3.

The Interaction of Speech Perception and Grammatical Structure in the Evolution of Language

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For use almost can change the form of nature.
[*Hamlet,* III, iv]

1. *Introduction and Summary: The Three Linguistic Capacities*

A person knows how to carry out three kinds of activities with his language: He can produce sentences, he can understand sentences, and he can make judgments about potential sentences. Recent linguistic investigations have concentrated on describing the facts brought out in speakers' predictions about the acceptability and structural relations of potential sentences. Such predictions have been assumed to reflect directly each speaker's knowledge of his language ("competence"), while the capacities to speak and understand sentences have been viewed as revealing a person's linguistic knowledge only indirectly, because of the interposition of

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behavioral factors ("performance"). It is clear that the activities of talking and listening can obscure much of a person's linguistic knowledge, but judgments about potential sentences also are behavioral manifestations of linguistic knowledge, and as such are not different *in principle* from the more tangible uses of linguistic structures. Even though predictions about sentences may be the most direct evidence we have concerning linguistic structures, it cannot be claimed that such judgments are entirely free from behavioral effects.

Thus, linguists and psychologists can utilize three kinds of manifest speech behaviors as data relevant to the study of linguistic knowledge: speech production, speech perception, and the prediction of new sentences. In this paper, we shall discuss the evidence for the interaction of the systems of speech perception and sentence prediction in the history of the English language. We shall demonstrate that the history of a language, and therefore its synchronic state as well, are the products of a dynamic interaction between the rules required for the prediction of new sentences, and the behavioral mechanisms used to understand sentences.

2. *The Grammar of Relative Clauses in Modern English*

The major result from recent investigations of predictive linguistic capacity has been that every sentence of a language has distinct external and internal forms. Consider the English sentences in (1); they both have the same internal ("logical") relations of actor, action, object, although (1b) has an external form which presents the terms of these internal relations in a different order from (1a).

(1a) Harry ate a baklava.
(1b) A baklava was eaten by Harry.

The recent linguistic investigations have demonstrated that a grammar of a language (the device required for the prediction of new cases) is composed of a set of rules for generating possible internal structures, and a separate set of rules, called transformations, which map internal structures onto external ones. The organization of a grammar is given in (2).

(2) [Internal Structure Generator] → {Internal Structures} → [Transformations] → {External Structures}

In the case of (1), the mapping is one-many: The same internal structure is mapped onto several external ones. The mapping may also be many-one, as in the case of (3), in which the different internal structures are mapped onto the same external structure.

(3) Your mother was nice to visit.

In constructing grammars, linguists attempt to account for the predictions that people can make using the simplest instance of a grammar allowed by linguistic theory (Chomsky 1965, Postal 1970).

In this paper, we shall be concerned with the nature and history of the transformational rules governing the formation and reduction of relative clauses in English. These rules generate the various external forms exemplified in (4) from the same internal structure.

(4a) Harry ate a baklava; it was slowly disintegrating.
(4b) Harry ate a baklava that was slowly disintegrating.
(4c) *Harry ate a baklava slowly disintegrating.
(4d) Harry ate a slowly disintegrating baklava.

We assume that the internal structure corresponding to (4) is closest in appearance to that of (4a), and that the rules in (5) are among the transformations of English.[1]

(5a) Relative clause formation: Given a structure of the form:[2]

$$[_S [_S X_1 [_{Nom_i} X_2]_{Nom_i} X_3]_S ; [_S X_4 [_{Nom_i} X_5]_{Nom_i} X_6]_S]_S$$

convert it into the form:

$$[_S X_1 [_{Nom_i} X_2 [_S X_4 [_{Nom_i} X_5]_{Nom_i} X_6]_S]_{Nom_i} X_3]_S$$

That is, embed the second sentence as a constituent of the nominal in the first.

(5b) Relative pronoun formation: Copy the nominal in the relative clause containing the shared nominal at the beginning of the relative clause, and replace the shared nominal in this copy by the appropriate relative pronoun.[3]

(5c) Shared nominal deletion: Delete the original shared nominal (not the copy) in a relative clause.
(5d) Relative clause reduction: Delete any finite form of the verb *be* in a relative clause provided that it is the initial element of the clause (i.e., no relative pronoun has been added).
(5e) Modifier preposing: Move any reduced relative clause consisting of an adjective phrase (an adjective plus its modifiers if any) to a position preceding the noun it modifies.

The reader can easily verify that none of the transformations in (5) have applied in the derivation of (4a); that rules (5a, b, c) have applied in the derivation of (4b); (5a, c, d) in that of (4c); and (5a, c, d, e) in that of (4d).

Some of the rules in (5) have the property that when they can apply to a structure they must—these are called "obligatory" transformations—while the others need not apply to the structures to which they can apply—these are called "optional" transformations. Rule (5a) is optional, since there is no syntactic necessity for converting two conjoined sentences sharing a nominal into one sentence containing a relative clause. Rule (5b) is also generally optional, since a relative clause need not necessarily contain a relative pronoun.[4] However, the rule is obligatory in most contexts in which the shared noun is the subject of the relative clause and the finite verb of the relative clause is not *be*. Thus, for most speakers of English the sentences of (7) are not grammatically acceptable as counterparts of those of (6). (An asterisk indicates an ungrammatical sentence.)

(6a) The man that wants to see the boss is waiting downstairs.
(6b) The secretary discouraged the man that wanted to see the boss.
(6c) There is a man that wants to see the boss downstairs.
(6d) It was low wages and poor working conditions that caused the workers to strike.

(7a) *The man wants to see the boss is waiting downstairs.
(7b) *The secretary discouraged the man wanted to see the boss.
(7c) *There is a man wants to see the boss downstairs.

(7d) *It was low wages and poor working conditions caused the workers to strike.

Rule (5c), on the other hand, is obligatory, since sentences which retain shared nominals within relative clauses are ungrammatical (the shared nominal in the relative clause is italicized):

(8a) *Harry ate a baklava that *it* was slowly disintegrating.
(8b) *The man that I saw *him* was wearing a polka-dot shirt.

If the shared nominal occurs in a relative or noun-complement clause within the relative clause, the sentence is ungrammatical both if the shared nominal is deleted or if it is retained:

(9a) *The choir limped through the anthem (that) the organist couldn't make up his mind at what tempo *it* should be played.
(9b) **The choir limped through the anthem (that) the organist couldn't make up his mind at what tempo should be played.

Omission of the shared nominal in such sentences as (9b) leads to an even greater degree of ungrammaticality than its retention, as in (9a). This is due to the operation of the "complex noun-phrase constraint" discussed in Ross 1967, according to which a constituent cannot be deleted under identity within a clause wholly contained within a nominal expression if the identical element is outside that expression. If the shared nominal is retained, then the complex noun-phrase constraint is not violated; rather the violation is that of the obligatory shared-nominal deletion transformation. Obviously, the retention of the shared nominal in sentences like (9a) serves to remind the speaker and hearer of the grammatical source of the relative pronoun in a situation where the syntactic complexity is so great that it is both easy to forget and hard to tell what that source is.[5]

Rule (5d) is also generally obligatory, since sentences containing relative clauses beginning with finite forms of *be* are generally ungrammatical, just as sentences containing relative clauses beginning with other verbs, such as those in (7), are. However, to resolve this ungrammaticality, it is not necessary to add a relative pronoun (although this may be done); rather the relative clause may be reduced further by the deletion of *be*. Thus we have the sentences in (10) derived from those in (11).

(10a, i) The man that is waiting downstairs wants to see the boss.
(10a, ii) The man waiting downstairs wants to see the boss.
(10b, i) The secretary called the man that was waiting downstairs.
(10b, ii) The secretary called the man waiting downstairs.
(10c, i) There are few koala bears that are in captivity outside Australia.
(10c, ii) There are few koala bears in captivity outside Australia.
(10d, i) It is the mayor that is responsible for this mess.
(10d, ii) *It is the mayor responsible for this mess.[6]

(11a) *The man is waiting downstairs wants to see the boss.
(11b) *The secretary called the man was waiting downstairs.
(11c) *There are few koala bears are in captivity outside Australia.
(11d) *It is the mayor is responsible for this mess.

Finally, rule (5e) is obligatory when the modifier consists of an adjective or an adjective plus adverbial modifiers, and is inapplicable when the adjective is followed by a preposition phrase or clausal adjunct. Thus, while (4c) is ungrammatical, (12a, b) below are fully grammatical.[7]

(12a) Harry ate a baklava made with love.
(12b) Harry ate a baklava so rich that it gave him indigestion.

The rules in (5) are also ordered in a particular way. To a great extent, this ordering is a consequence of the form of the rules themselves. For example, rule (5a) must precede all the other rules of (5), since the others all make reference to the relative clauses created by rule (5a). By similar arguments, one can show that rule (5b) must precede (5c), and that (5c) and (5d) must precede (5e). On the other hand, there is nothing in the form of the rules themselves which tells us whether rule (5d) should precede or follow rule (5b). We have chosen initially to state the rules such that (5d) follows (5b) for purposes of exposition and following previous analyses. But what if we chose to order the application of (5d) before that of (5b)?

It turns out that we can effect a simplification of the grammar of English as a whole if we order (5d) before (5b); that is, if we have relative clause reduction precede relative pronoun formation. The reason is that we can then simplify the statement of the conditions under which rule (5b) is obligatory. It is obligatory when the relative clause begins with the shared nominal followed by *any* finite verb (before, it will be recalled, we were obliged to say any finite verb other than *be*). Moreover, relative clause reduction can now be stated as an optional, rather than as an obligatory, rule.

To summarize, the rules of relative clause formation and reduction apply in the following order: Relative clause formation (5a); Relative clause reduction (5d); Relative pronoun formation (5b); Shared nominal deletion (5c); and Modifier preposing (5e).

3. *The Interaction between Universal Grammar and the History of Languages*

The acquisition of grammar by children determines its historical development. In the view of Halle 1962 the child brings to bear on the sentences he hears around him his (presumably intuitive) knowledge of the universal form of linguistic grammars. He uses this knowledge to develop an internal grammatical representation of what he hears. The main constraint that he applies to the language as he learns it is that of *grammatical simplicity:* He attempts to find descriptive representations of the sentences he has experienced which are produced by a maximally simple grammar—one which uses linguistic universals in the most efficient way.

The view of language learning and language change proposed by Halle underlies most of the current attempts to describe historical changes in language in terms of changes in grammatical structures. Halle has proposed that people can develop a grammatical representation of their language in two different ways: Young children (presumably up to about age twelve, cf. Lenneberg 1967 for arguments that there is a critical period for language learning) develop a series of grammatical representations, taking as the basis for each grammar the sentences they have experienced. When new sentences do not conform to the predictions made by the grammar in a particular state of the child's development, he modifies the grammar appropriately to accommodate the new sentences as well. By

the time the child is about twelve years old, he has experienced enough kinds of sentences for the predictive grammar he has developed to account for his linguistic experience to be the grammar of the complete adult language. Thereafter, his capacity to restructure his grammar is limited to the addition of rules to the end of the grammar, as opposed to adding rules within the grammar, or reordering existing rules.

The history of the conditions under which the relative pronoun formation rule (5b) was obligatory in English provides an illustration of the way in which grammatical restructuring is alleged to have occurred. There was a period of time in which sentences like (7b, c, d) were all grammatical; i.e., the subject relative pronoun did not have to be expressed when the clause modified an object nominal or a nominal following *be* in an existential or cleft sentence. Relative pronoun formation was therefore obligatory only under the conditions given in (13).

