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THE ASCENT OF THE SPECIOUS OR THERE'S A LOT WE DON'T KNOW ABOUT MIRRORS

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DIALOGUE–ARGUMENTATION IN LINGUISTICS

Meander (a linguist):	I have a theory that everybody's eyes are colourless.
Simplon (a psychologist):	But, Meander, everybody's eyes look brown, blue or green to me.
Meander:	That's because they are actually wearing contact lenses to color their eyes.
Simplon:	But, Meander, I know that I don't wear contact lenses, and when I look in the mirror my eyes look blue to me.
Meander:	Ah: but then, there's a lot we don't know about mirrors.

The other papers in this conference have devoted a good deal of attention to the question of whether linguistic theory is an explanation or a description, and whether it can in principle aspire to be either. Such discussions are often hampered by a lack of clarity as to what the subject matter actually is. In the present paper I shall sketch the nature of linguistic data and how it interacts with linguistic descriptions, which under ordinary usage would be termed "theories." It is my philosophically naive position that, properly managed, linguistic theory can have all the properties that we ordinarily demand of an "explanation." However, I leave the question as to

In D. Cohen (Ed.), Explaining linguistic phenomena (pp. 173-200). Washington, DC: Hemisphere Pub. Co., 1974.

whether our descriptions are in fact explanatory theories to those who claim they know how to set the terminology that would govern such a decision.

Let me start by outlining the structuralist program for the description of language that was enunciated by Chomsky and continued by many of his colleagues and students. The broad philosophical issue that a structuralist program of description in psychology meets concerns the compatibility of materialism (3t least in its functional interpretation) with experimental mentalisin as it is developing today.[1] More narrowly defined within psychology, the role of such a program is to keep clear what we are claiming to be in a child's mind that makes it possible to learn a language.

A grammar is, simply put, a theory of grammaticality. It purports to describe an aspect that sentences can have or not have, indcpcndcnt of acceptability intuitions of native speakers. In order that the notion of "grammaticality" be interesting and psychologically significant rather than arbitrary, grammatical description starts with intuitively "clear" cases of acceptability and builds a general grammatical theory around them. However, every theory can "outgrow its goal" by revealing new insights about cases that were originally "unclear." Fodor[2] puts this in the following way:

> **There is then an important sense in which a science has to discover what it is about: it does so by discovering that the laws and concepts it produced in order to explain one set of phenomena can be fruitfully applied to phenomena of other sorts as well. It is thus only in retrospect that we can say of all the phenomena embraced by a single theoretical framework that they are what we meant for example by the presystematic "physical event" . . . to the extent that such terms or their employments are neologistic, the neologism is occasioned by insights that successful theories provide into the deep similarities that underlie superficially heterogeneous events.**

David Layzer[3] gives a succinct analysis of how this worked in the history of alchemy:

> **Chemistry did not solve the problem of how to turn lead into gold. It outgrew it.**

It is often the case in the development of a theory that it starts out with pretheoretic assumptions as to what the important problems are and the ways

[1] See Fodor, Bever, & Garrett, The Psychology of *Language*, McGraw-Hill, Chapter 1. The prefatory dialogue is my own version of an apocryphal story passed among linguistics graduate students in the last decade.

[2] Fodor, J. A., *Psychological Exclamation*, Random House, New York, 1968, pp. 10–11.

[3] Paraphrased from David Layzer, "Science or Superstition," Cognition, 1, no. 2, p. 298.

in which they are clearly to be understood. Calculi are developed that account for the pretheoretically accepted phenomena. But these calculi and methods have further implications that can be tested, and make further predictions of new phenomena or of new ways to look at old phenomena. Grammatical theory may have just this characteristic. Once we have constructed a solid grammar based on the pretheoretically accepted facts, we may be in a position to discover internal propcrtics that originally unclear cases can be shown to have.

The basic set of pretheoretically determined cases are tlic so-called "acccptability" intuitions. One research program in linguistics has been to take sentences that are clearly acceptable and distinguish them from scntenccs that are clearly unacceptable by way of a calculus, known as "the grammar." From the very outset in generative grammar it has been clear that certain kinds of sequence unacceptability are not to be accounted for by the grammar. For example, sentences that are unacceptable because of their manifest length, sentences that are unacceptable because of their manifest absurdity, sentences that are unacceptable because of their manifest difficulty of comprehension or pronunciation are not necessarily treated as ungrammatical. Thus, the pretheoretic decision includes not only a classification of sentences into clearly acceptable and clearly unacceptable ones; it also includes a decision that there are systematic sources of acceptability judgments other than the grammar.

The non-grammatical sources of acceptability judgments that were articulated clearly by Chomsky and Miller[4] involved so-called "speech performance variables." For example, Chomsky and Miller were confronted with the fact that sentences with multiple embeddings are unacceptable; the problem was that there was no formally natural way of accounting for the unacceptability of center-embedded sentences that would not also claim that a number of other acceptable sentences are unacceptable.

The special difficulty was that in order to allow for sentences like (1) and (2), sentences like (3) would also be marked as "grammatical." The grammar would have to include a statement like (4). Such a statement would have had

(1) The man the girl likes kicked the dog.
(2) The man kicked the dog that barked at the girl who likes the boy.
(3) The man the boy the girl likes saw kicked the dog.

[4] Chomsky & Miller, "Introduction to the formal analysis of natural languages," Luce, Bush, & Galanter (eds), Handbook of Mathematical Psychology, 2, Chapt. 11, New York, John Wiley & Sons, 1963.

