Fragment of a dialogue between Meander and Simplon found and translated by M. Traegodos von Behr, Institut fur Wissenschaftliche Zwecke, Bad Tetz in 1969. The translator submits the dialogue for the consideration of his colleagues because of its continuing relevance to modern concern about the role of beliefs and expectations in the concept of grammaticality.

**This was before McGorgon's exile to the Middle Continent after which he was known as "McGorgon-in-the-corn". Later one head went West and became known as "McGorgon-on-the-beach". M.T.v.B.

Meander: You shall tell me. Is a language not a vehicle for communication among men?

Simplon: It is.

Meander: Good. Is it not also the case that when a sequence of sounds is not an example of the language that it is ungrammatical in that language?

Simplon: Indeed, by definition.

Meander: Fine. Let us suppose that you knew only one language, Simplon and that language was English.* If I addressed a sentence in English to you would you not understand it?

Simplon: Surely that must be true according to your assumption that I know English.

Meander: Very good. Now, suppose that nobody other than you knew the English language that you knew, and you never heard any sentences nor addressed any sentences to anybody else in that language at all? Would we not have to conclude that you knew no language at all?

Simplon: I am sorry that I do not follow you.

Meander: Well, it seems quite simple. We agreed that language is defined as that used to communicate among men, and just now proposed that you could not use your alleged knowledge of 'English' to communicate, nor could anybody else. Therefore, what you know could not be a language.

Simplon: The directness of your conclusion takes my breath away, o Meander.

Meander: But we may go further my young friend. Can we now not also conclude that if somebody says to you a sentence which you believe to be ungrammatical in English that you must believe that he has said nothing to you since he has said something outside the only language you understand?

Simplon: Yes.

*Of course, in the original Manuscript the language referred to was "Greek", in my original translation it was "German". "English" is used in the present translation to aid the American reader.

Meander: And if it were in English would you not both recognize it as grammatical and experience it?

Simplon: Most assuredly.

Meander: So we have demonstrated our first conclusion that if a stranger has said something that is ungrammatical to you, then his statement is not part of your experience and he has said nothing at all.

Simplon: Astounding. I never would have believed it if you had not shown it to me in this way.

Meander: Quite so.

Simplon: I am quite convinced by your words, Meander, but how will this help us to resolve the apparent frequency of unharmonious false statements in our experience?

Meander: We shall come to that directly. We now must examine the ancient savant's theory of the concept of ungrammaticality, since our previous discussion has taken that concept for granted. The McGorgon decided after many years of labour that the grammaticality of sentences in each language must be measured relative to the beliefs that they imply.

Simplon: Why did he think that? Is not a sentence grammatical if it follows the laws of the language, independent of personal beliefs?

Meander: One would think so; but I'm glad you asked. Let us illustrate the arguments with an example. Suppose I say to you the following sentence.* "The Max who is here is blue." Is the 'Max' a person or a thing?

Simplon: Assuredly he must not be a thing or you would have uttered 'which' or 'that' instead of 'who'.

Meander: Correct. If I had believed Max to be a thing or had wished you to believe so, then my sentence would have been an ungrammatical use of the English language, would it not?

Simplon: Yes.

*The examples here are translated into English from the original German from the Greek. The original name was *Maxis* *Τροφιλοδενδρον*.

Meander: Then we have shown how the ancient sage demonstrated that beliefs determine grammaticality, since if I had changed the intended belief I would have changed the grammaticality of the utterance.

Simplon: What marvelous simplicity of argument! How I would like to have sat at the feet of the great McGorgon.*

Meander: Perhaps. But let us continue since we are near the end of our discussion. We have now shown that if a sentence is perceived by you as ungrammatical that it does not exist for you and we have shown that your judgments of the ungrammaticality of sentences depends on your beliefs about them. Thus it is easy to see how the ancient McGorgon has shown us that any false sentences uttered by others do not exist.

Simplon: How is that true, o Meander? I have not followed your argument.

Meander: Well it is quite simple. If somebody appears to be telling you a sentence which you know to be false, you know that the beliefs implied by that sentence are at least partially false.

Simplon: True.

Meander: That is, from your standpoint another's false utterance is a statement which implies some beliefs at variance with your beliefs.

Simplon: Indeed.

Meander: In other words if you were to utter the sentence yourself it would conflict with your beliefs.

Simplon: As assuredly as the night is day.**

Meander: And of course thanks to the McGorgon we have established that if a sentence fails to agree with its implied beliefs then it is ungrammatical.

*According to M. v. Beinzahler the McGorgon had four feet. M.T. vB.

**Various scholars have already puzzled over this obviously contradictory utterance. Indeed T. v Sprudelwasser has pointed out that the dialogue should have stopped here according to Meander's interpretation of McGorgon, because Simplon's interjection was a contradiction and should have been recognized by Meander as ungrammatical, i.e. not recognized at all! M.T. vB.

Simplon: Again true.

Meander: And we have established that an ungrammatical sentence does not exist in your experience of a language.

Simplon: Indeed, true again.

Meander: So, if you believe somebody else's utterance to be false then that sentence is for you ungrammatical and does not exist in your experience. At least this is what one concludes from the writings of the ancient McGorgon.

Simplon: Miraculous! What a charmed life he must have led never to know the false statements made by others! How efficient his philosophical investigations must have been, unencumbered by others' mistaken ideas! But there is one thing that puzzles me, Meander and I hope you can help me understand it.

Meander: I shall try. What else are friends for?

Simplon: How do we know that a sentence said by another is true or not unless we have decided if it is grammatical first, so that we may experience it, and vice versa? Could one not take your conclusion from McGorgon's proposals as a demonstration that the proposals are incorrect?

Meander: Ah, that is another annelid container entirely. Perhaps we may discuss these matters tomorrow....

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1. Introduction

Language displays an awesome number of systematic phenomena. This is what makes it a favorite topic of those interested in the human mind. Here we see encapsulated a capacity that is uniquely human (on Earth) and one that draws on aspects of persona sapiens ranging from the most concrete to the most abstract. If we could advance our understanding of language we would make a major advance in understanding ourselves. The richness of structures in language has prompted many thinkers to despair of explaining their presence except by appeal to specific innate mechanisms. On this view language is the way it is for the same kind of reason that we have five fingers on each hand (not four or six): we are simply "programmed" genetically to be that way. In this regard linguistic science can be viewed as exploring the universals of language in order to specify what it is that constitutes our innate endowment that is specifically grammatical.

To many, this view seems stultifying--to claim that a structure is "innate" seems to leave no further reason for study--if a mental property is in fact innate, what else is there to say about it? An

opposing point of view is that linguistic structures arise because of the function that language serves or because of the way it operates. Scholars in this school attempt to argue that language is the way it is because it is shaped by other mental systems, which are presumed to be general properties of the world or mind, as opposed to specifically linguistic properties.