(13) Add the appropriate relative pronoun obligatorily to a relative clause which begins with the shared nominal and a finite verb and which modifies a noun which precedes the verb in its own clause.

Somewhat later, however, sentences like (7b) became very infrequent, and presumably were viewed for a time as stylistic anachronisms. According to the theory of linguistic change we outlined above, there was a period when people learned the system described in (13) as children, but then added a rule to the end of their grammar, so that sentences like (7b) would be marked as ungrammatical. Such a rule is described in (14).

(14) Add the appropriate relative pronoun obligatorily to a relative clause which begins with a finite verb and which modifies a noun which is an object of the verb in its own clause.

The complexity of a grammar which contains rule (5b) with the stipulation given in (13) and rule (14) is quite great, since rule (14) redoes obligatorily what rule (5b) does optionally. Thus, the children who heard adult speakers of the system described in (13)-(14) would restructure it to the simpler grammar containing the provision described in (15) as a condition under which rule (5b) is obligatory.

(15) Add the appropriate relative pronoun obligatorily to a relative clause which begins with the shared nominal and a finite verb, and which modifies a noun which either precedes the verb in its own clause or which is an object of the verb in its own clause.

The fact that language change can be described in this way has been used by Halle and others to justify the universal form of grammar in which there are ordered rules which transform internal structures into external structures. That is, the universal forms of grammar proposed for synchronic descriptions of languages provide the linguist with analyses relevant to the description of the history of languages. We agree that support for the claim that the history of a language is describable as a series of minimal changes in transformational rules is also empirical support for the form of specific synchronic descriptions; obviously a form of synchronic grammar which accounts only for the linguistic present and cannot be used to describe the recent linguistic past is unacceptable. The truth of the claim that the history of English can be described as a series of rule additions, simplifications, deletions, and reorderings justifies the use of ordered transformational rules to describe language in general.

However, no general principle of historical change itself emerges as a function of the rules. For example, many studies of language change explore possible principles needed as supplements for the principle of grammatical simplification to account for the historical development of languages. It is obvious that rule simplification itself is not a sufficient principle. Yet it is the only potentially explanatory device which the structure of a predictive grammar offers to the historical linguist in his quest for causes of historical developments. To find the causes of historical change we must therefore look beyond the structures offered by predictive linguistic grammars, to the structure of the interaction between the predictive and the behavioral system of language.

4. *The Independence of the Predictive and Perceptual Systems of Language*

Consider now the problem of understanding sentences. Recent psychological studies have shown that the form in which sentences

are understood corresponds closely to their internal structure (Miller 1962, Mehler 1963). Thus, any model for speech perception includes a mechanism which isolates the internal structure corresponding to each external form (16).

(16) External structures → Perceptual Mechanisms → Internal structures

When transformational grammars were first proposed, it was thought that the grammatical mechanisms could be embedded within the operation of the perceptual mechanisms. A preliminary series of studies appeared to support this view; they showed that certain sentences which involve more transformations in the *grammatical* description of the relation between their internal and external structures are relatively hard to understand. For example, passive sentences like (17b) involve one more rule than corresponding active ones like (17a), and are indeed harder to understand. This was shown in many different kinds of studies; for example, McMahon 1963 demonstrated that generically true actives (17a) are verified more quickly than generically true passives (17b).

(17a) Five precedes thirteen.
Thirteen follows five.
(17b) Thirteen is preceded by five.
Five is followed by thirteen.

The basic principle at issue in these studies was that every grammatically defined rule corresponds to a psychological operation, and that therefore sentences with more rules mapping the internal-onto-the external structure should be relatively more complex psychologically.

However, this view of the relation between grammar and perception is incorrect. There are many examples of sentences which have relatively more transformations in their derivation and which are clearly *less* complex psychologically. Thus, in (18)-(20), the grammatical derivation of the second sentence of each pair (b) is more complex than the first (a), but is much easier to understand.

(18a) Harry ate the baklava that was green.
(18b) Harry ate the green baklava. (Relative clause reduction, Modifier preposing)

(19a) That Harry liked the green baklava amazed Bill.
(19b) It amazed Bill that Harry liked the green baklava. (Subject-clause extraposition)

(20a) The boy the girl the man liked hit cried.
(20b) The boy the girl liked by the man hit cried. (Passive)

In addition, recent reviews of the existing experimental literature (Fodor and Garrett 1967, Bever 1970a) have argued that the previous evidence which appeared to support the hypothesis that grammatical transformations are part of perceptual operations is inconclusive on methodological grounds.

This negative finding leaves open the question as to what the nature of the perceptual mechanism really is. Some of our most recent work has suggested to us that listeners make primary use of an ordered set of perceptual strategies which directly map external strings onto their internal structures. In this discussion we will consider evidence for one such perceptual rule used to establish the segmentation of external sequences into those sub-sequences which are related in the internal structure by such basic relations as actor, action, and object.

For a perceptual mechanism which maps external strings directly onto internal structures to operate efficiently, the actual string of words in a speech event must be segmented into those substrings which correspond to full sentences at the internal structure level. For example, if one hears the string represented phonetically in (21), one must decide that it contains two distinct sentences which correspond to clusters at the internal structure level, and not more or less.

(21) ðəbɔylayksgərlzgərlzləvbɔyz (i.e., "the boy likes girls; girls love boys")

Failure to find the correct basic segmentation into strings which do correspond to internal structure sentences would seriously impair comprehension. For example, suppose that a listener were to assume that the second instance of *girls* in (21) was actually a spurious repetition; then he would be faced with the task of finding an internal structure for the following:

(22) The boy likes girls love boys.

The problem is that (22) has no corresponding internal structure representation.[8]

There is no known automatic procedure which insures the proper segmentation of external structures into those structures which correspond to sentences in internal structures. In cases like the above, however, pronunciation often provides many cues which indicate where the segmentation into internal sentences should occur. The operation of this segmentation strategy to separate sentences in a discourse like (22) can utilize many situational, semantic, and pronunciation cues. The segmentation problem is much more complex, however, for sentences embedded within other sentences.

(23a) When he left the party became dull.

(23a) has two internal structure sentences, each one corresponding to one of the clauses in the external string: When he left and the party became dull. Let us represent this structural division into clauses in external structure with parentheses ( ), and the corresponding internal structure segmentation with brackets [ ]; thus (23a) has the structural organization assigned in (23b).

(23b) ([When he left]) ([the party became dull])

If the wrong perceptual segmentation were attempted, then further perceptual analysis of the sentence would be impossible. For example, the listener could initially segment the first five words into a cluster (i.e., when he left the party), but then he would have two words left over (became dull), which cannot be analyzed as an internal structure cluster.

A recent series of experiments has given initial support to the claim that there exists a set of perceptual strategies which isolate lexical strings corresponding directly to internal structure clusters (Fodor and Bever 1965; Garrett, Bever, and Fodor 1966; Bever, Kirk, and Lackner 1969). These investigations have studied the perception of nonspeech interruptions in sentences with two clauses. The basic finding is that subjects report the location of a single click in a sentence as having occurred towards the point between the clauses from its objective location. For example, Fodor and Bever found that in sentence (24), a click objectively located in

yesterday or in *the* was most often reported as having occurred between those two words.

(24) Because it rained yesterday the picnic will be cancelled.

Fodor and Bever argued that the systematic displacement of the click towards the point between the clauses shows that the clause has relatively high psychological coherence, since it "resists" interruption by the click.

Several experiments have shown that this systematic effect of the syntactic segmentation is not due to any actual pauses or cues in the pronunciation of the sentence. First, Garrett, Bever, and Fodor used materials in which the exactly identical acoustic string was assigned different clause structures depending on what preceded. Consider the string:

(25) . . . eagerness to win the horse is quite immature.

If (25) is preceded by *your*, then the clause break immediately follows *horse.* But, if that string is preceded by *in its*, then the clause break immediately follows *win*. We cross-recorded one initial string or the other and tested subjects on their ability to locate clicks in the different sentences. The results showed that the clause structure assigned each string "attracted" the subjective location of the clicks. In a second study, Abrams and Bever (1969) found similar results with sentences constructed by splicing words from a spoken list.

Various kinds of perceptual knowledge are involved in segmentation. An example of how generic semantic relations assist in perception is provided by a recent study by Schlesinger (1966), who found that center-embedded sentences in which the separate clauses are uniquely related semantically are easier to understand; (26b) is easier perceptually than (26a).

(26a) The boy the man the girl liked hated laughed.
(26b) The gift the girl the dog bit received glittered.

Semantic relations like those in (26b) can also restrict the possible segmentations of external strings into internal structure clusters. Compare, for example, (27a) with (23a); in (27a) the unlikeliness that the string when he undressed the party corresponds to a complete unit in the internal structure prevents a listener from segmenting that string together. On the other hand, unique semantic relations can force the opposite segmentation, as in (27b).

(27a) When he undressed the party became dull.
(27b) When he joined the party it became dull.

Bever et al. (1969) found that knowledge of the internal structure potentialities of specific lexical items can also affect immediate segmentation of external strings. For example, clicks located in verbs like *defy*, which take both a direct object and a complement, are located subjectively following the verb less often than clicks located in verbs like *desire,* which take just a complement.

(28a) The general defied the troops to fight.
(28b) The general desired the troops to fight.

Bever et al. interpret this result as a demonstration of the claim that listeners know that the sequence following a verb like *desire* can begin a new internal structure sentence (as indicated by the underlining in (28b)). By contrast, a verb like *defy* is known to permit only a direct object immediately following it (as indicated by the underlining in (28a)); accordingly, listeners have a greater immediate tendency to establish internal structure segmentation following verbs like *desire* than they do for verbs like *defy.*

In this paper we are concerned with the effects on perceptual segmentation of the external patterning of syntactic lexical categories. In particular, we argue that there are the following perceptual rules: (a) A string consisting of a nominal phrase followed by a finite verb whose inflection agrees with that nominal phrase is the beginning of an internal structure cluster (i.e., sentence). (b) The verb phrase (optionally including a nominal) is the end of such a cluster. These perceptual rules may be stated formally as in (29).

(29a) X_1 Nominal $V_f X_2 \rightarrow [_S X_1$ Nonominal $V_f X_2]$
(29b) $[_S X\ V_f$(Nominal) $\rightarrow [_S X\ V_f$(Nominal)$]_S$

These strategies have interacted with the predictive grammar of English throughout its history in the development of the rules governing relative clause reduction.

At the moment we do not know what the appropriate formalism should be for such perceptual rules, so (29) should be taken only

as suggestive. Clearly such strategies presuppose lexical-class identification, which in some cases may include syntactic subcategorization features. For example, (29a) must apply to the second sequence in (28b), but not (28a), reflecting the difference in the two main verbs. As written, the application of strategy (29a) must precede that of (29b). The reason is that people have no difficulty understanding sentences like (30). However, if the right bracket were assigned before the left bracket, then the incorrect initial bracketing in (31) would result, and the sentence would be incomprehensible.

(30) John believed Bill was a fool.
(31) $_S$[John believed Bill]$_S$ was a fool.

Thus, strategy (29a) applies first to an entire string, and then strategy (29b) applies. After application of (29a), example (30) would be analyzed as in (32).