(4) No deep clause can be split up in the surface structure by a second deep clause which itself is split up in the surface by a third deep clause.

several disadvantages. First it merely catalogues the facts and cannot explain them: (4) is not a linguistic rule. Rather it is an extra-transformational statement to the effect that certain deep-surface clause configurations are ungrammatical despite the fact that the grammatical rules generate them. A second disadvantage is that (4) involves sensitivity to deep and surface clauses simultaneously. Obviously the descriptive power included in a grammar with this type of statement is greater than in a grammar which pairs deep and surface structures by a series of independent transformations. The increased descriptive power is reflected in the fact that the possibility of such statements increases the number of possible grammars for every set of data. This reduces the potential interest of any particular grammar because it reduces its uniqueness. Ideally a formal system of grammatical universals should offer only one particular grammar for a set of data: insofar as it does so, the validity of the particular grammar confirms directly the postulated universals. Insofar as particular grammatical solutions are non-unique the validity of the universals does not uniquely rest on the validity of a particular grammar. Consequently, if statements like (4) were included in the grammar then the postulated universals would be less significant and less open to empirical test. The consequence for a rationalist is that the linguistic universals make less precise and less significant claims about the child's mind.

Of course, if linguistic data like those in (1)–(3) exist and cannot be explained in some other way, then statements like (4) must simply be accepted as a necessary formal device of grammar. Chomsky and Miller argued that sentences like (3) are complex because they place an extra load on immediate memory in sentence processing. They pointed out that there must be some memory limit on the number of times that a psychological operation can interrupt itself. Each time a new application of the operation is initiated an additional phrase must be stored in the memory. Chomsky and Miller proposed that this can happen once, but not more. For example in sentence (1) the left-right perceptual operation that pairs subjects and verbs must store "the man" while pairing "the girl" and "likes," and only then pair "the main" with "kicked." In (3) the perceptual operation would first store "the man" and then also "the boy" before pairing "the girl" with "likes." Since there is only one perceptual store "the man" and "the boy" would be

confused in relation to the next two verbs. Thus sentences like (3) are complex.

This explanation follows from natural assumptions about the perceptual decoding of sentences; that perception proceeds from "left to right," that subjects and their verbs are comprehended in the order presented: that a subject is stored in the memory store until a verb for it is heard; and that if two subjects for different verbs are stored at the same time they become confused when the verb appropriate for one of them is heard. It appeared plausible that *any* perceptual theory for sentence comprehension would have these properties. And these properties were sufficient to predict the complexity of sentences like (3). Accordingly, (3) was declared to be grammatical, thus relieving the grammar of statement (4) and simplifying the grammatical universals.

(5)

"Facts"	Acceptable 1-embedding (e.g. 1)	Unacceptable 2+ embeddings (e.g. 3)
Grammar	Grammatical	Ungrammatical
Perceptual mechanism	Decodable	Decodable

(6)

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This argument has been widely accepted within the psychology of language perhaps because of its intuitive plausibility. The form of the argument has surprising implications for other linguistic phenomena that I discuss below. The situation is outlined in (5) and (6). The alternatives were either to explain the acceptability facts as due to a grammatical distinction or to a perceptual one. The grammatical theory could account for the acceptability distinctions only by using complex rules, that would require new kinds of universals. The perceptual theory predicts the acceptability facts with *no* additional mechanisms. Accordingly, the acceptability facts were explained as due to the perceptual mechanism (6). This decision reflects the methodological assumptions in (7), that seem characteristic of science:

(7) a) Specific factual phenomena are often the result of interactions among different (physical, psychological, biological) systems.
b) The formal theory in each system should be as limited as possible to be as testable as possible.
c) When a new fact can be described by two existing systems, but would require elaboration of one of them and not the other, the fact is interpreted as due to the system not requiring elaboration for its description.

In order to see how this descriptive paradigm operates in detail, it is useful to consider the current theory of speech perception and the kind of independent empirical support it has.[5]

The System of Speech Perception:[6]

The problem of the listener is to 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

[5] For a thorough review of this see Fodor, et al., *ibid*, Chapt. 6.

[6] For a discussion of (16)-(20) see Langendoen & Bever, "Can a not unhappy person be called a not sad one?," in *A Festschift for Morris Halle*, Holt, Rhinehart & Winston, Inc., USA, 1973, pp. 392-409. For discussion of acceptability and perception see Bever, "The Cognitive Basis for Linguistic Structures." *Cognition and Language Development*, Hayes, R., (ed.), Wiley & Sons, Inc., 1970, pp. 277-360.

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 (8) and (9). The linguistic sequence surrounding the click is exactly the same (indeed is a tape-recorded copy) in both cases; but the difference in structure predicts the relative perceived location of the clicks (indicated by the slashes). That the effect is *perceptual* rather than due

(8) His hope of marrying the girl/is impractical.
(9) In her hope of marrying/the girl is impractical.

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 is 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 (9) than (8). This is due to the fact that the intervening clause boundary in (8) 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 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 classes 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 (10) and (11): 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 latter onto the former. Since they

(10) $(\ldots \text{adv}_1 \begin{Bmatrix}\text{adj}\\ \text{adv}_2\end{Bmatrix} \ldots) \longrightarrow \text{adv}_1 \text{ modifies } \begin{Bmatrix}\text{adj}\\ \text{adv}_2\end{Bmatrix}$

(11) N_1 at clause beginning $\longrightarrow N_1$ = actor of next inflected verb.
N_2 following verb $\longrightarrow N_2$ = object of verb

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 (12): if one asks the two-year-old child to act out a simple sentence like those in (13) with dolls, the response pattern shows an early tendency to interpret any noun immediately before a verb as the subject of the verb. Around age four the child shifts to strategies more like those in (11), which assigns the initial noun the subject relation, regardless of whether

(12) $\ldots NV \longrightarrow \ldots$ N = actor, V = action.

it immediately precedes a verb or not. This leads to an actual *decrease* in

correct performance on sentences like (13b). The same developmental pattern occurs in children learning English as a second language–as their overall

(13a) The cow kisses the horse.
(13b) It's the horse that the cow kisses.

conversational ability in English improves, they shift from responding to sentences with a strategy like (12) to one like (11). 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.