If we now turn to other biological sciences we find that opposition between these points of view can be quite healthy. For example, it is a dual rallying cry of evolutionary theory that form precedes function and that function guides form. With respect to any particular structure the question becomes empirical, rather than philosophical: which aspects are directly evolved from previous structures, and which aspects evolved because of the function they could assume? In the case of language it is imperative to know which aspects are innate sui generis, and which exist because of the functions that govern it.

As an analogy consider the description of a home-shop drill press. Many of its functions are attributable to the functions it serves. It must be usable at different speeds, have a table to which objects-to-be-drilled can be clamped, a convenient lever for lowering the drill which can be used by hand, and so forth. Hence, many of its features are the way they are because of what the machine is for and who will use it. Other aspects, however, have no such direct explanation. For example, the pulley could be made out of many materials; the motor has an arbitrary number of windings; the drill chock a certain number of tightening holes--in fact all the function of a chock requires is that it grip the drill bit--how it does it is arbitrary and determined by current technology. Thus, a description of an actual drill-press is partially independent of the functions it serves--certain aspects may be convincingly guided by those functions; others will be due to the nature of machines in general, or to specific historical accidents in the evolution of shop tools. The description is initially independent of such considerations.

I shall argue that this is analogous to the current study of language. The description of what language is must proceed independent of particular functional explanations of why it is that way. At a practical level, we cannot know what to explain until we have isolated and described it. At a theoretical level, many aspects of language may indeed have become autonomous mental structures, whatever their original functional explanation might be. Specifically, I shall demonstrate that certain aspects of language structure are explicable as a function of the way language is used. I shall claim that such extra-grammatical functional explanations are characteristic of phenomena involving "global rules" and acceptability "squishes": that is, global rules and graded levels of grammaticality are not grammatical universals. This does not invalidate our quest as to what is linguistically innate: on the contrary, it sharpens that quest.

2. Brief History of Functional Explanations of Language

There have been two major kinds of attempts to explain linguistic

structure as the result of speech functions. One I shall call the "behavioral context" approach, the other the "interactionist" approach. The "behavioral context" approach argues that linguistic patterns exist because of general properties of the way language is used and general properties of the mind. The interactionist approach argues that particular mental mechanisms guide and form certain aspects of linguistic structure.

2.1 Behavioral Context Theories¹

G.K. Zipf offered one of the most noted attempts to explain language as a function of the context in which it is used. Zipf proposed that language evolves so as best to serve the speaker and the listener in a communication situation. Both conversational participants set constraints so that conversations can proceed with the least mental effort. This can explain why frequently used utterances are or become short (e.g., "television" becomes "TV"), and lead to the discovery of "Zipf's law"--the frequency of a word in ordinary use is logarithmically related to its length. This striking observation was a focus for much concern until it was demonstrated that it would follow from the assumption that word boundaries are randomly assigned. That is, the law of least effort applied to the speaker/listener interaction does not constrain possible linguistic structures. Zipf's law turns out to be a demonstration that word length is not itself a function of linguistic structure: some words are shorter than others for non-structural reasons.

We are left with Zipf's plausible claim that one reason that frequent words are shortened is that this reduces the average effort needed by speakers and listeners. This observation is an acceptable hypothesis as far as it goes. However, it is not clear how to test it critically. A theory of least mental effort presupposes an independently motivated theory of mental function that can specify which utterances are relatively complex. The ultimate difficulty with the law of least effort is not that it is wrong. In a sense it must always be circularly true if we discover which utterances are easy by looking for the ones that are uttered frequently. In Zipf's formulation, the "law" is too unconstrained to predict the particular linguistic structures that occur.

Zipf's considerations were rooted in the context of language being used by humans who actively apply a principle of least effort: language is assumed to strike a balance between the functional needs of the listener (for the speaker to be explicit) and the speaker (to utter as little as possible to convey an idea). Martinet and his followers have offered a more abstract context in which to examine linguistic structure. The nature of each language unit is assessed in the context of the "functional information" that it conveys, relative to other language units. This often focusses arguments on historical pressures to reduce the ambiguity of specific sounds or words. When a particular phonetic sequence carries too many potential meanings its "functional load" is out of balance, and provides pressure to change the language. This principle can apply to single sounds--for example in English the initial phoneme "/t/" has a higher frequency and hence different functional load from the initial phoneme

"/dj/"; this may result in a historical divergence of initial "t" into two separate phonemes if the functional load becomes too great, or a dropping of initial "dj" from the language if its functional load becomes too small. Martinet attempts to show that such pressures have determined the evolution of languages and thereby determine their apparent momentary structure.

The difficulty with this general proposal is that the notion of "functional load" does not rest on a theory of speech function; the only relevant facts are differences in abstracted frequencies in the units of a language, and the notion that listeners and speakers pressure the language units so as to be uniformly "informative." Like Zipf's views, this notion may explain some of what speakers do with their language, but not the structure of the language itself. As before the difficulty remains the functional theory does not constrain the possible language structures in a unique or motivated way.

The final attempt to explain language as a function of a general performance context is current in psychology and linguistics under the rubric of "computational models." Since this development is just beginning, its inadequacies have not been fully displayed, although gloomy prognosis is clearly indicated. These models attempt to describe regularities in language behavior as a function of computationally adequate representations of language use (e.g., Winograd; Lakoff & Thompson; Norman & Rumelhart). That is, language behavior is interpreted as arising in the context of a general set of computational mechanisms which can be used to simulate any behavior. On this view the goal of research on language is to provide an empirically adequate simulation of such behaviors as speech perception, production, question answering, sentence-picture verification, etc. Since such simulations can (in principle) represent data obtained in all language behavior they can be taken as representing an exhaustive account of why language is the way it is.

This approach surely is a refinement over Zipf's behavioral principle of "least effort" and Martinet's notion of "functional load." But it shares the same defect--a lack of a psychological theory of speech mechanisms. As in previous cases, there are no psychologically relevant constraints--rather, we must refer to general computational formalisms. Here too, the formalisms do not motivate any particular representation over many others. Different simulations are available to "account" for any pattern of results.

Therefore one must be cautious not to condemn a priori all such computational models of speech behavior. It is certainly the case that such investigators might hit upon the correct behavioral model: formal descriptive devices of general power must surely be able to describe the correct model as well as many incorrect ones. The point here is that isolation of the correct model would be a matter of descriptive luck, not a consequence of specific universal assumption.

One must also be cautious in claiming that computational models lack explanatory force in principle. After all, it certainly would be possible to represent a correct psycholinguistic theory in some computer program. Conversely, it might turn out to be the case that the elementary formal operations of a simulation program are just

those of universal psychology of grammar. Although possible, this is extremely unlikely in the present computational models, for several reasons. First, the current models are constrained by the characteristics of current computers and available programming languages: there is no reason to believe that the human mind is constrained in similar ways. Second, the computational models are directed at simulating aspects of human language performance, not at representing the mechanisms that carries out the performance. Finally, by focussing on performance, such models eschew linguistic knowledge: insofar as possible forms of linguistic knowledge constrain language, (i.e., insofar as there is a universal grammar), such behavioral simulations are doomed to represent only part of the data, and hence in danger of representing even that part incorrectly.