(32) $_S$[John believed $_S$[Bill was a fool.

Strategy (29b) would then apply to produce (33).

(33) [$_S$John believed [$_S$Bill was a fool]$_S$

Notice that (29b) is prevented from assigning a right bracket after *Bill* in (33) because (33) does not meet the structural index of (29b).

The presence of the perceptual strategies having the effect of those in (29) is demonstrated by the existence of many sentences in English in which the strategies produce temporarily misleading analyses, thereby making them hard to understand. In each of the examples (34)-(36) below, (a) is hard to understand relative to (b) because there is a nominal-verb sequence presented in its structure which does not, in fact, correspond to any internal structure cluster, or which results in there being lexical material left over which cannot be assigned to such a cluster.

(34a) The umbrella the man sold despite his wife is in the room.
(34b) The umbrella the man sold despite his relatives is in the room.
(35a) The horse raced past the barn fell.[9]
(35b) The horse that was raced past the barn fell.
(36a) The paper was considered by John finished.

(36b) The paper was considered by John not finished.

While such examples demonstrate the activity of a principle like (29), there are also some experimental studies which give further direct evidence for it.

Blumenthal (1966) examined the kinds of error that subjects make when attempting to paraphrase center-embedded sentences like (26a). He found that the largest class of errors takes the three nouns as a compound subject, and the verbs as a compound predicate. For example, (26a) would be paraphrased as though it were (37).

(37) The boy, the man, and the girl liked, hated, and laughed.

That is, a simple "Nominal-Verb" schema is imposed on what is actually a complex sentence. In a related experiment, Bever et al. (1969) found that center-embedded sentences which have plausible, but misleading, noun-verb sequences in them are relatively hard to paraphrase (see (38)).

(38a) The editor authors the newspaper hired liked laughed.
(38b) The editor the authors the newspaper hired liked laughed.

Experiments like the ones just described serve to strengthen the claim that the strategies in (29) are present in adults (it is in fact unlikely that anyone would deny the existence of a strategy like (29a, b) even if the experimental evidence were not available). However, the presence of such perceptual strategies in young children cannot be taken for granted just because they appear in adult intuitions and behavior. Some of our recent experiments have explored the basic dependence in the child on a strategy like (29). For example, we have found that children less than two years old tend to recall (and act out) the first "nominal-verb" string that they hear, even if it is in a dependent clause (e.g., dog jumped in (39)). Older children, on the other hand, tend to recall the main clause "nominal . . . verb" and to drop the dependent clause (they recall the dog fell in (39)).

(39) The dog that jumped fell.

That is, older children assign priority on the basis of superordinate structure, while the younger children take the first nominal-verb

string that they encounter as the most important. The main result of our investigations into the ways in which young children acquire perceptual strategies (see Bever 1970a for a review) is that the child from age two to five years is heavily dependent on perceptual strategies in speech perception, even to the point of overgeneralizing them to sentences where they should not be applied. For example, children of four years, *more* so than younger children, tend to take the first noun within a clause as the actor, even in passive (40b) or cleft (40c) sentences, in which that strategy leads to misperception.

(40a) The cow kisses the horse
(40b) The horse is kissed by the cow.
(40c) It's the horse that the cow kisses.

Thus, while adults have intuitive control over the application of such perceptual strategies in most cases, children are more often at their mercy.

5. *The Interaction of the Acquisition of Perceptual Strategies and of Grammar*

The relative dependence of the child on perceptual strategies of speech constrains the form of predictive grammars which can be learned. For example, a grammar which predicted every sentence to be ambiguous with respect to its internal structure could not be learned, nor could a grammar in which every predicted sentence violates universal perceptual principles. But existing grammars do predict sentences, *some* of which are ambiguous, and *some* of which do violate general perceptual principles. Thus, we cannot restrict the universal form of possible predictive grammars in any way except to say that sentences which it predicts must be *in general perceptually analyzable.*

This kind of restriction on the form of predictive grammar implies that certain universal features of such grammars are due to laws governing their actual use by young children and adults. This is distinct from the view that all the universal properties are internal to the predictive mechanism itself (such as the principle that transformational rules are ordered). The fact that the child is simultaneously acquiring a predictive grammar and systems for speech

production and perception requires a conception of language learning, with corresponding principles of linguistic change, which is different from a view centered on the learning of predictive grammar constrained by formal simplicity. Since language learning includes the simultaneous acquisition of perceptual and predictive structures, the ultimate structure of the predictive system is partially a function of two kinds of simplicity: simplicity of the predictive system itself, and simplicity of the systems for speech perception and production.

In the next section, we illustrate how the predictive and perceptual systems can place conflicting constraints on a language, and produce historical changes which increase complexity in one language system in order to simplify another language system.

6. *Informal Account of the History of Relative Clause Formation and Reduction in English*

The historical changes we are concerned with are the rules of relative clause formation and reduction described (for contemporary English) in (5). It is convenient to distinguish six stages in the history of English relative clauses. Stage 1, Old English, dates from the time of the earliest manuscripts to about A.D. 1100. Stage 2, Early Middle English, runs from 1100 to 1400; Stage 3, Late Middle English, from 1400 to about 1550; Stage 4, Early Modern English, from 1550 to 1700; Stage 5, Late Modern English, from 1700 to the beginning of this century; and Stage 6, Contemporary English.

In Stage 1, the only element that could function as a relative pronoun was the demonstrative *se*, "that," which was declinable, and which had a masculine, a feminine, and a neuter form. In Stage 2, the demonstrative as relative, which now existed only in a single indeclinable form *þæt* (a continuation of the neuter form in Stage 1), was joined by various interrogative pronouns (the modern forms of which are *who, whom, which, whose,* etc.) a situation which has continued to the present day (the demonstrative is now, of course, spelled *that*). In addition, in Stage 1, a relative clause could be introduced simply by the indeclinable relative particle (n.b., *not* pronoun) *þe*, or by the demonstrative plus *þe*. The latter was also a possibility in Stage 2, but by Stage 3, the use of the relative particle had been discontinued.[10]

In Stage 1, the shared nominal could be retained in all syntactic positions in the relative clause except in clauses introduced by a word other than a particle or a pronoun; indeed in relative clauses introduced solely by the relative particle *þe*, the shared nominal could be deleted only if it was the subject of the relative clause. The situation was the same in Stage 2, except that since relative clauses could not be introduced just by the particle, the shared nominal was deletable everywhere. By Stage 3, however, the shared nominal had to be deleted if it occurred next to the relative pronoun, and was optionally deletable elsewhere. Still later, the shared nominal could only be retained in a subordinate clause within the relative clause, a situation which has continued until the present day.

We come now to a description of the historical development of the rule which introduces relative pronouns. As far as we can determine from the evidence cited by various grammarians, such as Abbott (A),* Curme (C), Jespersen (J), Mustanoja (M), Poutsma (P), Roberts (R), Sweet (S), Visser (V), and Wilson (W), at no stage in the history of English was a relative clause which modifies a nominal preceding the verb in its own clause allowed to begin with a finite verb.[11] As Curme himself argued, we may assume derivations of the sort given in (41) were never allowed.

(41) the girl $[_S$she ate the baklava$]_S$ was fat. (SHARED NOMINAL DELETION)⇒
*the girl $[_S$ate the baklava$]_S$ was fat.

On the other hand, it was possible up to the end of Stage 4 for a relative clause modifying a noun which followed the verb in its own clause to begin with a finite verb, so that derivations like (42) could be obtained.

(42) Harry ate the baklava $[_S$it was disintegrating$]_S$ (SHARED NOMINAL DELETION) ⇒
Harry ate the baklava $[_S$was disintegrating$]_S$

*The grammarian who was the source for the various citations given below is indicated by the first letter of his surname; the number is the page on which the citation may be found in the work listed in the bibliography.

Examples of this sort, in which the subject relative pronoun has apparently been omitted are, however, quite rare throughout the history of English.[12]

From Stage 4 to Stage 5 it became obligatory to introduce a relative pronoun into clauses modifying an object noun, a development which we analyzed above. In Stage 5, the subject relative could only be omitted in existential sentences like (7c) and (43a) below, and in cleft sentences like (7d) and (43b), including question-word interrogative cleft sentences, either direct, as in (43c), or indirect, as in (43d).[13]

(43a) There are lots of vulgar people live in Grosvenor Square. [J 145; Wilde]
(43b) It was haste killed the yellow snake. [J 145; Kipling]
(43c) Who is this opens the door? [P 1001; Thackeray]
(43d) I wonder who it was defined man as a rational animal. [J 146; Wilde]

Finally, in Stage 6, it seems that subject relative omission has become archaic or ungrammatical in existential and cleft sentences of the type (43a,b), and for some people also in interrogative cleft sentences of the type (43c,d).

Omission of the object relative pronoun, which necessarily leaves a nominal or some constituent other than the finite verb as the first element of the relative clause, has always been possible in English, although instances are very rare in Stages 1-3 (examples being even less frequent than those of subject relative pronoun omission in Stages 1-2, although in Stage 2, the formula represented in "by the faith I have to you" is fairly often instantiated). But, by Stage 4, the phenomenon had become quite common (see figures cited in note 12), and it is, of course, firmly established in idiomatic English today.[14]

Fig. 1 outlines the historical developments relating to the form of the relative pronoun, the retention of shared nominals, and the omission of the relative pronoun, and also information concerning the loss of most noun and verb inflections in English.

Before proceeding with a formal statement of the rules of concern to us, we may point out that nothing special about the history of the relative clause reduction rule need be mentioned, given our

Figure 1

Synopsis of Developments in Relative Clause Formation in the History of English, Along with Some Other Developments

Phenomenon	*Stage*					
	1 (OE) (to 1100)	2 (EME) (1100-1400)	3 (LME) (1400-1550)	4 (EMnE) (1550-1700)	5 (LMnE) (1700-1900)	6 (CE) (1900-)
Relative Clause introduced by:						
Particle *þe*	yes	no	no	no	no	no
Demons. pronoun + *þe* (*that* in 2)	yes	yes	no	no	no	no
Demons. pronoun (declinable)	yes	–	–	–	–	–
Demons. pronoun (indeclinable)	–	yes	yes	yes	yes	yes
Interrogative pronoun	no	coming	yes	yes	yes	yes
Shared nominal retainable:						
Obligatorily if not subject & no rel. pronoun	yes	going	no	no	no	no
Next to rel. pron.	yes	yes	going	no	no	no
Elsewhere	yes	yes	yes	no	no	no
Subject rel. pron. form. obligatory:						
On clause initial preverbal nouns	yes	yes	yes	yes	yes	yes
On obj. nouns	no	no	no	coming	yes	yes
On subjects of existential & cleft sentences	no	no	no	no	coming	yes
In interr. cleft sentences	no	no	no	no	no	coming
Nom./Acc. distinction	yes	going	no	no	no	no
Verb inflection	yes	yes	going	residual	residual	residual

decision to order that transformation before the rule of relative pronoun formation. The rule has remained optional in all environments throughout the entire history of English.[15]

7. *Formal Account of the History of Relative Clause Formation and Reduction in English*

In Stage 1 a relative clause could be introduced by the relative particle *þe*, by the inflected demonstrative pronoun *se* functioning as a relative pronoun, or by the two together in the order *se þe*. The shared nominal also was retainable except in clauses introduced by zero, and indeed had to be retained in clauses introduced by *þe* alone when it was not the subject of the relative clause.[16] (44) is a formal statement of the rules of relative clause formation and reduction in Stage 1. A verbal account of each rule follows each formal statement.