In brief the perceptual system operates something like the following. During a clause the listener assigns lexical class information to the words and attempts to find an appropriate deep structure for the sequence–the set of possible deep structures is assigned on the basis of perceptual strategies which map internal relations onto the external sequence. When an internal structure is found, the listener assigns it to the sequence and establishes perceptual closure around it, removing its external form from the focus of attention. It is, of course, true that this general picture of the perceptual process is not precise enough in most cases to allow for critical experimentation and that much research remains to be done. Nevertheless, the main points are well supported–namely that the perceptual system operates in part independently from grammatical knowledge, and that its operation has measurable behavioral effects.

The Effects of Perception on Acceptability

Such facts allow for an elaboration of the traditional distinction between competence and performance which can clarify the psychological basis for intuitions about acceptability. Every acceptability intuition necessarily involves some aspect of behavior, with the result that one can never be absolutely sure that a particular acceptability intuition reveals a property of grammatical knowledge and not of some other linguistic system. The interaction of the perceptual system and grammatical system in such judgments exemplifies the theoretical solution to this problem. Consider (14) for example: the operation of the perceptual strategies summarized in (11)

(14) *The horse raced past the barn* fell

would categorize the first NVN sequence as a plausible clause, leaving the

listener bewildered as to how to deal with the remaining word "fell," thus, leading to an intuition that the entire sequence is unacceptable. It is clear how to rule out sentences like (14) in transformational terms–whenever a relative clause on an initial noun is passivized and the past participle of the verb in that clause is homonomous with the simple past, then the relative pronoun and form of "be" may not be deleted from the relative clause. Thus, (15a) is fully acceptable since it maintains the presence of the "that is . . ." (blocking the NVN strategy) and (15b) is acceptable because the verb from "ridden" is not a possible inflected past verb. In this interpretation (14)

(15a) The horse that was raced past the barn fell.
(15b) The horse ridden past the barn fell.

would be unacceptable because it is ungrammatical. However, the statement of such a restriction within the grammar would involve making the transformations in a derivation sensitive to *potential* derivations that the relative clause verb *might* have entered into. This is necessary to check whether the simple past of the verb would sound the same as the past participle. To do this the rule would have to take into account a potential derivation of the verb in a simple past sentence, which involves greater formal power than a grammar that does not require rules to be sensitive to potential derivations. The existence of an independently motivated perceptual theory that can account for the unacceptability of (14) allows the conclusion that (14) is grammatical, but often unacceptable because of its interaction with the perceptual strategies in (11).

It should be emphasized that this treatment not only relieves the grammar of unneeded formal power, but also offers an explanation of why the restriction is the way it is. To treat the phenomenon as a grammatical restriction, leaves it described but unexplained. However, treating it as due to the behavioral application of (11) explains *why* it is the homonymy of the inflected past with the past participle that is at issue–only insofar as that confusability exists will (11) apply to the initial part of sentences like (14) and render them unacceptable.

In certain cases we can use the same methodology to demonstrate that an acceptable sequence is in fact *un*grammatical but acceptable because of its comprehensibility. Consider the cases in (16). They suggest that while a noun phrase containing *det not adj* is not acceptable, (16a), (16c), a sequence with *det not* $\begin{cases} un+adjective \\ im+adjective \end{cases}$ is acceptable, (16b), (16d). However, cases like (16b)

(16a) *The not happy man sat down
(16b) The not unhappy man sat down
(16c) *The not possible problem took a long time.
(16d) The not impossible problem took a long time.

and (16d) are restricted to negative adjectives that meet the conditions in (17). Condition (17a) is demonstrated by the unacceptability of cases like

(17a) The adjective must be a lexical item when separated from the negative prefix *un* + or *im* +.
(17b) The separated adjective must be used in the same way in that context.
(17c) The separated adjective must *sound* the same in its separated form as in its prefixed combination.

(18a) in which the non-negated form of the adjective is not a separate word. (e.g., *"trepid" is not a word). Condition (17a) is demonstrated by the unacceptability of (18b). (E.g., "holy" in "holy roller" has different meaning

(18a) *The not intrepid sailor sat down.
(18b) *The not unholy roller disgusted us.
(18c) *The not impious regent sat down.

than in "unholy roller.") Finally condition (17c) is demonstrated by the unacceptability of a case like (18c) which meets criteria (17a) and (17b), but the separated adjective sounds different when it is a distinct lexical item (e.g., "paious", as opposed to "im+peeous").

One could try to incorporate the restrictions in (17) within the grammar. This would involve a partial liberalization of the rule that preposes complex adjective phrases like that in (19a) to produce sequences like (19b). The

(19a) The man who was *not very happy* sat down.
(19b) The not very happy man sat down.
(19c) The man who was *not unhappy* sat down.

liberalized rule would be allowed to apply to sentences like (19c) to yield (16b). The descriptive problem is how to block such a rule from applying to acceptable sequences like those in (20a,b,c) and generating from them the corresponding unacceptable sentences in (18a,b,c). The restrictions on the

preposing rule would allow it to apply just in case the conditions in (17) are

(20a) The sailor who was *not intrepid* sat down.
(20b) The roller who was *not unholy* disgusted us.
(20c) The regent who was *not impious* sat down.

met (which is not the case in (20a,b,c). But *all* these conditions require consideration of how a lexical item (the unnegated form of the adjective *would* be used in *other* sentences. To do this would add formal power to the grammar, which makes this treatment of the phenomena suspect if the acceptability facts can be accounted for in another way.