2.19 Behavioral Context Theories: Summary

These theories share the same virtues and limitations: they purport to describe specific features of language by reference to the behavioral context in which language exists. One could hope that such investigations can clarify the extent to which grammatical properties of language are due to behavioral systems. However, the behavioral context theories are so general that they do not effectively predict specific properties of grammar. In any case, they characteristically do not consider grammar (Zipf), view synchronic grammar as non-existent (Martinet) or hold that "grammar" is a "convenient abstraction" (Lakoff and Thompson). On this view, there are no properties of language that are specifically "grammatical"; therefore there is nothing to be accounted for by a functionalist explanation.

2.2 Interactionist Explanations²

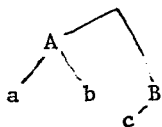
The previous models are reductionist in the sense that they seek to describe regularities of language behavior as a function of "lower-level" micro-structures and constraints. An alternative form of explanation is to refer to the mental systems which use language, rather than elements out of which it is constructed. These approaches assume that a grammar exists as a psychologically real structure--the quest is to show that certain aspects of it are due to the way it interacts with other mental systems. There have been three investigations of this type during the last few decades.

Osgood has claimed for many years that the hierarchical nature of many grammatical structures is due to the way the mechanism of learning operates in general, rather than to innate grammatical structures. Expanding on Hull's studies of "habit family hierarchies," Osgood argues that laws of learning in animals provide a direct precedent for the acquisition of hierarchies in humans. Consequently, phrase structure in language is not due to some specific linguistic property, but is simply an extension of learning mechanisms which govern the acquisition of behavior in mammals. In this sense, phrase structure hierarchies are not unique to language, but are characteristic of the structure that the mechanism of learning imposes on all complex behavior.

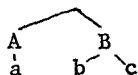
As a student of Hull, and as committed behaviorist, Osgood has been careful to maintain the empiricist position that all psychological-

ally real "abstract" entities are rooted directly in observable behavior and stimuli: that is, that "abstractions" are subsets of overtly describable events. Consequently, Osgood attempts to reject any term (e.g., "space," "time," etc.) unless it can be shown to be grounded in observable data. This limits the possible grammars to those that are taxonomic. The specific theory of grammar that he chose to "explain" as a function of mechanisms of learning was essentially a phrase structure model, a model which is inadequate in a number of ways. Thus Osgood's enterprise was exactly correct: to explain aspects of grammatical structure as due to general psychological laws governing learning. However, he was working with a limited theory of learning and an incorrect theory of linguistic structure. Thus, the enterprise was correct but limited both by its theory of language and its theory of behavior.

A second specific model has been provided by Yngvie. He focuses primarily on the influence of speech production on grammatical structure. His main hypothesis is that the needs of the speaker re-struct the amount of phrase-structure left-branching. This, in turn, "motivates" the existence of rules which reduce the amount of left-branching in any given surface phrase structure. "Transformations" are such "rules", since many transformations appear to reduce the amount of left-branching in the surface phrase-structure tree. Yngvie suggests that (at least part of) the motivation for transformation is to reduce the psychological strain on the speaker. Yngvie argues that left-branching places an inordinate processing load on the speaker--for every initial constituent in a left-branching structure is related to what follows at least two levels.



That is, "a" is simultaneously the initial terminal member of (a,b) and of (AB). Thus, when uttering "a," the speaker must keep both "b" and "c" in mind, until they are uttered. This is not the case with a right-branching structure, as below. Thus, the needs of the speaker pressure the language to form right-branching structures--which, Yngvie claims, is the overall function of transformations.



Yngvie's proposals are intuitive and attractive, as far as they go. Their limitation was inherent to the fact that he was not clear as to whether they were intended as synchronic or historical explanations--and whether "transformations" were to be viewed as current psychological structures, or as psychologically motivated relics. Despite this obscurity, Yngvie's proposals remain a landmark in the series of attempts to explain language as a function of specific properties of how it is used.

A separate difficulty is that Yngvie's proposals did not explain why left-branching does not facilitate sentence perception, since it increases the predictability of the latter parts of a sequence. This directs the discussion to the third attempt to explain structures of language as a function of a mechanism for its use: by reference to speech perception. I shall discuss examples of this view in greater detail in the next section. The main features that have been explored so far involve the limitations on short-term memory: this pressures listeners to segment incoming sentences into major syntactic units. This, in turn, constrains the way in which certain sequences are interpreted and explains grammatical and behavioral restrictions which correspond to those constraints.

2.29 Interactionist Explanations - Summary

These models presuppose that grammar is a psychologically real entity. They attempt to explain certain properties of grammar as a function of one of the behavioral systems with which the grammar interacts. Taken together, the three specific interactionist proposals define the major systems of language behavior which could constrain grammatical structure: language learning (Osgood), speech production (Yngvie) and speech perception (Bever). As these systems emerge in the child, they constrain the kinds of speech neologisms and linguistic restructurings that the child will create.³ Thus, certain types of linguistic structures never appear, not because they are incompatible with grammatical universals, but because they are unusable or unlearnable. The importance of the interactionist program is that it allows us to state which observed facts about languages are due to behavioral systems and which are due to formal grammatical universals. This makes more precise the claims concerning innate linguistic structure, and thereby makes those claims more testable.

3. Speech Perception⁴

Before giving some examples of what the interactionist model can explain, it is necessary to review what is known about speech perception.

For several decades psychologists have been investigating the problem of speech perception as defined by G. Miller in the early 1950's. Miller and his colleagues showed that listening to speech involves simultaneous reference to a number of linguistic "levels" including the level of the "sentence" and "meaning." A sample demonstration of this is the fact that a sequence of random words is harder to hear than the same words ordered into a sentence. The most striking aspect of this phenomenon is the fact that the words themselves seem to be acoustically clearer as a function of their role in the sentence. This suggests that the sentential structure is providing information that can guide the acoustic analysis of the signal. The question was how does this kind of interaction in speech perception occur?

That question is with us today, still unanswered. However, it has stimulated a considerable body of research which has advanced our understanding of how to answer it. There are several principles which guide virtually every kind of research program on speech perception.

(1) The amount of information that can be stored in memory in a single form is extremely limited.

(2) The structure of language specifies a number of forms in which speech information can be simultaneously represented. These forms are structurally ordered in a hierarchy of "levels".

(3) The way to study the perception of a representation at a particular linguistic level is to vary the stimulus at another level and observe the changes in reports about the representation.

The linguistic levels applicable to an utterance include (at least) the following: (ordered roughly according to a traditional and intuitive notion of increasing "abstractness").