(44a) Relative clause formation:

$$[_S, [_S X_1 [_{Nom_i} X_2, \emptyset,]_{Nom_i} X_3 {}_S], ;, [_S X_4 [_{Nom_i} X_5]_{Nom_i} X_6 {}_S],]_S$$

1	2	3	4	5	6	7 ⇒
∅	2	(*þe*+) 6	4	∅	∅	∅

This is simply a formalization of rule (5a), together with a provision for the optional addition of the relative particle *þe*.

(44b) Relative clause reduction:

$$X_1 [_{Nom_i} X_2 [_S [_{Nom_i} X_3]_{Nom_i}, \text{Tense} + be, X_4]_S]_{Nom_i} X_5$$

1	2	3 ⇒
1	∅	3

This is a formalization of rule (5d).

(44c) Relative pronoun formation:

$$X_1 [_{Nom_i} X_2 [_S, \emptyset, (þe) X_3, [_{Nom_i} X_4]_{Nom_i} X_5]_S]_{Nom_i} X_6$$

1	2	3	4 ⇒
1	se_i	3	4

Conditions: (i) Not applicable when neither X_3 nor X_5 contains Tense.

(ii) Obligatory when X_6 begins with a Verb and $3 = \emptyset$.

The demonstrative pronoun *se* is added at the beginning of a relative clause. It agrees in case and gender with the shared noun, something not explicitly provided for in this rule. The non-applicability condition is necessary to insure that the rule does not apply to reduced relative clauses. The obligatory condition insures that relative clauses on preverbal nouns do not themselves begin with a verb.

(44d) Shared nominal deletion:

$$X_1\,[_{\text{Nom}_i}\,X_2\,[_S\,,(se_i),(\text{þe}),X_3\,[_{\text{Nom}_i}\,X_4\,]_{\text{Nom}_i}\,X_5\,]_S\,]_{\text{Nom}_i}\,X_6$$

$$\begin{array}{cccccccc} 1 & & 2 & 3 & 4 & 5 & 6 & \Rightarrow \\ 1 & & 2 & 3 & 4 & \emptyset & 6 & \end{array}$$

Conditions: (i) Not applicable when $2 = \emptyset$; $3 \neq \emptyset$; $4 \neq \emptyset$.
(ii) Obligatory when $2 = \emptyset$; $3 = \emptyset$.

Shared nominals within relative clauses are deleted optionally except when the clause is introduced just by þe and the shared nominal is not the subject (if it is, $3 = \emptyset$). They are deleted obligatorily when there is no relative marker (either particle or pronoun).

(45) presents Old English examples of relative clauses containing shared nominals; (46) gives examples of clauses introduced by *se*, þe, and *se* þe; and (47), examples of clauses introduced by zero.

(45a) Nænig forþum wæs, þæt he æwiscmod eft siþade. [V 59] "No one previously was there, that afterwards departed ashamed"
(45b) þonne fisc þe . . . mine geferen mid anum slege he mæg besencean. [V 59] "than a fish that . . . can sink my companions with one blow"
(45c) Se god . . . þe þis his beacen wæs. [V 58] "the god whose beacon this was"
(45d) We, þe us befæst is seo gyming Godes folces. [V 523] "we to whom is entrusted the care of God's people"

(46a) Geseoh þu, cyning, hwelc þeos lar sie, þe us nu bodad is. [Bede's *Ecclesiastical History*] "Consider, king, what doctrine this is, which now is preached to us"

(46b) He þæt beacen geseah þæt him geiewed wearþ. [S118] "He saw the beacon that was shown to him."
(46c) Ond gif þu forþ his willan hearsum beon wilt, þone he þurh me bodaþ ond læreþ, . . . [Bede's *Ecclesiastical History*] "And if you henceforth are willing to be obedient to his desire which he claims and teaches through me, . . ."
(46d) Ure ieldran, þa þe þas stowa ær hioldan, hie lufodon wisdom. [*Pastoral Care*, Preface] "Our forebears, who previously possessed these places, they loved wisdom"

(47a) Hwa is þæt þe slog? [C 16] "Who is that [who] smote thee?"[17]
(47b) Sum welig man wæs hæfde sumne gerefan. [C 25] "There was a rich man [that] had a steward"
(47c) Alle mæhtiga þæm gelefes. [C 180] "All things are possible to him [who] believes"
(47d) Se fæder hire sealde ane þeowene Bala hatte. [J 133-34] "Her father gave her a maid [who] was called Bala"
(47e) Her on þys geare gefor AElfred wæs æt Baþum gerefa. [J 133] "In this year died Alfred [who] was reeve at Bath."
(47f) Se þæt wicg byrþ [V 537] "He [whom] that steed bears"
(47g) Wiste forworhte þam he ær wlite sealde [V 537] "He knew to be guilty those [to whom] he previously had given beauty"
(47h) Bed him þet he scolde him giuen ealle þa minstre þa hæþen men hæfden ær tobrocon. [V 536] "He asked him to give him entirely the monasteries [that] the pagans had earlier destroyed"

The rules of relative clause formation and reduction for Stage 2 are the same as (44), except that relative pronoun formation is obligatory if the relative particle has been introduced, the demonstrative pronoun has become the indeclinable form þæt (modern spelling, *that*), and the interrogative pronouns are beginning to come into use as relative pronouns. Condition (i) on rule (44d) is, of course, no longer necessary.

In Stage 3, the relative particle is no longer introduced by the rule of relative clause formation. Shared nominal deletion is now obligatory when the shared nominal immediately follows the relative pronoun. That rule had become (44d').

(44d′) Shared nominal deletion (Stage 3):

$$X_1\,[_{\text{Nom}_i}\,X_2\,[_S,\ (\text{Rel-pron}_i)\ \emptyset,\ X_3\,,[_{\text{Nom}_i}\,X_4\,]_{\text{Nom}_i}\,X_5\,]_S\,]_{\text{Nom}_i}\,X_6$$

1	2	3	4	5	⇒
1	2	3	$\emptyset$	4	

Conditions: (i) Obligatory when 3 = $\emptyset$.
(ii) Obligatory when 2 = $\emptyset$.

In (48), examples from Stage 2 of sentences in which the shared nominal immediately follows the relative pronoun are given; in (49), examples in which the shared nominal is separated from the relative pronoun. In (50) and (51) reduced relative clauses from both stages in which the subject relative and object relative pronouns, respectively, have been omitted are given.

(48a) ther no wight is that he ne dooth, or sei that is amys [V 59; Chaucer, *Canterbury Tales*]
(48b) he knew sir Blamour de Ganys that he was a noble knyght. [V 59; Malory, *Morte d'Arthur*]

(49a) Our Lord that jn hevene ne Erthe he hath non pere. [V 59; Merlin]
(49b) a jantyllwoman that semeth she hath grete nede of you. [V 59; Malory, *M. d'A.*]
(49c) it was þat ilk cok þat peter herd him crau. [V 59; *Cursor Mundi*]
(49d) seynt lucie . . . , þat þe holy gost made hire so hevy þat sche myght not be draw . . . to þe bordelhous. [V 522; c. 1400]
(49e) And this man began to do tristely in the synagoge, whom whanne Priscilla and Aquila herden, they token hym. [V 522; Wyclif]

(50a) He sente after a cherl was in the toun. [V 12; Chaucer, *C. T.*]
(50b) Ye ryde as coy and stille as dooth a mayde, Was newe spoused.[18] [W 41; Chaucer, *C. T.*]
(50c) Ther was noon auditour coude on him winne. [J 146; Chaucer, *C. T.*]
(50d) This es the loue bes neuer gan. [C 184; Cotton MS]

(50e) Whar es now Dame Dido was qwene of Cartage? [R 109; *Parlement of the Thre Ages*]
(50f) Where is the lady shold mete vs here? [J 147; Malory]
(50g) Lete fetche the best hors maye be founde. [J 143; Malory]
(50h) With a knyght full sone she mette hyght Syr lucan de bottelere. [V 12; Malory]

(51a) Sir be þe feith I haue to yow . . . [V 538; *Cursor Mundi*]
(51b) The tresor they hadden, he it hem reft. [V 538; *Brunne Chronicle*]
(51c) He had a sone men cald Ector. [V 538; *Brunne Chronicle*]

In Stage 4, the rule of shared nominal deletion had become effectively what it is today—a shared nominal was obligatorily deleted. Also in this period, the relative frequency of object relative pronoun to subject relative pronoun omission had become extremely great (see note 8), so that subject relative pronoun omission began to take on the appearance of something unusual.

In Stage 5, the necessity for subject relative pronoun formation in clauses modifying object and predicate nominals had become established. The rule of relative pronoun formation for this period had become (44c′).

(44c′) Relative pronoun formation (Stage 5):

$$X_1\,[_{\text{Nom}_i}\,X_2\,[_S,\ \emptyset,\ X_3\,[_{\text{Nom}_i}\,X_4\,]_{\text{Nom}_i}\,X_5\,]_S\,]_{\text{Nom}_i}\,X_6$$

1	2	3	⇒
1	Rel-pron$_i$	3	

Condition: (i) Obligatory when X_6 begins with a Verb and $X_3 = \emptyset$.
(ii) Obligatory when X_1 = Nominal Verb (where the Nominal is not an expletive such as *there* or *it*) and $X_3 = \emptyset$.

In (52), we give examples from Stage 4, which include relative clauses beginning with a finite verb modifying an object, and in (53) examples from Stage 5, which represent archaisms (cf. Jespersen 1927:144). In (54) we give examples which include such relative clauses in existential and cleft sentences of the type given in (43a-d).

(52a) My father had a daughter lov'd a man. [J 143; Shakespeare, *Two Gentlemen* II, iv. 110]
(52b) I see a man here needs not live by shifts. [J 143; Shakespeare, *Comedy of Errors* III, ii, 186]
(52c) I've done a deed will make my story quoted. [J 143; Otway].
(52d) I bring him news will raise his drooping spirits. [J 143; Dryden]

(53a) I had several men died in my ship. [J 147; Swift]
(53b) I will advance a terrible right arm Shall scare that infant thunderer, rebel Jove. [J 144; Keats]
(53c) You beat that great Maryland man was twice your size. [P 1001; Thackeray]
(53d) I knew an Irish lady was married at fourteen. [P 1002; Meredith][19]

(54a) Some men there are loue not a gaping pigge. [J 134; Shakespeare, *Merchant of Venice* IV, i, 47]
(54b) There's one did laugh in's sleepe. [J 146; Shakespeare, *Macbeth* II, ii, 24]
(54c) 'Tis the God Hercules, whom Antony loued, Now leaves him. [J 145; Shakespeare, *Antony and Cleopatra* IV, iii, 16]
(54d) 'Tis thy design brought all this ruin on us. [J 144; Dryden]
(54e) See who it is lives in the most magnificent buildings. [J 145; Fielding]
(54f) 'Tis I have sent them.[20] [J 145; Hardy]
(54g) Grandpa, what is it makes your eyes so bright and blue like the sky? [V 13; G. Cannan (1913)]

Finally, in Stage 6, we observe that sentences like (43a,b), in which the subject relative pronoun has been omitted from relative clauses modifying the subject of existential and nonquestion word cleft sentences, are felt to be ungrammatical. Nevertheless, there are some speakers of Contemporary English, the authors included, who find the question word cleft sentences of the sort (43c,d), with subject relative pronouns omitted, grammatical. For such persons, the rule of relative pronoun formation has become (44c″).