In fact the phenomena can be accounted for by the perceptual system. On this view the adjective preposing rule applies only in cases like (19a), which is easy to state grammatically. This classifies (16) and (16c) as ungrammatical. However, it also marks (16b) and (16d) as ungrammatical without explaining their acceptability. This is explained by the fact that strategy (10) can easily misapply to such sequences. An initial stage in perceptual processing is to assign lexical class information to the sequence and then to use such strategies as those in (10) to find potential internal relations for such a sequence. Suppose that in the initial lexical-class analysis of the sentence like (16b) the *un+adj* is treated as a sequence like *adv#adj* in which the *adj* is a separate lexical item; then strategy (10) would treat the sequence in (16b) roughly like that in (19a), and lead to a similar interpretation for it. Thus the acceptability of (16b) and (16d) is accounted for as due to miscategorizing the *un* and *adj* as separate words. However, the initial miscategorization of *un+adj* as *adv#adj* is only likely to occur *insofar as the non-negated form of the adjective itself is recognizable in that environment as a separate word with a relevant meaning.* This is just what conditions (17a,b,c) spell out. Thus, we can not only account for the acceptability of such cases by treating them as ungrammatical but acceptable, we can in fact "*explain*" why the restrictions on acceptability are the way they are.

The concept of a sequence that is ungrammatical but acceptable because of its predictability in a non-grammatical system may seem strange. But what we have done is merely to make precise the notion of linguistic "analogy," which is often invoked to account for the acceptability of forms that are otherwise predicted to be ungrammatical. This notion has been extended into generative grammar to explain certain phenomena and been attacked because it appears *ad hoc.*[7] However, given the present considerations we can make precise the limits on possible analogies, and thus render the concept potentially an explanatory one. As empirical research develops the theory of

(21) Analogies can occur that produce ungrammatical sequences if they
  (a) are comprehensible by the speech perceptual system;
  (b) are utterable by the speech production system.

these "behavioral" systems, the constraints on possible "analogies" may render the concept as a fully explanatory one. In these examples we have seen that the decision to treat the acceptability differences as a function of the perceptual system not only relieves the grammar of otherwise unneeded descriptive power, it also offers an explanation as to why the facts are the way they are.

Center-embedded Sentences—a Reprise

Now that the theory of speech perception has been somewhat more developed we can examine its application to center-embedded sentences in detail. The action of another perceptual mapping rule does partially explain the initial complexity of double-embeddings. Consider the perceptual mapping rule which assigns the functions of underlying subject and object to noun phrases with relative clauses (22). This rule capitalizes on the fact that in clause initial (or postverbal) position two adjacent noun phrases followed by a verb other than BE (with other noun phrases optionally intervening) are uniquely related such that the first noun phrase is the object (direct or indirect) of an underlying clause of which the second noun phrase is the subject. For example, the initial sequence of noun phrases in (2) and (3) would be assigned the appropriate relations by (22) as shown in (23) and (24).

(22) In a surface sequence "... NP_1NP_2 ($\neq$ who) (NP*) V ($\neq$ Be) ..." NP_1 is the object of a clause of which NP_2 is the subject.

(23)	The man	the girl	likes ...	
	Object	Subject		
(24)	The man	the boy	the girl	likes ...
	Object	Subject/ Object	Subject	

[7] Proposed by Chomsky under the term "derivative generation"; criticized by Hankamer, "On Analogical Rules," Chicago Linguistic Society, 1972. See Bever, Carroll and Hurtig's chapter on analogy in Bever, Katz and Langendoen (Eds.) *The Integrated Description of Verbal Skill* Chandler Press, New York, (in press).

Clearly (22) must apply twice to double-embeddings to mark the middle noun phrase as both a subject and an object. This double marking by the same perceptual rule lies at the heart of the difficulty of center-embedded sentences.

There is a logical restriction on the utilization of any conceptual dimension, (25), which interacts with the double application of rules like (22)

(25) A stimulus may not be perceived as simultaneously having two positions on the same classificatory relation.

to double-embeddings. (25) articulates the tautology that a stimulus cannot be perceived in two imcompatible ways at the same time. For example, a noun phrase in the surface sequence cannot simultaneously be subject and object of the same non-reflexive verb. This principle, when applied according to the view of speech perception as a direct mapping of external sequences onto internal structures, will predict the difficulty of any sequence in which a phrase has a "double function" in such a mapping operation.

The general double-function hypothesis for speech perception following from (25) is this:

(26) In a sequence of constituents x, y, z, if x has an internal asymmetric relation R_i to y and y has the same internal relation to z, and x, y, and z are superficially identical in construction type, then the stimulus is relatively complex.

This is due to y's double function in the perceptual mapping rule, r_i, in which y is both a p and a q. (Note that $R_i \neq$ conjunction)

$$pq \longrightarrow (r_i) \qquad p\, R_i\, q$$

Thus, doubly embedded sentences are complex because they involve the second noun phrase in a double function with respect to the perceptual mapping rule (22).

It should be emphasized that the difficulty implied by (26) does not refer to all cases in which a single phrase has more than one role in the deep structure. For example, in (27) "the boy" is simultaneously the underlying *subject* of "sleep," the *object* of "like," and the *indirect object* of "give." Yet

(27) The girl liked the sleeping boy Sam gave the sandwich to.

the sentence is quite simple. Principle (26) applies only to those cases in which exactly the same perceptual mapping rule is used to assign different functions to the same phrase. That is, it is not the "double relation" of the middle noun phrase in the underlying structure which makes such sentences complex. It is, rather, the double application to it of the perceptual rule (22). In applying the rule the listener first categorizes the middle phrase as the right-hand member of a pair related by rule (22) and then must characterize it immediately as the left-hand member of the same kind of pair defined by the same rule. In the terms used in (26) the middle noun phrase of (3) is simultaneously a "p" and "q" of the same mapping rule.

There are other examples of complex constructions explained by principle (26). Consider the relative complexity of sentences (28) and (29). (28) is an

(28) Maxine did not ask Harvey not to say he would not go.
(29) ? Maxine did not ask Harvey to say he would not go.

example of "triple negation," which has often been recognized as extremely complex, if acceptable at all. Like singly embedded sentences, sentences with only two negation markers are perfectly comprehensible and acceptable (as in (29)). Principle (26) predicts the relative difficulty of sentences with three negations. The perceptual mapping operation corresponding to the negative marks the second "not" in (28) as *simultaneously* the scope of the first negation and the operator on the third negation. Following principle (26) any sequence containing such a double perceptual function is perceptually complex.