Psycho-acoustics: a physiological specification of the speech wave-form as transmitted by the ear.

Phonetics: a segmentation of the signal into discrete categories of speech sounds, using universal features.

Phonemes: a segmentation in terms of the categories of sounds and features used in the particular language.

Syllables: a segmentation of the sequence in terms of canonical acoustic forms that could be uttered in isolation (e.g., CVC, CV, VC).

Morphemes: a segmentation in terms of the (memorized) meaning-bearing units of the language.

Words: the minimal units, that could be uttered in isolation, in universal categories (N, V, etc.).

Phrases: hierarchical groupings of adjacent words into universal categories (NP, VP, ...).

Clauses: Groupings of adjacent phrases in terms of the canonical external relations they bear to each other (e.g., subject, verb, object).

Sentoids: groupings of the phrases (not necessarily adjacent) in terms of the canonical internal grammatical relations they bear to each other (agent, action, object, modifier).

Semantics: interpretation (usually of a sentoid) in terms of relations to other utterances with which it is synonymous, contradictory, etc.

Speech act: analysis of the utterance in terms of the act it performs (promise, request, inform, etc.)

Intention: an analysis of what the utterance indicates to be the speaker's state of mind (often in universal terms: supportive, critical, assertive, submissive, etc.).

This list is by no means complete, nor is it the case that every school of linguistics claims that all of these levels are properly included within the domain of a formal "grammar." The fact remains that we can analyse even the simplest utterance simultaneously in terms of a large number of different kinds of knowledge. For example (1) can be represented in ways varying from an acoustic speci-

(1) Can you take out the garbage tonight dear?

fication to a (possible) description of an act by a speaker who intends to indicate that he/she feels unwell.

In a logical sense, it might appear that each of the levels of

representations must be present before the more abstract levels can be fully specified: for example, how can one isolate the phonetic segments without first having fully analyzed the acoustic structure?

The answer is that some acoustic analysis must be available, but not necessarily a complete one, only one which renders those specific parameters that are criterial for phonetic analysis. Furthermore the number of choices at a "lower" level are restricted by the representations at "higher" levels of analysis. For example, lexical and sentential information renders almost completely predictable the phonetic segment following the fragment in (2). Almost any acoustic parameter of /z/ will be sufficient for its perception

(2) Can you take out the garba--

at that point. Thus, perception at each level can facilitate the perception at the others. The availability of such a large number of interacting forms of simultaneous representation can reduce the limiting effect of immediate memory. On this view, speech perception is at least not magic; but how does it in fact occur?

If the mechanism for speech perception could operate without any time constraint, then a grammar would be the only computational device needed to comprehend sentences. One such time-independent mechanism would be an analysis-by-synthesis model of perception, in which the grammar is used to generate candidate sentences to match the input. When a candidate sentence is generated that does match the input (to some criterion) then the device assigns the particular structure that is generated to the input sequence. Given an unlimited amount of time to make false guesses as to what the input sequence is, such a device would ultimately assign all of the grammatical structures that a particular sequence should have assigned to it. However, real speakers and hearers do not have unlimited amounts of time in which to make incorrect guesses about the structure of what they hear.

The problem of the listener is to use psychological mechanisms that can quickly extract the meaning of an utterance from its outer form. Studies of this have isolated three processes which apply directly to the outer form of a sentence during comprehension; segmentation, erasure and functional labeling. The process of segmentation groups together as a perceptual unit each part of a sequence that could constitute (or is likely to constitute) a complete underlying structure clause. One way of showing this is to observe the pattern of location errors in response to a click introduced while listening to sentences. A variety of experiments have confirmed that listeners tend to think that the click actually occurred at the boundary between clauses, suggesting that the "perceptual integrity" of the clause "repels" the perception of the click to its boundaries. That the effect is truly caused by the structure contributed by the listener rather than some physical parameter of the signal contributed by the speaker can be shown by using sentences like those in (3) and (4). The linguistic sequence surrounding the click is exactly the same (indeed is a tape-recorded copy) in both cases; but the

- (3) His hope of marrying the girl/is impractical.
 (4) In her hope of marrying/the girl is impractical.

difference in structure predicts the relative perceived location of the clicks (indicated by the slashes). That the effect is perceptual rather than due to memory is shown by the fact that the response pattern is the same when the subject does not have to write out the sentence. To show that it is not due to guessing one can compare the pattern of responses when subjects are in fact guessing--such patterns do not show the same effect of structure. Thus we can conclude that listeners actively apply their knowledge of the structure of a sequence to segment it as they hear it.

The role of such structural segmentation in reflected in variations in attention--listeners alternate between attending to all external stimulus inputs during a clause and to internal processes of organization at the end of a clause. Accordingly, at the ends of clauses attention is weakest for any external stimulus, reaction time to a click is slowest, discrimination is poorest. These effects are reflected physiologically in an unconscious way--the electroencephalic brain response to a click is slowest when the click occurs in the last word of a clause compared with the first word. Such results suggest that at the end of a clause listeners are preoccupied with an internal activity that reduces attention (for about 1/10 second) to all external stimuli.

Other studies show that this internal activity involves the assignment of an internal organization to the sequence that has just been heard and the erasure of its external form--that is, at such points it is recoded into a more "abstract" level. This is reflected in the fact that listeners can recognize that the word "girl" was in a sentence more quickly if it is presented following (4) than (3). This is due to the fact that the intervening clause boundary in (3) occasioned recoding of the first clause by the listener so that it is harder to extract the information that the acoustic item "girl" occurred. Nevertheless, the semantic information within a clause is retained, as can be shown by the responses to questions following clause closure. Such responses characteristically reveal uncertainty as to the precise external form of the sentence, but show mastery of the semantic information. Another fact demonstrating that the internal organization of a sequence is assigned by the end of a clause is that the sentential ambiguity has no effect if the response task follows the clause boundary. The fact that a clause contains an ambiguity is no longer relevant once the clause boundary is passed, because listeners have chosen one interpretation by that time. However, before the boundary is reached the ambiguity does have an effect because the listener is actively entertaining both meanings implied by each structural interpretation.

The assignment of the structural interpretation to each clause utilizes a set of mapping rules, "perceptual strategies," which assign internal functional relations to the phrases. Such strategies can be viewed as having the effect of "inverse transformations;" they take an external sequence of lexical clauses as input and map it onto a

possible internal form. However, there is no evidence that these rules operate in stages that correspond to the operation of transformations. For example, several basic strategies are summarized in (5) and (6): clearly they do not correspond directly to transformational operations. Rather, they appear to be a separate set of rules which pair inner and outer sentence forms by mapping the

(5) $\left\{ \begin{array}{l} \text{adj.} \\ \text{adv.} \end{array} \right\}$ modifies the lexical item to which it is adjacent

(6) In N_1VN_2 N_1 = actor of next inflected verb.
 N_2 = object of verb.

latter onto the former. Since they do not correspond to transformations individually, it is possible that they operate in a system that is psychologically independent from the grammar.