(44c″) Relative pronoun formation (Stage 6):

$$X_1\,[_{\mathrm{Nom}_i}\,X_2\,[_S\,,\emptyset,\,X_3\,[_{\mathrm{Nom}_i}\,X_4\,]_{\mathrm{Nom}_i}\,X_5\,]_S\,]_{\mathrm{Nom}_i}\,X_6$$
$$1 \quad 2 \quad 3 \quad \Rightarrow$$
$$1 \quad \left\{\begin{matrix}\textit{that}\\ \mathrm{Interr}\end{matrix}\right\}_i \quad 3$$

Condition: Obligatory when $X_3 = \emptyset$, except when $X_2 = \emptyset$ and X_1 = Interrogative *it* Tense + *be*.

For those speakers of Contemporary English who, unlike us, find (43c,d) also ungrammatical, the condition on rule (44c″) lacks the *except*-clause.

The following is a summary of the rules for each stage (structural indices are renumbered to facilitate stage-by-stage comparison).

Stage 1.

a. Rel. clause formation:

$$[_S\,,[_S\,X_1\,[_{\mathrm{Nom}_i}\,X_2\,,\emptyset,]_{\mathrm{Nom}_i}\,X_3\,]_S\,,\,;\,,\,[_S\,X_4\,[_{\mathrm{Nom}_i}\,X_5\,]_{\mathrm{Nom}_i}\,X_6\,]_S\,,]_S$$
$$1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \Rightarrow$$
$$\emptyset \quad 2 \quad (\textit{þe} +)6 \quad 4 \quad \emptyset \quad \emptyset \quad \emptyset$$

b. Relative clause reduction:

$$X_1\,[_{\mathrm{Nom}_i}\,X_2\,[_S\,[_{\mathrm{Nom}_i}\,X_3\,]_{\mathrm{Nom}_i}\,,\ \mathrm{Tense} + \textit{be},\ X_4\,]_S\,]_{\mathrm{Nom}_i}\,X_5$$
$$1 \quad 2 \quad 3 \quad \Rightarrow$$
$$1 \quad \emptyset \quad 3$$

c. Relative pronoun formation:

$$X_1\,[_{\mathrm{Nom}_i}\,X_2\,[_S\,,\emptyset,(\textit{þe})\ X_3\,,\,[_{\mathrm{Nom}_i}\,X_4\,]_{\mathrm{Nom}_i}\,X_5\,]_S\,]_{\mathrm{Nom}_i}\,X_6$$
$$1 \quad 2 \quad 3 \quad 4 \quad \Rightarrow$$
$$1 \quad \textit{se}_i \quad 3 \quad 4$$

Conditions: (i) Not applicable when neither X_3 nor X_5 contains an unembedded instance of Tense.
(ii) Obligatory when X_6 begins with a Verb and $3 = \emptyset$.

d. Shared nominal deletion:

$X_1 [_{Nom_i} X_2 [_S, (se_i), (\text{þ}e), X_3, [_{Nom_i} X_4]_{Nom_i}, X_5]_S]_{Nom_i} X_6$

1 2 3 4 5 6 ⇒

1 2 3 4 ∅ 6

Conditions: (i) Not applicable when $2 = \emptyset$; $3 \neq \emptyset$; $4 \neq \emptyset$.
(ii) Obligatory when $2 = \emptyset$; $3 = \emptyset$.

Stage 2.

a. Same as Stage 1.
b. Same as Stage 1.
c. Add condition:
(iii) Obligatory when þe is present.
Change se_i to $\left\{ \begin{matrix} that_i \\ \text{Interr}_i \end{matrix} \right\}$
d. Omit Condition 1.
Change se_i to $\left\{ \begin{matrix} that_i \\ \text{Interr}_i \end{matrix} \right\}$

Stage 3.

a. Omit (þe) from structure change.
b. Same as Stage 1.
c. Omit (þe) from structure index. Omit Condition (iii).

d. $X_1 [_{Nom_i} X_2 \left(\left\{ \begin{matrix} that \\ \text{Interr} \end{matrix} \right\}_i \right), X_3, [_{Nom_i} X_4]_{Nom_i}, X_5]_S]_{Nom_i} X_6$

1 2 4 5 6 ⇒

1 2 4 ∅ 6

Conditions: (i) Obligatory when $4 = \emptyset$.
(ii) Obligatory when $2 = \emptyset$.

Stage 4.

a. Same as Stage 3.
b. Same as Stage 1.
c. Same as Stage 3.
d. Replace Conditions (i) and (ii) by:
(i) Obligatory

Stage 5.

a. Same as Stage 3.

b. Same as Stage 1.

c. $X_1 [_{Nom_i} X_2 [_S, \emptyset, X_3 [_{Nom_i} X_4]_{Nom_i} X_5]_S]_{Nom_i} X_6$

1 2 3 ⇒

1 $\left\{ \begin{matrix} that \\ \text{Interr} \end{matrix} \right\}_i$ 3

Conditions: (i) Obligatory when X_6 begins with a Verb and $X_3 = \emptyset$.
(ii) Obligatory when X_1 = Nominal Verb, but when Nominal is not an expletive such as *then* or *it*, and $X_3 = \emptyset$.

d. Same as Stage 4.

Stage 6.

a. Same as Stage 3.
b. Same as Stage 1.
c. $X_1 [_{Nom_i} X_2 [_S, \emptyset, X_3 [_{Nom_i} X_4]_{Nom_i} X_5]_S]_{Nom_i} X_6$

1 2 3 ⇒

1 $\left\{ \begin{matrix} that \\ \text{Interr} \end{matrix} \right\}_i$

Conditions: (i) Not applicable when neither X_3 nor X_5 contains an unembedded instance of Tense.
(ii) Obligatory when $X_3 = \emptyset$, except when $X_2 = \emptyset$ and X_1 = Interr *it* Tense + *be*.*

8. *The Interaction of These Developments with Speech Perception*

The development of the relative-clause formation system over the last millenium can be described straightforwardly in terms of slight changes in the description of rules and their domain of application. As we argued above, this fact in itself is an empirical demonstration of the appropriateness of the form of grammar used to describe each stage of the language. Clearly, a form of grammar which required that each stage be represented as radically distinct from every other stage would be less satisfactory. Thus, our investigation to this point constitutes an empirical demonstration in favor of the

*For some speakers, omit the *except*-clause.

use of a transformational grammar to describe diachronic aspects of language and (by direct inference) to describe synchronic aspects as well.

However, our formal outline of the historical developments is less satisfactory as the basis for an *explanation* of what has happened. Indeed, there is no general sense in which the changes we outline demonstrate any overall tendency for grammars to evolve in a particular formal way. The major historical shifts are outlined in (55). The formal reflex of these changes in the statements of the rules does not offer any insight as to why these changes occurred and whether they are related developments.

(55a) Disappearance of inflections, first in nouns then in verbs.
(55b) Appearance of restrictions on the absence of relative clause markers on clauses modifying postverbal nouns.

There is no general trend towards formal rule simplification or elaboration to be found in these developments, and examination of the formal rules alone leaves us without any understanding of the processes which might be involved. For example, the shift from Stage 4 to Stage 6 represents a generalization of the restriction on the absence of the relative pronoun in relative clauses. This generalization is represented formally as a simplification of the rule which inserts relative pronouns. However, the shift from Stage 3 to Stage 5 represents a reduction in the generality of the restrictions on relative pronoun insertion since the relative pronoun is still optional before a verb in the relative clause if the head noun is preceded by an expletive construction. This loss of generalization is represented formally as an addition to the rule which inserts relative pronouns. (We should emphasize that the oscillation of the formal complexity underlying the description of the relative pronoun system in English is not a consequence of our decision to treat the presence of relative pronouns as due to the operation of a single rule of relative pronoun formation as opposed to an early rule of formation and then optional deletion proposed in previous accounts (Smith 1964). If one adopted the previous solution then one would find that the formal complexity of relative pronoun restrictions decreased from Stage 3 to Stage 4 but increased from Stage 4 to Stage 6.)

Of course, we do not want to prejudge the possibility that some formal aspect of the rules might be found which represents a generally observed historical shift, nor do we wish to claim that our formalization of the developments is not potentially subject to reformulation in the light of data that we have not considered. Such a reformulation might offer a formal characteristic which would allow a satisfactory generalization about the historical developments. However, whatever formal account is found in terms of transformational rules it will fail to represent that the two historical changes in (55) are related. Yet it is the presence of such a relation which partially explains the historical changes themselves.

In Section 5 we argued that the child's system for the use of language is reflected formally in constraints on the grammatical rules that he can learn. We concentrated on the nature and acquisition of the child's system of speech perception and suggested that at certain points the learning of the perceptual system and of the system for the prediction of new sentences would come into conflict with each other. The first area for such conflict of concern to us is the perceptual and predictive use of a rich system of inflectional endings. The current research on speech perception argues that the primary goal of speech perception is to extract the internal relations from an external sequence—the more explicit and unique the markers in the external sequence of the internal relations, the easier it is to perceive the sentence. For example, a language in which the first noun is *always* the internal subject would be perceptually simple. Or a language in which the subject is invariably marked by one sort of case marking while the object is marked by another, regardless of their order, would also be perceptually simple: The listener would not need to attend to the order of the words; only the inflectional markers would be at issue. While there may be no language which is entirely dependent on the use of case markings or entirely dependent on surface order, Old English was a relatively extreme case-marking language with a variety of inflectional paradigms.

From the standpoint of language learning it is clear that a rich inflectional system is a mixed blessing. On the one hand, if the inflectional system is extremely general and without exception then the child need learn only one inflectional system for nouns and for verbs, and then can apply it ubiquitously. However, in the evolution

of most inflectional systems (Jespersen 1940: 59), it appears that even if inflections are small in number at one stage, they tend to multiply and become differentiated into many different systems of inflection, which vary according to the syntactic, semantic, or phonological property of each lexical item. Once learned, such a varied inflectional system may increase the perceptual simplicity of the language as a whole, since the inflectional endings themselves carry partial lexical information (see below for a discussion of this). However, the learning problem is considerably complicated. Many authors have noted that even in an inflectionally simple language like modern English children go through a period of great difficulty with exceptional forms for which they overgeneralize the inflectional regularities (e.g., they say "wented" instead of "went," or "childrens" instead of "children"). A language in which there is greater variety of inflections than Modern English must be more difficult to learn, at least in that respect.

This was the state of affairs in Old and Early Middle English; the variety of distinct paradigms of noun declensions was high. Depending on the delicacy of the criteria one wishes to apply, one can speak of anywhere from four to ten basic paradigms without including any of the more marginal classes. Thus the child was faced with a formidable learning task. When the opportunity for some restructuring of his language arose it is not surprising that noun inflections were leveled. Of course, we have not explained what the basis of the opporuntity to change the language was, only why it was utilized in this particular way.