Principle (26) also explains some examples of perceptually complex constructions which are intuitively of the same sort as the preceding examples. Consider the sentences in (30) and (31). In each case the sentences are extremely difficult to understand, if they are acceptable at all. As in double-embedding and triple-negation sentences, the complexity of these sentences is a function of the presence of three superficially identical phrases in which the second phrase is modified by the first phrase in the same way

(30) ? They were tired of discussing *considering* producing toys.
(31) ? They were tired of the discussion of *the consideration* of the production of toys.

that the second phrase modifies the third phrase (in the underlying structure). Consider the relative perceptual ease of such constructions if only two

phrases occur:

(32) They were tired of discussing producing toys.
(33) They were tired of the discussion of the production of toys.

Sentences like those in (30) and (31) are much easier to understand if the internal relations among the three critical phrases are varied as in (34) and (35). The explanation is that the middle phrase no longer has a double function since *different* perceptual mapping rules relate the first two and

(34) They were tired of discussing *ceiling* producing toys.
(35) They were tired of the discussion of the evolution of the production of toys.

second two verb phrases. (Note that in (34) the middle phrase ("ceiling") is the underlying structure object of the following phrase ("producing") while the first ("discussing") and second phrase are not directly related. In (35) the middle phrase ("evolution") is the action carried out by the third phrase ("production") but the object of the first phrase ("discussion").)

Finally, (30) and (31) become perceptually simpler if the superficial form of the critical phrases is varied, even while the internal relations are held constant. The explanation for the relative ease of (36) and (37) is that the

(36) They were tired of discussing the consideration of producing toys.
(37) They were tired of the discussion of considering the production of toys.

middle phrase does not have a double function with respect to the *same* exact perceptual mapping rule. The superficial difference in the middle phrase allows the listener to use a different mapping rule for relating the first two phrases than for relating the second two phrases.

It is striking that such a subtle difference in superficial form can have major effects on the perceivability of sentences, although it is just what the double function principle predicts. This raises the possibility that if we change the superficial form of the noun phrases in sentences like (3) so that they differ from each other, then the sentences should become more comprehensible. Sentence (38) is an example of this. Most listeners find it immediately acceptable. Each of the initial noun phrases is of a different surface lexical type and thus differentiates the operation of rule (12) into

(38) The reporter everyone I met trusts said the president won't resign yet.
(39) The pictures a reporter everyone I met trusts took showed that arson caused the fire.

different rules. In fact, many listeners find (39) to be acceptable though it is *triply* embedded; even (40), a quadruply embedded sentence, may be acceptable.

(40) The banker your portrait an art dealer everyone I met trusts appraised belonged to knows nothing about art.

The acceptability of (39) and (40) is not due to the fact that certain subject-object verb relations are semantically facilitated (e.g., "reporter" "take" "pictures"; "art dealer" "appraise" "portrait"). In the structurally parallel sentences (41) and (42) almost every subject-verb-object relation is semantically constrained but the sequences are not acceptable. This is due to the fact that the noun phrases are not superficially distinguished in

(41) The cricket the mouse the cat the dog barked at miawed at squeaked at chirped at midnight.
(42) The hearth the cricket the mouse the cat the dog barked at miawed at squeaked at chirped at warmed the room.

the lexical class look-up phase of perception and a number of them carry perceptual double functions.

This analysis modifies the proposal that center-embedding is unacceptable due to the difficulty of holding and extracting two noun phrases in the same memory. The present argument is that the memory difficulty is itself due to the fact that the middle noun phrase must be contradictorily coded by the perceptual mapping rules. This analysis, in turn, predicts new cases, and even isolates critical examples of multiple embeddings that are acceptable. As in the previous cases our procedure of allowing the perceptual theory to account for acceptability phenomena when it can do so naturally has relieved the grammar of formal complexity. It has also predicted new critical facts, which turn out to confirm the analysis.

Current Linguistic Practice

Each of the three cases I have discussed would require grammatical formalisms that exceed the descriptive power of a simple transformational

grammar. To exclude (3) as "ungrammatical" but include (2) as "grammatical" would require that a derivation from deep to surface structure be sensitive to the relation between deep and surface phrase configurations. Such a constraint has been dubbed "derivational" by those transformational grammarians who call themselves "generative semanticists." They argue that such constraints are needed for a variety of phenomena. Similarly, to mark (15) as grammatical and (14) as ungrammatical would require at least lexical comparison of the participle and simple past. To exclude (18c) and include (16b) would require sensitivity to alternative derivations for other sentences. These latter constraints have been termed "transderivational" since they require the grammar to be sensitive to potentialities outside the derivation.[8]

Such formalisms weaken the interest of any specific linguistic grammar because they increase the possible grammatical analyses for every set of data. However, these formalisms appear to be needed just for those cases that can be handled naturally by one of the systems for language use. This is not surprising since it is the use of sentences that makes the relation between deep and surface sentence structures pertinent. Furthermore, it is in the communicative use of sentences that their relation to other potential sentences is important. This impression and the preliminary success we have had thus far underlies the proposal in (42). It remains to be demonstrated

(42) Derivational and transderivational constraints are not grammatical formalisms. The acceptability facts they are invoked to describe are naturally predicted by the theory of speech perception or speech production or one of the other systems of linguistic skill and knowledge.

whether (42) is true in general. The cases I reviewed above illustrate how such a demonstration will proceed. If (42) is true then it will make more precise and testable the hypothesis that the formal grammatical universals are innate.