One source of behavioral evidence supporting this proposal rests on studies of the development of the child's patterns of sentence comprehension. The child appears to go through several stages of perceptual strategies; the first is to use the strategy in (7): if one asks the two-year-old child to act out a simple sentence like those in (8) with dolls, the response pattern shows an early tendency to interpret any noun immediately before a verb as the subject of

(7) ...NV ...N = actor, V = action.

the verb. Around age four the child shifts to strategies more like those in (6), which assigns the initial noun the subject relation, regardless of whether it immediately precedes a verb or not. This leads to an actual decrease in correct performance on sentences like (8b). The same developmental pattern occurs in children learning English as a second language--as their overall conversational

(8a) The cow kisses the horse.

(8b) It's the horse that the cow kisses.

ability in English improves, they shift from responding to sentences with a strategy like (7) to one like (6). Since the strategies are not based on transformations such developmental shifts suggest strongly that the system of comprehension emerges at least partially independently from other systems of linguistic knowledge.// These considerations allow us to define the notion of "perceptual clause," independently of "grammatical clause." I have suggested that the perceptual mechanism can be viewed as establishing closure and recoding whenever possible in order to relieve the load on short-term memory. Typically this will occur when phrases have accumulated that can be related using the basic grammatical relations, "actor, action, object, modifier."⁵ However we can expect that other factors influence the process; e.g., the coherence of the meaning, the length in words, the complexity of the sequence, and so forth. That is, we should expect fully grammatical clauses to vary in the extent to which they act as perceptual clauses. We could expect this to vary with the extent to

which a clause can stand alone as a complete unit of thought. Initial support for this comes from an experiment in which we asked subjects to rate initial clauses as to how "complete" they seemed to be. We then showed that the judged "completeness" of a clause correlated highly with the reaction time to a click at the end of the clause--that is (in our general interpretation of such results), the more "complete" a clause the more perceptual recoding occurs at the end of it.

This variability in perceptual closure was defined operationally, and therefore may involve some circularity. Carroll and Tannenhaus have worked out part of a structural definition of perceptual clauses which can predict which sequences will be "good" perceptual clauses and which will be weak. Their paper appears in this volume, so I shall avoid detail here. Their main line of reasoning is this: the more like a simple declarative main clause a sequence is, the better it will fit the perceptual strategies and consequently the better a perceptual clause it will be. Carroll and Tannenhaus discuss two factors that can reduce the applicability of the clausal perceptual strategies: subordinate markers, and nominalizations that reduce the number of grammatical relations. On the theory I outlined above, the less marked the grammatical relations are in the surface sequence, the less likely the perceptual strategies can construct an underlying recorded representation. Carroll and Tannenhaus propose that this variable should define a "hierarchy" of perceptual clauses as exemplified in (9). In (9a) the clause is

- (9) a)....that Jim refused the offer
b)....Jim's refusing the offer
c)....Jim's refusal of the offer

complete; in (9b) the verb form is nominalized (though recognizable as a verb); in (9c) the verb form is deleted and replaced by a noun.

ran several experiments demonstrating
the initial validity of such a hierarchy.

3.9 Speech Perception - Summary

As I mentioned at the beginning of this section sentence comprehension can involve information at a number of levels. Most research of the past two decades has concentrated in the mapping of words onto meanings. The reasons for this focus are not arbitrary. First "words" and "meanings" are easily recognizable entities for both experimental subjects and experimenters to manipulate. Second, in any theory part of understanding a sentence involves assigning internal functions to words and phrases. Finally, it is the study of this aspect of sentence perception that is most likely to reveal the nature of the relation between a grammar and the perceptual system. The upshot of that question seems to be that grammatical structures are manipulated in perception (e.g.; words, grammatical relations). However, grammatical processes (e.g.; transformations) are not used in perception. Rather, listeners use a distinct set of strategies to pair external sequences with underlying forms. The independence of the grammar and perception

make it possible that certain linguistic phenomena are due directly to perception and not the grammar.

4. Some Linguistic Phenomena Explained by Speech Perception⁶

In the past few years, we have attempted to explain certain historical and linguistic phenomena as due to the constraints set by the system of speech perception outlined in Section 3. In this discussion I shall concentrate on phenomena that involve relationships between clauses, in particular the perceptual analysis of subordinate and main clauses. I shall apply this analysis to an example of a linguistic universal (the penthouse principle), a derivational constraint (command) and levels of acceptability (the nouniness squish). In each case, I shall argue that the phenomenon is due to the way in which the perceptual system deals with subordinate and main clauses: that is, in each case I shall argue that the phenomenon is not a direct property of grammar, but rather the result of the operation of speech perception.

4.1 The Penthouse Principle

It is a commonplace in perception that we distinguish the "figure" from the "ground" which provides the context for the figure. In visual perception the figure receives more attention (e.g.; as measured by eye fixations), and tends to be the first aspect of a stimulus configuration that we recognize and is better retained. In sentence analysis, it has often been noted that the subordinate clause characteristically provides "background" information in contrast to the main clause which provides the central information of the utterances. This difference can be spoken of in terms of "old" vs. "new" information, in terms of "presupposition" vs. "assertion," or in terms of "context" vs. "focus." Each of these distinctions covers a wide variety of cases (although none of them renders exactly the main-subordinate clause differentiation).

The fact that language is presented serially can pose particular problems on our desire to focus first on "figure" and secondarily on "ground." In the preceding discussion I emphasized that one goal of the perceptual system is to recode clause by clause as much as possible. However, this process should apply first to main clauses (the "figure") and then to subordinate clauses. That is, the subordinate clause is less of an independent clause unit than main clauses, and, as such, should be recoded less completely during the first stage of perceptual analysis. Another way of putting this is to note that the subordinate clause information generally must be integrated within the main clause information, as opposed to the reverse. Still another way of putting it is that in the perceptually recoded representation of a two-clause sentence, it is the main clause that dominates the subordinate rather than the reverse.

The conclusion from all of these considerations is that when listeners hear a subordinate clause they hold it partially unrecoded as a separate clause. When the subordinate clause is the first clause in a sentence it must be held unrecoded to accommodate the fact that it is not yet known how to integrate it with the following main clause. When the subordinate clause follows the main clause, the listener's goal is to recode the subordinate clause information in relation to

the main clause, rather than to recode it completely as an independent unit.

In the preceding section I pointed out that there is a canonical phrase order within clauses, actor-action-object. This order is ordinarily recoded by a dominant perceptual strategy; e.g., (6). If the clause does not have this order, then a second-order strategy must be applied to provide the correct recoding of the clause. Similar strategies apply to the attachment of modifiers (e.g., adjectives or adverbs) to their head phrases (as in 5). In this case, the strategy attaches the modifier to an adjacent lexical item. Here too, if the modifier has been displaced from its canonical position, second-order strategies must apply.