Subsidiary evidence for this interpretation of the loss of inflectional endings in English is found in the fact that noun inflections disappeared before verb inflections. Indeed, a system of verb inflection is residual in Modern English. Our argument is that the basic pressure to change the noun system came from the fact that there were so many different paradigms. But the verb system was far more regular: There were two main classes, each with its own system of inflectional endings.[21] Thus, the learning problem for the verb system was far less complex than for the noun systems, and the verb inflections dropped out of the language at a later time.

Of course, many languages persist in maintaining complex irregular declension systems. Consequently, we cannot claim that the

emergence of an intricate set of declension systems was the direct cause of the loss of all inflections. One might be tempted to argue that the *real* "cause" of the loss of inflections was the Germanic tendency for word-initial stress. This "caused" a reduction of stress on other syllables, which "caused" the ultimate loss of phonetic differentiation of the inflectional endings, which "caused" their ultimate deletion. Such an "explanation" would merely beg the question as to why the inflectional endings were dropped entirely: There are many examples of neutralized vowels which remain in English and have not disappeared. Thus vowel reduction *may* be a prerequisite for the loss of inflectional distinctions, but to take it as a direct cause would be as naive as to take the complexity of the declension system as the single direct cause. It is unlikely that linguistic evolution has single causes of this sort.

Consider now the implications of the loss of inflections for the marking of subordinate and superordinate clause relations in general and the relation of a relative clause to its head noun in particular. First, it was apparently the case in Old English as well as Modern English that the first Nominal Verbal sequence in a sentence was almost always part of the main clause unless specifically marked otherwise. Thus, if the first verb introduced a relative clause there had to be *some marker* present in the surface structure. Of course, in Stage 1 the number of different possible relative clause markers makes difficult the formal statement of the restriction that at least one of them must be present, since they are introduced by at least partially independent rules.[22] However, it is predictable that such a constraint exists if the perceptual principles in (29) are to be useful. For example, if there were no marker on an initial relative clause which has subject order, then it would be confused with the main clause of the sentence, as in (7a).

Cases in which the verb-initial relative clause modified a non-subject noun would have created less ambiguity in Stages 1 and 2, since in many instances the noninitial nominal was inflected either in the noun or the article or as an inflected pronoun. Thus, the absence of a relative clause marker in such cases did not lead to perceptual difficulty because the nominals were often marked by their inflected case endings as nonsubject. Of course, proper names and plural inflections in most noun declensions were phonologically the same for the nominative and accusative cases, so that the lan-

guage would not have been entirely without the possibility of generating cases which would be perceptually difficult. But as cases like (34-36a) show, one cannot require of a language that it never generate a sentence which violates a perceptual generalization, only that the actually uttered sentences be *in general* perceptually recoverable.[23]

When the declensions were entirely leveled at Stage 3 (except for personal pronouns, as in Contemporary English) the frequency of the kinds of ambiguity increased, especially since the number of alternative ways of marking a relative clause had diminished by the end of Stage 3 to the interrogative relative pronoun and the indeclinable demonstrative "that," as in Contemporary English. We interpret the appearance of an obligatory relative clause marker on noninitial nouns that are subject of the relative clause as a response to the increase in perceptual ambiguity occasioned by the loss of declensions.

Thus, in our view the two historical trends in (55a) and (55b) are directly related since the first is a precondition for the second. As the number of false *NV = Subject verb* segmentations determined by perceptual strategy (29) became too great the independent marking of the relative clause became obligatory. There are several subsidiary facts which strengthen our interpretation that the restrictions on the presence of relative markers are due to perceptual confusions, some of which we can observe at work in the modern development of the language. Consider the sentences in (56). According to the data we have collected, sentences like (a) are grammatically unacceptable for most speakers, and sentences like (b) are unacceptable for a subset of those speakers.[24]

(56a) ??{It's / There's} a boy wants to see me.

(56b) ? Who is{there / it} wants to see me?

Consider the operation of perceptual strategies (29) on the last part of a sentence like (56a). It would yield the segmentation in (57).

(57) There is $[_S$ a boy wants to see me$]_S$

It is important to note that this segmentation is appropriate to the meaning of the sentence, unlike the inappropriate segmentations which the strategy would yield on cases like (6) (see above): (56a) is synonomous with (58).

(58) A boy wants to see me.

That is, in cases like this operation of strategy (29) interferes little with the recovery of the internal grammatical relations. What is lost by such a preliminary segmentation of (57) is the information that the sentence is an existential statement about *a boy*. This information, however, is uniquely recoverable from the expletive use of the initial word *there*.[25] If the locative use of *there* is intended then the absence of the relative clause marker involves a much less acceptable sequence, because the operation of strategy (29) leads to a nonsynonomous sentence (60).

(59) ? (Over) there is the boy wants to see you.
(60) The boy wants to see you.

Further evidence that it is the temporarily incorrect segmentation which makes these sentences (56) unacceptable is shown by the fact that any feature of the sentence which either reduces the salience of *there* as an expletive or heightens the salience of the "Noun-verb" association increases the unacceptability of the sentence. For example, in (61a) the constraint between *dog* and *bark* makes the operation of strategy (29) more powerful and makes the sentence less acceptable than (61b). In (62a) the intervening phrases reduce the force of the sentence as an existential statement and make it relatively less acceptable.

(61a) It was a dog barked at the cat.
(61b) It was a dog fell on the cat.

(62a) There is according to the secretary on the phone a boy wants to see you.
(62b) There is a boy wants to see you according to the secretary on the phone.

Furthermore, if an adverb intervenes between the noun and the relative clause verb the sentence also is more acceptable, as in (63a) compared with (63b). According to our interpretation this also is

due to the fact that the intervening adverb reduces the force of *the boy* as subject of the verb *wants*.

(63a) There's a boy outside wants to see you.
(63b) Outside there's a boy wants to see you.

Consider now questions like (56b), which are still fully acceptable in many modern dialects. We interpret this as due to the fact that the *it* in such sentences functions as an "expletive" (analogous to *there*) rather than as a referential pronoun. This is not true for the unacceptable questions with pronouns or nouns and no relative clause markers in (64).[26]

(64a) *Who is he saw the fire?
(64b) *Who is the one saw the fire?
(64c) *Who is the person saw the fire?
(64d) *Who is the boy saw the fire?

In (56b) the *it* is unambiguously an expletive, since it cannot be coreferential with the personal pronoun *who*. However, if the interrogative pronoun used is *what*, the resulting questions, such as (65), are less acceptable than (56b), presumably because of the uncertainty as to whether *it* is a personal pronoun or an expletive.

(65) What was it fell on you?

Thus cases like (56b) are acceptable only because they do not lead to a false segmentation.

Given that cases like (56a) and (56b) do not involve perceptual difficulty, we might ask why they appear to be in the course of becoming ungrammatical. Presumably this active development could be taken as an example of the pressure for simplification of a rule of predictive grammar—that is, if cases like (56a) and (56b) always required a relative pronoun, then the relative pronoun insertion rule would be as stated in Stage 6, but without *any* qualifications. Thus, this generalization can be taken as an instance in which the pressure to simplify the predictive rules is forcing a grammatical restructuring.

One other historical change remains for discussion—the evolution of the system of relative clause markers themselves, in particular the disappearance of the shared nominal and the appearance of the

relative pronoun. The shared nominal could be deleted in a set of environments which are superficially heterogenous:

(66a) if the shared nominal was the subject of the relative clause verb
(66b) if the shared nominal is the object and the relative clause was introduced by (i) an inflected form of the demonstrative *se* or (ii) an inflected interrogative pronoun
(66c) obligatorily for both subject and object shared nominal if there is no relative clause marker (either þe or *se* or interrogative pronoun)

There is no representation offered by the rules themselves which reveals what generalization underlies these facts—the statements that account for the different deletion environments are simply presented as a list in (66). Yet it is clear that what is at issue in case (66b,i) and (66b,ii) is that there be *some* marker in the surface structure as to what the shared noun is and what its function in the relative clause is. Since the system of verb inflections was fully developed during Stages 1 and 2, a great deal of information about the shared noun could be gathered simply by examination of the particular inflectional ending on the verb in the relative clause. Furthermore, the relation in the relative clause of the (deleted) shared nominal is presumably perceptually recoverable because of the fact that only subjects of inflected verbs are ever deleted—as in the hortative or imperative constructions. However, no information about the object is revealed in the verb inflection. Accordingly, object pronouns could be deleted only if there was some other signal as to the fact that the shared nominal is the object—namely the presence of the relative pronoun or demonstrative inflected to be in the accusative case.

The fact that shared nominals *must* be deleted if there is no other relative clause marker may be interpreted as due to the confusion that would arise between compound and subordinate constructions. For example, if (67a) and (68a) were to appear as (67b) and (68b), the meaning would not be affected but the sequences would be interpreted as a compound of two independent sentences:

(67a) He hit the boy likes Mary

(67b) He hit the boy he likes Mary

(68a) He hit the boy Mary likes
(68b) He hit the boy Mary likes him

Thus, the obligatory deletion of the shared nominal when there was no other relative clause marker had the effect of creating a sequence which could *only* be interpreted as a subordinate (relative) clause rather than being mistaken as an independent sentence.

The details of the formation of the relative pronoun itself pose quite a difficult formal problem in their own right. What occurred is represented in (69).

(69)	Stage 1	Stage 2
undeclined rel. marker	þe	demonstrative (that)
declined rel. marker	demonstrative (se)	interrogative (who, what, etc.)

It is clear that in Stages 1 and 2 (indeed even in Modern English) there was both a declined and undeclined function word available to introduce relative clauses. However, at Stage 2 the demonstrative marker *se* that had been declined at Stage 1 now appeared in the form þ*æt* as the (undeclined) relative clause marker, while the inflected interrogative pronoun was now used as the inflected relative clause marker. Furthermore, just as *se* could optionally precede þ*e* in Stage 1, the interrogative pronoun introducing a relative clause could appear optionally before þ*æt* in Stage 2. Thus the only change between Stage 1 and Stage 2 in the relative clause markers themselves was that þ*e* became þ*æt* while the inflected demonstrative as relative clause initial was replaced by interrogative pronouns.

The facts are straightforward, as is their functional interpretation. However, their formal description in terms of changes in rewrite rules does not reveal the fact that the syntactic pattern of the language remained the same in this respect while the individual words used in that pattern changed. While the formulation in (69) above represents these facts of each stage, it does not appear to do so in a way that naturally represents the changes, nor does it offer any explanation as to the cause of the developments. In this respect we can only offer the conjecture that with the general leveling of

inflections on the demonstrative pronoun (often used as the article) and nouns, that the *se* converged on þ*e* in the form þ*æt*, leaving no inflected form except the interrogative pronouns to be used as inflected relative clause markers. But this does not explain *why* there was a continued pressure for an inflected relative clause marker.[27]

9. *Some Synchronic Effects of the Perceptual Parsing Principle*

So far we have outlined the way in which the perceptual operations used to isolate the main clause of sentences have constrained the historical development of the rules governing the insertion of relative pronouns and particles in English. The main result of the currently operative constraints on English grammar is that young listeners are not misled into parsing a noun together with a subordinate verb form as an independent clause. There are other aspects of modern English structure which appear to reveal the same constraints. For example, R. Kirk and others have observed that the grammar of English is such that a sentence-initial subordinate clause is always marked in the surface structure so as to be distinguishable from the main clause.

The most obvious mark of subordination is a clause-initial subordinating conjunction, as in (70).

(70a) While I was listening to E. Power Biggs, I had a vision of the Virgin Mary.
(70b) Since he comes from Brooklyn, John knows how to stiff a cabbie.