The Complexity of Acceptability Intuitions

The view that every linguistic fact reflects some interaction between different systems of linguistic knowledge distinguishes a number of systematic sources that contribute to sentence acceptability judgments. For example, (43) is grammatical but unacceptable due to the perceptual plausibility and salience of the phrase "my brother's fiance"; the structurally identical sequence in (44) is acceptable due to the implausibility of the phrase

(43) The friend of my brother's fiance left town.
(44) The owner of my apartment's fiance left town.

"my apartment's fiance." Similarly (45) is grammatical but unacceptable due to the ease with which the relative pronoun could be attached to the immediately preceding noun. This is highlighted by the structurally identical acceptable sentence in (46) in which the relative clause is semantically constrained to modify the previous noun.

(45) The man likes the girl who lives in Chicago.
(46) The man likes your idea who lives in Chicago.

These two cases involve further interactions of the perceptual and grammatical systems. Other systems of linguistic knowledge and skill also interact to produce acceptability intuitions that are not directly due to grammatical structures. There are cases in which sentences are unacceptable because they are impossible to utter (at least without special practice which allows one to circumvent the usual system of speech production):

(47) Peter Piper picked a peck of pickled peppers.
(48) She sells seashells by the sea shore.
(49) Rubber baby buggy bumpers bug Bugs Bunny.

Certain sentences are unacceptable because they involve inherent contradictions:

(50) All bachelors are married.
(51) The king isn't a king.

Other sentences are unacceptable because they have presuppositions which are either generically or factually false:

(52) Why don't all the married bachelors get divorced?
(53) Why doesn't the present king of France abdicate?

Certain sentences are unacceptable given the conversational context in which they occur; thus, following (54c), (54a) is less acceptable than (54b).

[8] Lakoff, "Transderivational Constraints," in *To Honor Henry & Renee Kahaney*, 1974.

(54a) The river is three miles south of the house.
(54b) The house is three miles north of the river.
(54c) Where is the house?

The personal context in which a sentence is uttered can influence its acceptability: (55) is unacceptable spoken to one's sergeant, but perfectly acceptable when spoken to one's psychiatrist. Conversely (56) is unacceptable

(55) My eldest male sibling enjoys rhythmic relaxation in his abode.
(56) My brudder frugs in his pad.

when spoken to one's grandmother (at least for the author) but entirely acceptable when spoken to certain (of the author's) contemporaries.

Finally, there is a set of sentences which might be spoken and understood but which are felt to be unacceptable anyway (57-58). Unlike the previous kinds of unacceptability we may agree that such sentences are unacceptable but we cannot find any particular aspect of speech behavior that makes them so. It is not the case that they are hard to understand or say, that they are meaningless, or that they violate certain contextual conventions. They are

(57) I hope it for to be stopping raining when I am having leaving.
(58) In English, article precedes noun.

simply unacceptable English sentences, no matter what the situation. It is cases like these, which have no obvious source for their unacceptability, that are classified as "ungrammatical." When we cannot find any other behavioral or contextual reason for the unacceptability of an utterance we conclude that it is *structurally* incorrect and modify the theoretical grammar accordingly, so that it marks such sequences as "ungrammatical."

Unfortunately, most of our judgments about the acceptability of a given sequence combine several features of the different systems of speech behavior. I tried above to give examples of each kind of unacceptability that would be maximally clear; most real cases are compounded. Even if we can all agree that a particular sentence is unacceptable, it is much more difficult for us to agree *why* it is unacceptable. Yet this agreement is crucial since a syntactic analysis of a language is intended to account for "pure" structural acceptability judgments, and not for acceptability judgments caused by non-syntactic, semantic, psychological or contextual factors.

Although intuitions about sequence acceptability do not directly reflect the structure of the language in all cases, such intuitions are the main data the linguist can use to verify the grammar. This fact could raise serious doubts as to whether linguistic science is about anything at all since the source of the data is so obscure. However, this obscurity is characteristic of every exploration of behavior. Rather than rejecting linguistic study, we should pursue the course typical of most psychological sciences; give up the belief in an "absolute" intuition about the acceptability of sentences and study the laws governing the process involved in producing such intuitions.

The effect of stimulus context on the absolute judgment of the stimulus has become a part of almost every branch of psychology. One of the most basic laws governing the interaction between stimuli is the *law of contrast*; for example, the well-known phenomenon of feeling that the ocean is cold on a hot day while the same temperature feels warm on a cool day. One's "absolute" judgment of a stimulus can be affected by the difference between the stimulus and its context. This influence by contrast clearly can affect "intuitions" about structural grammaticality. For example, in the sentence triples in (58-60), (b) compared with (a) may be judged "ungrammatical" but contrasted with (c) they will probably be judged as "grammatical." That is,

(58a) Who must telephone her?
(58b) Who need telephone her?
(58c) Who want telephone her?
(59a) He sent money even to the girls.
(59b) He sent money to even the girls.
(59c) He sent money to the even girls.
(60a) I wouldn't like John to win the race.
(60b) I wouldn't like for John to win the race.
(60c) I wouldn't force for John to win the race.

not only are there several kinds of systematic bases for the unacceptability of sequence, but even the judgment of structural grammaticality is itself subject to contextual contrast.

It is also true that the physical context of a speaker can influence linguistically relevant intuitions. One of the primary intuitions which is used in transformational theory is the notion of "sentence relatedness." For example, (61) is perceived as related to (62) and (63), a relation which Chomsky explained in grammatical terms by the fact that they share a common deep structure, despite the transformational differences. To test the

(61) The meat upset the dog.

(62) The dog was upset by the meat.
(63) The dog was upset at the meat.

implications of this we asked subjects to rate the relatedness of sentences like those in (61-63).[9] We found that indeed they tend to rate sentences as more related to each other than to sentences like (64) or (65). This would seem to confirm empirically the decision to treat (61-63) as sharing a deep structure that is different from that underlying (65-65). However, the analysis that postulates a separate deep structure has been challenged by Postal.[10] For a

(64) The dog was upset because of the meat.
(65) The meat made the dog upset.

variety of linguistic reasons he argues that all of the sentences are basically causative, and that they share a deep structure. Furthermore, (63) would be closer in form to the deep structure than (61), which is just the opposite analysis that had been proposed before.