We can now turn to a feature of rules which reorder constituents within clauses, either placing modifiers away from their canonical positions or ~~reordering~~ the basic grammatical relations. Since the subordinate clause must be maintained unrecoded in short-term memory for a longer time, we might expect more restrictions on word order in subordinate clauses than in main clauses: the special processing load imposed by subordinate clauses constrains word order to be closer to the canonical order than would be the case in main clauses. Of course, this behavioral differentiation of main and subordinate clauses does not predict that there will be a difference in freedom of word order in the clauses. What it does predict is that if there is a difference in word order flexibility, that it will always be in the direction of greater flexibility in main clauses than in subordinate clauses.

In fact, this phenomenon has been observed by Ross. He notes that rules which optionally reorder constituents within clauses operate more freely in main clauses than in subordinate clauses. Ross examined this phenomenon across a number of languages and proposes it as a language universal: "the penthouse principle" (more goes on upstairs than downstairs). If my interpretation is correct, the penthouse principle exists not as a property of universal grammar but as a behaviorally caused universal of grammars.

The perceptual explanation of the penthouse principle makes a further prediction: the constraints on optional reordering of constituents in subordinate clauses should be stronger when the clause is at the beginning of a sentence than when it is at the end of a sentence. This follows from the fact that when a subordinate clause precedes the main clause it is not recoded as a separate clause and it also must be held in memory until the main clause has been recoded. This is not the case when the subordinate clause follows the main clause: in this case the constituents of the subordinate clause can be integrated with the main clause, in part, as they are heard; although here too the constituents must be held unrecoded in relation to each other until the end of that clause. Consequently the perceptual system is more vulnerable to non-canonical orders when the subordinate clause precedes the main clause than when it follows the main clause.

Ross observes that this is also true of the penthouse principle; the application of reordering transformations is more restricted when the subordinate clause precedes the main clause than when it follows.

Consider the implications of the discovery that the penthouse principle is not a property of universal grammar but rather due to the perceptual mechanisms associated with clause segmentation and recoding. In Ross' formulation, the penthouse principle must be stated as a rule of universal grammar: that the reordering rules that apply in the subordinate clause are a subset of those that apply in the

main clause, and that the reordering rules that apply in a final subordinate clause are a subset of those that can apply in an initial subordinate clause. This statement captures the observed facts, but provides an explanation for them only by terminological fiat, or by the claim that the penthouse principle is innate. In contrast to this, the perceptual explanation follows from an independently motivated theory of perceptual functioning, and thereby explains the facts without recourse to new hypothetical universals.

4.2. Command

The preceding characterization of the different way in which subordinate and main clauses are treated perceptually suggests that the perceptual mechanism must be sensitive to markers that indicate whether a clause is subordinate or not. I have suggested that the main principle of perception at the clause level is to segment together and recode any sequence which has a complete set of internal grammatical relations. This will apply naturally to any main clause. However it will apply inappropriately to a subordinate clause unless the subordinate clause carries with it a marker which can indicate that recoding should be blocked. Such markers in English include conjunctions and complementizers, as well as word orders, which are characteristic of subordinate clauses. The needs of the perceptual system suggest that some marker that a clause is subordinate must be present in the surface sequence. This is true (at least for English), for initial subordinate clauses. A further prediction based on the perceptual mechanism is that when the subordinate clause follows the main clause the appearance of the marker will be less mandatory. The reason for this is that after the main clause, the listener will be less likely to assign main clause status to the subordinate clause. The predicted difference in restrictions is also true: non-initial subordinate clauses may often delete complementizers.

These facts have been discussed within linguistic theory as examples of "command" constraints among clauses. Basically, "command" requires that a deep structure main clause either precede a subordinate clause in the surface sequence, or that there be some marker in the surface subordinate clause which allows recovery of its subordinate status. This linguistic generalization about English is true but must be stated in the form of a "derivational constraint" if the generalization itself is to be captured within a grammar of English. Constraints on specific transformations could have the effect that command has, but would miss the generalization that underlies the facts. I am suggesting that the generalization is due to the operation of the perceptual system on sentences, not to some property incorporated in the grammar itself. That is, the generalization is captured and explained using an independently-motivated theory of speech perception. As I have argued above, if all derivational constraints can be shown to be explicable in such a fashion, then universal grammar will make stronger and more testable claims about the child's mind.

4.3. The Nouniness Squish

In listening we often must deal with deep structure clauses that are sufficiently degraded on the surface so that they do not contain an explicit set of phrases. I discussed this in Section 3 with reference to the research by Tanenhaus & Carroll. Their work

suggests that the rules of nominalization create a perceptual clause hierarchy with full sentential complements at one end, and deverbal nouns at the other end. Suppose it is the case that there is a certain amount of confusion between perceptually acceptable sequences and grammatically correct sentences. This could lead to a continuum of acceptability in the case of grammatical movement rules which move full sentences.

We have argued elsewhere that the occasional mismatching between the analysis of sentences provided by a grammar and that provided by the systems of speech perception and speech production are the basis for neologisms in linguistic evolution.³ In particular, if an ungrammatical sequence is perceivable and utterable it may become useable and its use may ultimately force a restructuring of the grammar so that it becomes "grammatical". As an example, consider the perceptual strategy which would apply to sentential noun phrases following psych verbs as in:

- (10) a) It surprised me that Jim refused the offer.
 ?b) It surprised me Jim's refusing the offer.
 *c) It surprised me Jim's refusal of the offer.
- (11) a) That Jim refused the offer surprised me.
 b) Jim's refusing the offer surprised me.
 c) Jim's refusal of the offer surprised me.

The grammatical treatment that transforms the sentences in (11) into those in (10) would be a rule like (12).

- (12) S VP \Rightarrow It VP S (if S includes an inflected verb form and VP includes a psych verb).

Consequently, in grammatical terms only sentence (10a) is well-formed, while the other two are ungrammatical. Now consider the perceptual analysis of the same sentences. A hypothetical strategy of the sort we have studied would be like (13).

- (13) It VP S \Rightarrow S is subject of VP if the V in VP is a psych verb.

This is obviously modeled on the transformation (12) and states roughly the same facts (in reverse "direction"). However the referent of "S" in the perceptual strategy (13) is the "perceptual clause" discussed by Tanenhaus & Carroll, not the grammatical clause. Thus, strategy (13) will tend to misanalyze any structure which contains a sequence relatively high in the perceptual clause hierarchy. This explains why sentence (10b) is behaviorally acceptable. It also explains why sentence (10c) is behaviorally unacceptable, namely, because the nominalization is a relatively poor perceptual clause.