Sentence-initial subject complements, on the other hand, are marked by clause-initial complementizers, as in (71).

(71a) The fact that the rattlesnake had been milked did not make me like him.
(71b) For the man to introduce the speaker was nice.
(71c) The boy's winning the race so handily delighted the coach.

At first glance, such facts could appear to be a coincidental manifestation of unrelated rules which place morphemes like *while*, *that*, *'s*, etc., at the beginning of sentence-initial subordinate clauses. However, the patterning of these morphemes makes it clear that their appearance is governed by the general constraint that an

initial subordinate clause not be confusable with a main clause. Notice that in sentences like (71a), either one of the two initial complementizers may be deleted, but not both, as illustrated in (72).

(72a) The fact the rattlesnake had been milked did not make me like him.
(72b) That the rattlesnake had been milked did not make me like him.
(72c) *The rattlesnake had been milked did not make me like him.

Moreover, there are situations in which the clause-initial subordinating conjunction may be deleted, but if so, the subject and the verb of the subordinate clause are also deleted and the verb of the subordinate clause becomes nonfinite. This is illustrated in (73); the examples are synonymous with those in (70).

(73a) Listening to E. Power Biggs, I had a vision of the Virgin Mary.
(73b) Coming from Brooklyn, John knows how to stiff a cabbie.

In our interpretation, sentences like those in (73) are acceptable versions of those in (70) just because the verb forms in their subordinate clauses are nonfinite. Note that this situation is exactly parallel to that created by the rule of relative-clause reduction; (74b) is an acceptable version of (74a) just because the verb of the relative clause is nonfinite, whereas (74c) is unacceptable, because the verb is finite and hence would mistakenly be taken to be the main verb of the sentence.[28]

(74a) The man who maintains a fleet of six cars deserves to be taxed at the highest rate.
(74b) The man maintaining a fleet of six cars deserves to be taxed at the highest rate.
(74c) *The man maintains a fleet of six cars deserves to be taxed at the highest rate.

In section 5 above, however we pointed out that certain sentences which are complex perceptually because they contain subordinate clauses which may be mistaken for main clauses are nevertheless grammatical, for example (35a), which is repeated here for convenience.

(35a) The horse raced past the barn fell.

Such sentences would appear to weaken our claim that there are constraints operating on all derivations which block the generation of sentences which are perceptually confusing because of the lack of markers to indicate the subordinate status of subordinate clauses. How is it that the grammar allows sentences such as (35a) to be generated as fully grammatical? The answer has to do with the difficulty one would encounter in ruling out as ungrammatical perceptually confusing sentences such as (35a), while admitting large classes of sentences which are structurally parallel but which are not confusing.[29] For example, (75a), which is completely parallel to (35a), is not at all confusing.

(75a) The horse ridden past the barn fell.

In order for a grammar to block the derivation of (35a) while admitting (75a) and similar sentences, relative-clause reduction would have to include a restriction so as to disallow it only when the past participial form of the verb in the relative clause is homophonous with its past of present finite form (thus blocking clause reduction when the main verb of the relative clause is the passive of a verb like *race, walk, sell, run,* etc.). However, as (75b) reveals, this restriction is too strong: Although *sold* is homophonously the past participle and past tense form of *sell*, the sentence is not confusing, since if *sold* were acting as the main verb of the sentence, it would require a direct object.

(75b) The horse sold at the barn fell.

Consequently, the constraint on relative-clause reduction would have to be stated so as to allow reduction of clauses containing a homophonous verb form when the syntax of the verb would rule out the particular initial string as a possible main clause. But even this constraint is too strong, since it would block both (75c) and (75d), when only the latter is confusing:

(75c) The pillows tossed in the bed stayed there all night.

(75d) The men tossed in the bed stayed there all night.

Thus the constraints blocking clause reduction which would be appropriate to the perceptual facts are of the following sort:

(76) Relative-clause reduction may not apply within a passive relative clause if:
- (a) the past participle of the verb is homophonous with a finite form of the verb appropriately inflected to have the preceding noun as subject, and
- (b) the constituents which follow the verb form are permitted by the strict subcategorization of the active form of the verb, and
- (c) the sentence formed by the string including the object phrase(s) following the verb is a semantically plausible independent sentence.

In other words, anything that would allow the listener to interpret the first subordinate clause as a main clause would have to be blocked, but not otherwise. The formulation given in (76) is furthermore probably incomplete as it stands, but it does give a good idea of the complexity that would be involved in stating the appropriate restriction on relative-clause reduction, and it is this complexity which has maintained sentences like (35a) as grammatical in English. Having to learn restrictions like those in (76) is more problematic than the occasional perceptual embarrassment caused by sentences like (35a).

Another problem is raised by sentences like (71b,c), in which the markers *for* and *'s* may not be deleted even though such deletions would leave distinctive markers: In such sentences the initial clause is redundantly marked as subordinate by the elements *to* and *ing* as well as the *for* and *'s*. Nevertheless (77a,b) are disallowed as variants of (71b,c):

(77a) *The man to introduce the speaker was nice.
(77b) *The boy winning the race so handily delighted the coach.

The reason is that although the verb phrase is marked as subordinate (by the *to* or *ing*), the subject of the subordinate clause would mistakenly be taken as a reduced relative clause modifying that subject. In other words, (77a,b) are taken to be variants of:

(78a) The man who was to introduce the speaker was nice.
(78b) The boy, who was winning the race so handily, delighted the coach.

It is because of this confusion that the grammar does not contain special deletion rules that would exploit the apparent redundancy in the subordinate clause marking of sentences like (71b,c). Moreover, the absence of these deletion rules is formally parallel to the absence of a rule which would delete one or the other of the clause-initial complementizers *the fact* or *that*, and so does not occasion any additional complexity in the grammar of English—indeed it would involve added complexity in the grammar to have rules to delete them. We conclude that the addition of rules that would create ambiguities, increase the complexity of the grammar, and resolve no behavioral or structural complexities (other than to reduce apparent redundancy) would be linguistically quixotic and an unlikely historical development.[30]

In the foregoing discussion we have shown some consequences for present-day English of the perceptual parsing principle (29b) with regard to sentence-initial subordinate clauses and clauses which modify the subject noun phrase. The principle also has some grammatical consequences for subordinate clauses in English which follow the verb.

Consider verbs such as *mention* and *say* (which we shall call class "M") which occur with indirect objects obligatorily introduced by the preposition *to* and with *that*-clause object complements, as in (79).

(79) I $\left\{\begin{matrix}\text{(a) mentioned}\\\text{(b) said}\end{matrix}\right\}$ to Marsha (that) Frieda was crazy about Harvey.

(The parentheses around *that* in (79) indicate that this complementizer is optional.) Suppose one were to question the indirect object. Two possibilities arise. First, the preposition may be fronted along with the question-word, resulting in sentences like (80).

(80) To whom did you $\left\{\begin{matrix}\text{(a) mention}\\\text{(b) say}\end{matrix}\right\}$ (that) Frieda was crazy about Harvey?

Second, the preposition may be left behind, or stranded, but in this case, the expletive *it*, acting as a dummy direct object, must be inserted directly following the main verb, as in (81).

(81a) Who(m) did you {(i) mention / (ii) say} it to (that) Frieda was crazy about Harvey?

(81b) *Who(m) did you {(i) mention / (ii) say} to (that) Frieda was crazy about Harvey?

From a purely syntactic point of view, the obligatory insertion of the dummy direct object *it* following verbs of the class M when and only when the indirect-object preposition *to* has been stranded[31] is certainly a curious and inexplicable state of affairs.

There is, however, a straightforward explanation on the basis of the perceptual parsing principle. Whenever a preposition is stranded, there is a danger that if a noun phrase immediately follows it in the surface string, that noun phrase will mistakenly be taken to be the object of the preposition. In (81) that situation obtains: A stranded preposition is directly followed by a noun phrase which is nevertheless not its object. What is needed is a marker in the surface structure which signals that the entire clause which follows the stranded preposition is the complement of the main verb. English grammar can provide such a marker, namely, the expletive pronoun *it*, which independently of the sentences under consideration, functions as a signal that a complement clause follows. It also signals what grammatical relation that clause bears to the main verb: If the *it* is the surface subject, then the clause is subject; if the *it* is the surface object, then the clause is object, as the examples in (82) indicate.

(82a) It is likely that the Latvians will reach the moon before the Lithuanians do.
(82b) I have it on good authority that the budget cuts will not be restored.

Accordingly, in cases like (81), the grammar of English requires that the expletive *it* be inserted before the preposition exploiting its general capacity to act as a signal that that which follows the stranded preposition is necessarily the object complement of the verb and not the object of the preposition.[32]

10. *A Speculative Smorgasbord*

A. SUMMARY

We have argued that the constraints which a child and adult have on the utilization of language in speech behavior limit the kinds of sentences that are understood and therefore restrict the kinds of grammatical structures which are learned. The history of the grammatical restrictions on relative clause markers in English has been our example of the effects on linguistic evolution of this interaction between the systems for understanding sentences and learning sentence structure. As the nominal inflections disappeared between the 11th and 15th century, certain constructions with relative clauses became perceptually complex. This complexity was counteracted by changes in the restrictions on the presence of relative clause markers, which removed most of the perceptually difficult cases from the language.

Such developments exemplify the historical competition between what makes a language easy to understand and what makes it easy to learn. Between the 11th and 15th centuries the overall tendency with respect to the subcomponent of grammar we have been considering was to simplify the learning of grammatical structures by leveling the different systems of inflection—as we pointed out above, a rich inflectional system may make sentences easier to comprehend but it also makes the language harder to learn. Thus, the disappearance of all inflections had the effect of simplifying the learnability of one part of the language. Similarly the gradual disappearance of the shared nominal in relative clauses also had the effect of making the language easier to master, although harder to understand. The disappearance of shared nominals increased the generality of the shared-nominal-deletion rule (44d), but made certain sentences more confusing. (It is clear that in those cases in which the shared nominal appears in modern English, e.g., (9a), it is retained in order to remind the speaker or the listener of the grammatical source of the relative pronoun.)

In the 15th century the first change in the restrictions represented an increase in the grammatical complexity (and a decrease in the corresponding "syntactic regularity") of the restrictions on the

presence of the relative pronoun. Finally, the modern generalization of the restrictions represents a grammatical resimplification.

These developments in the past millenium are not susceptible to any generalization about the evolution of formal grammars as such. No tendency appears always to simplify rules or to maximize a formal property of the rules, such as the extent to which the output of one rule is part of the input to a subsequent rule (cf. Kiparsky 1968 for a discussion of this principle as a formalized motivating force underlying certain linguistic developments). Thus, while a plausible account can be found in the consideration of the interaction of the ease of learning and of understanding the language, the structure inherent in the formal account of what is learned and perceived does not itself reveal any plausible formal account of the historical changes.

However, in all these examples of the interaction of perceptibility and learnability we have only considered one small subcomponent of the grammatical structure and the perceptual mechanisms. How the whole language maintains a balance between learnability and perceptibility cannot be formulated at the moment since there is no common theoretical language available in which to compare the two kinds of complexity. Unfortunately, languages cannot as yet be rated for their overall "usability." Consequently, we cannot predict *a priori* which languages are highly "unusable" and likely to undergo some sort of evolution that will simplify learnability or perceptibility. (Note that this problem arises even within the consideration of synchronic "structural" facts, such as the comparison of the relative complexity of a change in a phonological rule with the use of several lexically-marked exceptions to that rule.) The inevitable incompleteness of every grammar is particularly damaging to the formulation of a univocal explanation of historical developments.