It would seem at first that since sentence relatedness intuitions confirmed the traditional analysis, Postal's proposal is invalid. However, we also asked subjects to rate the relatedness of the sentences in a condition which is alleged by social psychologists to increase the extent to which a subject performs a task "introspectively." The condition involves placing the subject in front of a mirror so that he must see himself while he is making the judgments. In this condition Postal's analysis was confirmed more strongly than Chomsky's.

This result, which was reliable according to standard statistical tests, accords with the general intuition that somehow Postal's analysis is more "abstract" than Chomsky's—accordingly when we place subjects in a more introspective mood, they render judgments that reflect the more "abstract" analysis. Thus we can understand the systematic basis for the shift in judgments. However, the fact that it is systematic does not mean that it is *ipso-facto* to be treated as part of the grammar itself. Rather, it reveals the extent to which the intuitional process is vulnerable to the situation in which the intuition is elicited.

[9] See Bever & Carroll forthcoming. For discussion of the processing of such sentences in memory see Bever, "Integrated Study of Language Behavior," in Morton (ed), *Biological & Social Factors in Language Learning*, Logos Press, London, 1970.

[10] Postal, *Crossover Phenomena*, Holt, Rhinehart & Winston, 1971.

The fact that linguistic intuitions are subject to the same kind of influences as other types of human judgment does not invalidate many results from linguistic investigations. Many intuitions about sentences appear to be strong enough to resist contextual effects. We can expect that these intuitions will remain constant even when we have developed an understanding of the intuitional process (e.g., the relationship between actives and passives; the fact that "john hit the ball" is a sentence of English, etc.). However, recent linguistic theoreticians have placed increasing dependence on relatively subtle intuitions whose psychological status is extremely unclear.[11] Since there are many sources for intuitional judgments other than grammaticality, and since grammaticality judgments can themselves be influenced by context, subtle intuitions are not to be trusted until we understand the nature of their interaction with non-grammatical factors. We require a science of linguistic introspection to provide a theoretical and empirical basis for including some acceptability judgments as syntactically relevant and excluding others.

THE IMPLICATIONS FOR LINGUISTIC UNIVERSALS

Up to this point I have discussed cases in which the interaction of grammatical and non-grammatical systems determines acceptability judgment of individual sentences. We can also observe that certain grammatical rules are themselves constrained by other systems of linguistic knowledge. For example, consider the sentences in (66), which exemplify the restrictions on the optional deletion of the complementizer markers "that" and "the fact."

(66a) John mentioned the fact that Sam is a fool.
(66b) John mentioned the fact Sam is a fool.
(66c) John mentioned that Sam is a fool.
(66d) John mentioned Sam is a fool.

It would appear that these words can be freely deleted, as represented by the syntactic rule (67).

(67) Delete complementizers "that", "the fact" freely.

[11] See, for example, Postal, *ibid*; McCawley, "English as a VSO Language," *Language*, 46, pp. 286-299; Ross, *Nouniness in "3 Dimensions of Linguistic Theory,"* TEC Co., Tokyo, 1973; Lakoff, "On Derivational Constraints" in *Papers from the Fifth Regional Meeting*, Chicago Linguistic Society, 1969.

As the young child learns rules like these we can expect that he will bring to bear his perceptual strategies based on the sentence as the main unit of perception. We have found that at first (age 1½-2 years) young children repeat the first plausible sentence they hear; for example they repeat "the elephant jumped" in response to (68). That is, the young child takes the first

(68) The elephant that jumped kissed the cow.

non-verb sequence as the main clause of a complex sentence, even in cases like (68) where that is inappropriate. Certain facts of adult English syntactic structure appear to accommodate this perceptual strategy: for example, R. Kirk (personal communication) has observed that a subordinate clause verb which precedes its main verb is generally marked as subordinate by the end of its verb phrase. The most obvious device is the subordinate clause conjunction, as in (69-70). In each case the first verb is marked by the subordinate conjunction as subordinate.[12]

(69) Although the research was secret the liberated files revealed that it actually concerned the metabolization of sauce Bearnaise.
(70) Because the demands were non-negotiable nobody agreed.

Subordinate conjunctions are specific lexical items which act as specific markers of those cases in which a subordinate clause occurs before its main clause. There are also certain syntactic rule systems which appear to have formed in response to the principle that initial subordinate clauses are marked in English: restrictions on the "syntactically" allowed deletion of words which mark functional relations among clauses.

Rule (67) is incorrect as shown by the unacceptable sentence (71a) in which both complementizers are deleted. However, one of the complementizers can be deleted in initial position, so long as the other remains. Thus rule (67) must be reformulated to (72). Notice that (72) also applies to allow

(71a) *Sam was a fool was mentioned by John.
(71b) That Sam was a fool was feared by John.
(71c) The fact Sam was a fool was feared by John.

deletion of the complementizers so long as the complement clause is marked

[12]For further discussion see Bever, "Cognitive Basis for Linguistic Structures," 1970.

(72) Delete the complementizers, except in sentence initial position, in which case at least one complementizer must remain.

by some lexical item [e.g., "the discovery . . ." in (73, 74)].

(73) The discovery that Sam was a fool frightened John.
(74) The discovery Sam was a fool frightened John.

As the child acquires the rules of syntax he applies global restrictions about sentences to the properties of sentences. One might argue that the fact that such restrictions are reflected in particular syntactic rules is sufficient evidence that the restrictions be included as a proper part of linguistic theory. For example, we might propose a universally available syntactic restriction that initial subordinate clauses always be uniquely marked as such. In a language which has such a restriction any set of syntactic rules that would produce constructions violating that constraint are modified appropriately. However, this would merely represent within the linguistic theory a structural property while leaving opaque the behavioral explanation for the existence of that property.