This interpretation of the potential role of the perceptual clause hierarchy predicts that whenever a grammatical rule contains an S there may be an acceptability continuum ranging from full S's to single nouns, and that this continuum will be defined by the perceptual clause hierarchy. In fact, such a continuum has been found by Ross and documented in a variety of ways. Ross interprets the apparent acceptability continuum in facts like those in (10) as showing that there is no discrete distinction between grammatical and ungrammatical utterances. He argues that there is rather a "grammaticality squish" in which the grammar marks sequences as more or less well-formed.

To say of a sentence that it is slightly grammatical strikes me as saying of a woman that she is slightly pregnant. To give up the notion that a grammar defines a set of well-formed utterances is to give up a great deal. This is not to say that it is impossible in principle that grammars are squishy. Rather the possibility of studying precise properties of grammar and exact rules becomes much more difficult, as Ross himself points out. Thus, if we can maintain the concept of discrete grammaticality, we will be in a better position to pursue an understanding of grammatical universals. There is no question that Tanenhaus, Carroll and I have not yet explained all of the facts which Ross has noted. Rather we have sketched a framework that predicts that the nouniness squish could occur and also applied it to some of the specific examples, showing that the perceptual explanation of the squish is initially confirmed. Here too, we are in a position of relying on an independently motivated theory to explain a set of facts about language.

5. Interactionism and the Power of Grammars⁷

I have given several examples in which a linguistic phenomenon is due to the way language is perceived. I have intentionally addressed the discussions to phenomenon that have been raised in the past decade as reasons to abandon transformational grammar in favor of a more powerful model. In each case I have argued that independently motivated aspects of speech perception explain the phenomenon: this relieves the grammar of the descriptive responsibility and potentially reduces the descriptive power of grammatical universals.

There are several aspects of this research that are worth noting. First, our preoccupation with speech perception should not be taken as intended to exclude the interaction of language structure with other behavioral systems--most notably that of speech production. The role of perception has dominated our discussions because more is known about how perception operates--that is, to some extent, we have an independently motivated perceptual theory. However, our general view is that there is a dynamic interaction between the grammar and both the system of speech production and perception in the child and adult.

Second, I have taken care to argue that each specific linguistic phenomenon is interpreted as due to independently motivated aspects of speech perception. I have attempted to avoid vague reference to properties such as "mental effort," "informativeness," "importance," "focus," "empathy," and so on. I do not mean that these terms are

empty in principle: however, they are empty at the moment, and consequently can have no clear explanatory force. This is a stolid but necessary methodological stance. 'Because of it, the rapidity of linguistic theorizing may often seem to outrun our behavioral explanations. But ultimate explanatory correctness requires that we base our claims on reasonably verified principles, not unconstrained theorizing. Remember the tortoise and the hare.

The final point concerns the claim that a grammar is psychologically real.

For the past two decades, linguists have accepted that the goal of linguistic description is to account for a speaker's knowledge. This was in marked contrast with the position of the previous decades which emphasized that "regularities in linguistic data" are to be accounted for, leaving open the question of whether those regularities reflect knowledge or not. The claim that a grammar is a representation of knowledge is crucial to making linguistic science a contributor to the understanding of the human mind. Insofar as the grammatical descriptions are correct for adult speakers, they specify mental structures which underlie both linguistic behavior and linguistic knowledge. These structures in turn constrain our hypotheses about the structures in the infant's mind: clearly, structure which is possible in an adult language must either be learned by the child or must be innate. Hence, only if linguistic structures represent knowledge can we use linguistic science to increase our understanding of ourselves.

What is at issue in modern linguistics is the notion of the "descriptive power" of grammars. Confusion about this problem lies at the heart of many continuing controversies in the study of language. The term "descriptive power" refers to two kinds of questions concerning the status of grammar and the linguist's goal in constructing grammars: are the formal devices in a grammar general or specific: and, is the domain that a "grammar" describes broad or limited? Individual answers to these questions tend to coincide; that is, those who argue that grammars are made up of an assemblage of specific descriptive devices also accept circumscribed goals for the domain of grammatical investigation.

The answers to the two questions are not logically linked even though they occur together--however, they are related methodologically. Consider first the generalist's view. We can feel impelled as scientists searching for general truths to find the most general formalisms to describe language. The reason for this is intuitively clear: the more general the mechanisms are, the less specific any given claim about their representation in the mind is, and therefore the less radical appearing the claim that they are learned or innate. This goal would appear to accommodate the scientific method in the best sense: namely, to keep to a minimum the number of different kinds of formal devices which are postulated to exist, thereby increasing the plausibility and generality of the descriptions. Coupled with this is the desire to treat all systematic properties of language as due to the grammar--that is, the domain of grammatical description is intended to be as broad as possible. This goal, too,

appears to follow the requirements of good scientific practice: namely, it appears to our desire to have one single theory account for many superficially different kinds of facts. I will characterize this position as the "pan-theoretical" approach--the attempt to reduce all linguistic phenomena to a single theory which itself includes a single formal device.

I have noted that "pan-theoretists" tend also to be formal "generalists." It is clear why the decisions to describe all linguistic phenomena in a grammar and to use a single formal device are mutually reinforcing. If every regular fact about language is ipso facto relevant to a grammar, then the researcher must try to find a common formal thread. Otherwise every new kind of fact forces a revision of the theory, thus reducing its significance. After all, to treat all linguistic phenomena within a "grammar" is of interest only insofar as it does not require a distinct theoretical mechanism for every kind of fact. Accordingly, the more kinds of facts about speech a grammar describes, the more pressure to find some common theoretical denominator. The danger is that such pressure impels theorists to resort to the common theoretical denominator that is least.

The pressures are bilateral: if one pretheoretically accepts the goal of using the smallest and most generally applicable number of formalisms then one is under pressure to show that the formal devices have wide applicability--after all to show that a single formal device is adequate to describe "language" is of interest only insofar as the notion of "language" is broad and superficially heterogeneous. Thus, the simpler the formal devices, the more pressure to find a wide variety of facts they describe. The danger here is that such pressure impels theorists to ignore real distinctions between different kinds of facts about language.

The individual cases discussed in this paper highlight the dangers of this dual dynamic for linguistic description. Too often, current linguistic practice appears to be at the mercy of this force, resorting to theoretically vacuous generalizations and obscuring the distinctions that must be maintained if we are to understand language at all. There are two kinds of pressures which make this position attractive, despite the fact that it stultifies theoretical understanding. First, the smaller the number of formal mechanisms is, the weaker appears the claim that such mechanisms are "innate" or "learned." That is, psychologists and philosophers who maintain that language (and all other mental faculties) are learned, are comforted by the apparent formal simplicity of what there is to be learned. Those who view human beings in terms of "general purpose computational mechanisms" are charmed by the possibility that there may be only one elementary kind of mental operation involved in language.

This question comes into sharp focus over the need for "global rules," rules which are sensitive to non-adjacent trees in a derivation. Some have argued that transformations are simply special cases of such general rules. The question now is, what is wrong with viewing all grammatical rules as different kinds of global rules, and thereby reducing universal grammar to one formal structure? The

answer lies in the descriptive power of a universal grammar which includes both "transformations" between adjacent trees and "derivational constraints" between non-adjacent trees. Such a universal grammar has more ways of describing any particular phenomenon than a universal grammar consisting of only "transformations." For example, consider the formation of the passive in English. Somehow cases like (14) must not be derivable from those like (15). In a universal grammar with transformations, but no derivational constraints, this

(14) *Into the room was walked by Bill

(15) Bill walked into the room

is handled by marking phrases like "into the room" as "locative" and verbs like "walk" as intransitives, thereby exempting them from qualifying as V_1NP_2 in a standard passive rule. This solution also satisfied one's intuition that "into the room" is a locative phrase and "walk" is intransitive, as reflected in its relation to sentences like (16) and (17).

(16) Where Bill walked was into the room

(17) Bill walked

A separate permutation rule (18) would account for cases like (19).

(18) $NP\ V_{int}\ Prep\ NP \Rightarrow Prep\ NP\ V_{int}\ NP_1$

(19) Into the room walked Harry

A universal grammar containing global rules would allow for the same solution: however, it would also make statable a number of other solutions, that would seem equally plausible. For example, one could simplify the passive transformation to (20), allowing any NPVNP combination to be permuted transformationally (optimally inserting "Be + pp" and "by") and not differentiating locative phrases

(20) $NP\ V\ NP \Rightarrow NP_2\ (Be + pp)\ V\ (by)\ NP_1$

from other NP s in the grammar. This would allow both passives and inverted locatives (19). Incorrect forms such as (14) and (21) would be marked as ungrammatical by a derivational constraint like (22).

(21) *That Bill was a fool believed Harry

(22) $NP_1\ V\ NP_2 : NP_2\ V\ NP_1$

if and only if NP_2 is not direct object of V .

This solution also has two "rules," of roughly the same complexity as the pure transformational solution. It should be clear that other solutions would be readily possible, given the availability of derivational constraints. We do not mean to suggest that our solutions are the best, or even reasonably appropriate, since the range of facts in our examples is so narrow. Our point is that

the more powerful the formal mechanisms, the more solutions are available and theoretically plausible for any finite set of facts. The multiplicity of solutions quickly becomes a plethora. Recall that the goal of linguistic analysis is to use a set of universal formalisms to describe linguistic knowledge. The minimal set of formalisms that are adequate for the description of known languages are candidates for psychologically innate or learned structures. However, this line of inquiry can proceed only if the grammatical solution for any set of linguistic facts is reasonably unique. If a variety of solutions is possible the psychological pertinence of any particular solution is reduced: whether it is empirically valid or not is of little interest because its non-uniqueness means its validity can neither uniquely confirm nor disconfirm the universal formalisms.

The less unique a particular solution is the less its validity confirms the explanatory power of the proposed universal formalisms. Finally, the less subject to confirmation the formal universals, the less of an empirical science is linguistics. For this reason, the invention of formal grammatical structures of increased descriptive power is to be avoided.

This highlights the complementary approach to linguistic research which ordinarily accompanies attempts to increase the formal power of universal grammar--the attempt to embrace all facts about language as necessarily "grammatical." Suppose the phenomena discussed in Section 4 are true (the penthouse principle, command, NP squishes), what makes them grammatical facts? Is their existence as generalizations only truly represented if they are represented within the grammar, among the many rules and structures that generate sentences? After all, (23) is a true generalization about language, but it is not ordinarily included as a grammatical universal. The reason for not including (23) as a universal of grammar is two-fold. First to include acoustic sensitivity within gram-

- (23) Speech power 1 cm. from the mouth is louder than 5 db (ref. - dyne = 0 db) and softer than 150 db.

mar would introduce new formal power and conceivably multiply possible grammatical solutions for any data set (in this case, perhaps multiplying the possible solutions for stress phenomena). Second there is a plausible, independently-motivated explanation for (23) to be found in the mechanisms of speech perception and production. Less than 5 db at the mouth would not be sufficient for ordinary listening, and more than 150 db the vocal system cannot produce. Thus the constraints of the mechanisms of perception and production predict that (23) is a true generalization about language, albeit an extra-grammatical one.

The question now concerns the facts in Section 4. Are they grammatical or extra-grammatical phenomena? We have reviewed the theoretical disadvantages of admitting them as grammatical phenomena, but if there were no alternative solutions then we must accept them.

After all, the argument that transformations are needed beyond phrase structure rules involved increasing the formal mechanisms in a grammar and in weakening the specificity of any grammatical solution.⁸ Transformations had to be accepted because there was no (known) way of accounting for the accepted facts with the existing formalisms (phrase structures). However, I argued in Section 4 that there are independently motivated descriptions for the phenomena: thus we are not forced to accept the less constrained universal formalisms to describe those particular facts.

Of course, all such questions are empirical. It remains to be seen if all the phenomena that are referred to as motivating "derivational constraints" can be explained as due to independently-motivated extra-grammatical mechanisms. It is our working hypothesis that all formalisms which constrain the structure of relations between basic and surface trees will be shown to be due to non-grammatical structures. But if that turns out to be false, so be it. My main motivation here is to explain why it is that such formalisms must be accepted reluctantly rather than apocalyptically embraced.

To put it briefly: If we can exclude such formalisms as global rules and maintain the notion of discrete grammaticality,

- (a) For any data set, the number of available grammatical solutions of equal complexity decreases.
- (b) This increases the uniqueness and power of a particular grammatical solution.
- (c) This in turn increases the interest of the possible grammatical universals underlying that grammatical solution.
- (d) Finally, this increases the precision and testability of claims about the human mind.

And, that is what the study of language is all about.

Footnotes

1. For discussions of the material in Section 2.1 see Zipf (1949), Miller (1951), Martinet (1962), Winograd (1972), Norman & Rumelhart (1975), Lakoff & Thompson (1974).
2. See Osgood (1963), Yngve (1960), Bever (1970) for basic discussions of each point of view.
3. See Bever & Langendoen (1971) and Bever, Carroll & Hurtig (in press).
4. See Fodor, Bever & Garrett (1974), Chapter 6 for a review and experimental references.
5. Note that so far as my claims about perception are concerned it does not matter whether these are syntactic or semantic relations.
6. See Ross (1972) (4.1), Langacker (1969), Lakoff (1970), Bever (1970), Bever & Langendoen (1971), and Ross (1973) (4.3).
7. See Bever, Katz & Langendoen for a collection of papers on interactionist approaches. See Lakoff (1970) and Postal (1972) on the alleged necessity and virtues of global rules.
8. Actually, this may not be the case. Phrase structure grammars may be like global rule grammars in that they also offer many equally-valued analyses for each data set.

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