The importance of this observation is that it allows us to interpret linguistic universals as due either to grammar or to a distinct system of linguistic knowledge and behavior. Just as every acceptable fact is in principle a result of an interaction of different systems, every linguistic universal is the result of the interaction of different linguistic systems. Recently some researchers have distinguished between "strong linguistic universals" and "weak linguistic universals."[13] A strong linguistic universal is one which exists purely because of innate linguistic structures. A weak linguistic universal is one which exists because of "general" properties of cognition. Our research on the interaction of different linguistic systems can clarify the notion of "general" cognition in certain cases.

Consider Ross's proposal that syntactic rules which order constituents into non-canonical positions apply more readily to main clauses than subordinate clauses.[14] For example, the rule which places a manner adverbial at the beginning of the clause can apply to main clauses but not to subordinate clauses as shown by the acceptability of (79) and the unacceptability of (76).

[13]See, for example, McNeil's Chapter in Morton (ed.), *Biological & Social Factors in Language Learning*, Logos Press, London, 1970.
[14]Ross, *Upstairs Primacy*, presented at the NELS meeting, October 1972.

(75) After Jack hurriedly ate his sandwich Bill left.
(76) *After hurriedly Jack ate his sandwich Bill left.
(78) Bill hurriedly left after John ate his sandwich.
(79) Hurriedly Bill left after John ate his sandwich.

Ross has suggested that this kind of comparative restriction on reordering constituents in subordinate clauses is universal, under the Rubric "The Penthouse Principle; More goes on upstairs than downstairs." It might be proposed that the Penthouse Principle is obviously a "strong" linguistic universal since there is clearly no "general" cognitive explanation for why reordering rules can apply more readily to main clauses than to subordinate clauses.

Consideration of the way material is stored in perceptual memory suggests that there is in fact a perceptual basis that could explain the Penthouse Principle. L. Shedletsky and I found that immediate memory for material in subordinate clauses is searched from left to right.[15] However, immediate memory for material in main clauses shows no left-right pattern. Our interpretation is that information in a main clause can be accessed in parallel while information in the subordinate clause is accessed serially. The reason for this difference may be that the main clause is primary in perception and accordingly listeners store it in the most flexible manner possible. Since subordinate clauses are constitutents by definition they are stored as units: to access their internal content requires starting at their beginning and searching left to right.

This perceptual differentiation of main and subordinate clauses predicts the Penthouse Principle. The goal of a perceptual mechanism is to isolate the major grammatical relations: a clause in which the constituents are in a non-canonical order will be more complex than a clause in which they are in a canonical order [as reflected in strategy (10)]. In a main clause, this effect should be relatively slight since constituents are accessed perceptually in parallel: if they are out of the canonical order they can be reordered directly. However, in a subordinate clause, constituents in a non-canonical order should produce much greater perceptual difficulty: if the subordinate clause is accessed from left to right any constituent which is out of canonical order must be stored until its appropriate "slot" is found. This explains why more reordering transformations can apply to main clauses than to subordinate ones.

[15] Shedletsky & Bever, forthcoming.

This example underscores the fact that linguistic universals have a variety of sources. In the absence of a particular "general" cognitive theory it is hard to know how to decide whether a particular universal is "strong" or "weak." Isolating the different systems of linguistic knowledge may resolve the difficulties by making more precise the notion of "general" cognitive mechanisms.

CONCLUSION

I have described an interactionist program of linguistic description. It assumes that acceptability facts and universals in language involve a variety of systems of linguistic knowledge and skill. The result of this approach is that certain "linguistic" properties have been discovered to be due to non-grammatical systems. This process isolates those characteristics that are uniquely due to grammar from those that are due to other mechanisms.

It is unclear whether such an approach can claim to be "explanatory." However, it is clearly more desirable than the alternatives. One could assume that there is no grammar at all and that all facts are the result of behavioral functions.[16] Since many of the behavioral functions presuppose a grammar, namely a formal device which pairs deep and surface structures, this suggestion is both specious and invalid at the outset.

Alternatively we could decide that every observed property of language is *ipso facto* to be described by grammatical devices.[17] To do so would not merely complicate the set of formal grammatical universals, it would also fail to place the burden of description on the appropriate non-grammatical system. For example, it is true that a grammatical constraint [e.g., (4)] could account for the difficulty of center-embedded sentences. However, this would lose the possibility of describing the complexity of such sentences as *predicted* by an independently motivated perceptual system. The fact that the perceptual system naturally predicts the difficulty of center-embedded sentences seems to me intuitively to qualify it as an "explanation."

If we are to describe the true state of language we must cut linguistic nature at her joints. The specific claim that there are partially independent

[16] I may misunderstand Clark and Havilland's point of view as expressed in their chapter in this volume. However, It seems to me that either their consideration supports the "interactionist" approach developed in Bever, 1970 and the present paper, or they are proposing that there is no psychologically interesting "grammar."

[17] This approach is characteristic of the writings of those who currently call themselves "generative semanticists." c.f. recent works by Postal, McCawley, Ross, Lakoff and others.

systems of speech perception, speech production and grammar, among others, may turn out to be incorrect. However, there are many examples from the history of science which show that failing to make distinctions in the description of a phenomenon can lead to misleading goals and specious generalizations. For example, nothing was gained by assuming that a dolphin is a kind of fish, simply because it swims in the sea. Similarly, nothing was gained by assuming that planets are simply a special kind of "wandering" star. In linguistics we must also distinguish the different sources for the facts we observe. If all knowledge contributes to language in a homogenized theory then the science of linguistic acceptability and language universals will become a catalog of everything. But, a catalogue of everything is a science of nothing.