B. THE MUTATIONAL BASIS OF LINGUISTIC EVOLUTION AND THE COMPETENCE/PERFORMANCE DISTINCTION

Recent linguistic theorists have drawn a rigid distinction between linguistic structure ("competence") and speech behavior ("performance"). The corresponding theories of linguistic evolution have concentrated on the changes that take place within linguistic structure. The main proposal has been that suggested by Halle (1962), that children *restructure* their grammar to provide simpler accounts of the language than they hear in the grammar of their parents. This presupposes that new forms appear in languages spontaneously (at least from the standpoint of the grammar), which then motivate a grammatical restructuring. This picture of linguistic change is outlined in (83). (See also the discussion in section 3, pp. 38-40 above.)

(83)

Stage	Sentence Types	Grammatical Structures
(a)	a. . . . . .z	A. . . . . .Z
(b)	b. . . . . .z+@	A. . . . . .Z+#
(c)	a. . . . . .z+@	A′ . . . . . .Z′

In this model there is a period when adults may have one grammar (e.g., 83b) while children have advanced to a restructured grammar (e.g., 83c). Such a model follows directly from three claims:

(84a) Children can replace learned grammatical structures, while adults can only add rules to already learned structure.
(84b) Grammars learned by children are maximally simple representations of the linguistic forms the children hear.
(84c) New linguistic forms appear spontaneously.

The first claim (84a) is related to the psychological hypothesis that there is a "critical period" for "creative" language learning, which cuts off about age 12. After that point new language learning is viewed as a relatively artificial process, in which it is easier to learn new forms as a function of old structures than to restructure the already learned grammar *de novo*. This hypothesis has both clinical and anecdotal evidence in its favor (cf. Lenneberg 1967). However, it is a moot point whether or not children from 2-12 are themselves willing to restructure their own grammars totally when presented with new linguistic forms. Recent investigations of the development of grammatical structure (at least as revealed by speech production; cf. Brown, Bellugi, Bloom) have demonstrated that the child's linguistic ability itself develops at each point by minimal changes in highly articulated grammatical rules. Thus the fact that the adult appears not to be able to change his grammar in a major way may also be true of the child at every point in his language de-

velopment: It may simply be the case that during the ten years that the child is acquiring language he has the lability to perform many more slight grammatical restructurings than an adult. That is, principle (85) governs the restructuring that a child will carry out at each point.

(85) The child's grammar at one stage is a minimal change from the grammar at the preceding stage.

(85) raises an old theoretical problem: What constitutes a "minimal" change in grammatical structure? Detailed examination of the ontogenetic restructurings in the course of language acquisition may provide some empirical data which will clarify this theoretical question.

Proposal (84b) that children always learn the maximally "simple" grammar would provide a natural basis for constraining the extent of restructuring that a child applies to his own grammar when he hears linguistic forms that are novel to him. The problem left open by (84b) is this: How does a child decide which of the sentences he hears are relevant data for a grammatical restructuring and which are not? Clearly if a child is presented with a foreign language at age four he does not learn it as a function of his already-mastered linguistic structures. He recognizes intuitively that the difference between the foreign language and what he knows already is *so* great that it must be considered as entirely distinct (even if the same people in his environment speak both the first and second language). Presumably at each point in his speech development, there are certain possible additions to his first language that he will also be unable to learn as part of his language because their grammatical description represents too great a departure from the grammar he has already mastered. Thus, the possible novel forms that a child will try to take account of within his grammar are limited in part by the following sort of principle (86):

(86) Neologisms that are recognized by children as motivating a restructuring, (a) must be comprehensible, and (b) imply grammatical structures that are "close" to the already-learned structure.

Of course, like (85), this principle leaves open the definition of structural "closeness."

The third proposal, (84c), that neologisms occur, is not intended as an explanation of their occurrence or of their form. No doubt new forms may be introduced into a language by cross-cultural contacts, as well as by creative individuals within the culture. Whatever the source of a particular neologism the problem remains to characterize the general constraints on what kind of neologisms are likely to occur. Part of the argument in the present paper is that nonstructural behavioral constraints modify linguistic evolution by their presence in the language-learning child. Another way in which these behavioral systems influence language change is by limiting the neologisms that adult speakers themselves will produce and accept as "semi-sentences." Clearly semi-sentences (potential neologisms) which are incomprehensible or which violate some general behavioral laws will tend not to be uttered or picked up as part of a new argot (87).

(87) Possible neologisms are limited by the systems of speech behavior ("performance").

Of course the main burden of this paper has been to point out that language learning and linguistic evolution are the learning and evolution not merely of grammatical structure but also of the perceptual and productive systems for speech behavior. The novel structures that the child recognizes as relevant motivation for restructuring his grammar must be sentences he can (at least partially) understand, desire to say, and learn from. Thus, we can see that there are at least two sorts of requirements that the child applies to a novel sentence before attempting to modify his grammar to predict it: (1) It must be comprehensible. (2) Its grammatical description must not be radically different from the grammar the child has already mastered. In this way we can view the child as "filtering" constructions that are new to him, and learning those that meet the conditions in (86). Sometimes constructions are novel to a child merely because he has not heard them, and at other times because they are new to the language as a whole. Certain otherwise possible neologisms will never be incorporated into a language because they will be filtered out at all points in the child's development.

In this respect linguistic evolution can be interpreted as an interaction of systematically constrained neologisms with the ontogenetically shifting filter in the child: Those neologisms that are appro-

priate to the particular stage in the child "survive"; they are picked up by the child and incorporated into the predictive grammar of his language. In this sense the effect of linguistic neologisms is analogous to the role of biological mutations in species evolution: Their form is somewhat constrained by existing synchronic structures, and if they create a structure which is too much at variance with existing structures they "die out" and do not become part of the structural evolution. In brief, the linguistic future is highly constrained by the structural and behavioral systems implicit in the linguistic present.[33] One consequence of this is that certain universals of language which appear to be aspects of synchronic "linguistic structure" have sources in the ways in which language is learned and used. There is other evidence that this theoretical entailment of our empirical investigation of the history of English is correct. (See Bever 1970b for empirical investigations of the ways in which linguistic structures can be interpreted as linguistic reflections of cognitive structures.)

Once we have taken into consideration learning and perceptual factors as part of the explanation for linguistic evolution we are faced with the question of how to interpret language history in terms of changes in formal linguistic structure. One recent proposal (Kiparsky 1970) is to include such factors as "functional roles" (and presumably perceptual mechanisms) as part of the linguistic structure ("competence"), since such factors obviously play a part in linguistic evolution and consequently determine certain universal properties of language. Such a claim must be carried out in its entirety. That is, one cannot accept one part of the perceptual system as being within linguistic competence and exclude other parts from competence because they do not appear to interact with formal structure. To do this would allow for completely circular explanations of historical changes–every time we observe a particular perceptual or functional constraint motivating a linguistic change we could merely postulate it as part of linguistic "competence" and take that as our explanation. Surely this will not do. If we are to take certain nonstructural factors ("performance") into account at all in explaining linguistic evolution we cannot pick and choose what is relevant *post hoc*. Rather, the entire range of behavioral aspects of language must be considered simultaneously as constraining the possible changes a language structure can exhibit. But to include all systematic behavioral properties of language within "competence" would be to claim that there is no such aspect of language as "performance"–that is, that linguistic structure does not have a reality distinct from its use except as a subcomponent of its use. It is doubtful that such an all-inclusive notion of "competence" is fruitful. We will understand more about linguistic structures by carefully drawing distinctions between linguistic systems, rather than by blurring them together.

C. SOME TRADITIONAL ISSUES

Our investigations also bear on several issues which have been of traditional interest for all students of linguistic change: (1) the notion of "functional load" as an explanation for linguistic developments; (2) the claim that languages tend to change from depending on inflections to express internal relations to depending on superficial word order; and (3) the relative importance of factors external and internal to a culture in triggering linguistic change.

(1) Various scholars have appealed to the notion of "functional load" as an explanation for the appearance of particular changes in the evolution of a language (cf. Martinet 1962). Basically, the proposals depend on a notion of optimum distribution of information-bearing features in a language: If a particular sound or distinctive feature becomes too important in distinguishing words or sentences, the disproportion of the "functional load" on that sound or feature can be taken as forcing a restructuring of the language so that other units or sentences can take over some of the information load. The interest of such arguments depends entirely on the postulated nature of the language in which functional load is optimally distributed. Clearly, maximum equality of distribution across sound types or syntactic constructions is not an intuitive linguistic *desideratum*, since many languages reveal large disproportions between the most and least frequent structures. Our arguments in this paper suggest that optimum *frequency* of a construction or *informational* load must be measured vis-à-vis the particular mechanisms for language perception and production. With this proviso, we agree with those who argue that the motivation for linguistic change can be found partially in the ways in which the structure of

language is used. However, our position is that it would be circular to define changes in language structure in terms of its function (cf. Jespersen 1941, Martinet) or function in terms of structure (cf. Kiparsky 1970). Rather, the two systems of linguistic organization must be defined and studied independently in order to understand how they interact within the speaking child and adult. Our advantage today over earlier scholars concerned with this interaction is that we have available independently motivated theories of linguistic structure and speech performance.

(2) The change from relative dependence on inflections to relative dependence on surface order to indicate the internal structure relations between phrases has been a traditional topic for linguistic historians. Our argument is that the secondary cause of such a development can be the relative difficulty of learning a language in which there is a large number of phonologically different nominal declensional systems (as opposed to one with a highly regular declensional system). This pushes the question back as to why simple declensional systems have a tendency to become elaborated at all. We have suggested that this may be due to the increased perceptual ease of a language in which there are many different cues as to the particular lexical items which are being heard. But of course other factors such as the introduction of new vocabulary items or sets of irregular forms from foreign languages may be even more important.

The evolutionary pattern of inflectional systems described by Jespersen is that inflectional systems characteristically evolve from simple to complex and then are leveled. This pattern may be interpreted as resulting from the conflict between the perceptual and the predictive systems of language. We assume that there is continual evolutionary pressure for a language to maximize the recoverability of deep structure relations in individual sentences. These languages tend to develop both surface order constraints (using function words) *and* inflectional markings. Consider a (hypothetical) language in an initially stable stage, having both inflections and ordering restrictions. If this language has one regular declension class it is easy to learn—but the homogeneity of a single-class inflectional system contributes information only about the logical relations within a sentence and this information is also generally recoverable (by hypothesis) from surface order (and special mor-

phemes). However, the perceptual simplicity of each individual sentence would be increased if the inflectional endings contributed differential information about each phrase and attributive relations between words separated from each other (e.g., as between adjectives and their head nouns). (Note that this would be relatively difficult to attain through proliferation of ordering restrictions—there is an upper limit to the number of possible lexical-class orders within an average size clause, but there is no theoretical limit to the possible number of inflectional classes in the lexicon). Accordingly, the second phase of the hypothetical language is one in which the ordering restrictions are somewhat tightened and there is a large number of inflectional classes. This in turn strains the learning process, which provides the conditions for leveling all the inflections, with order restrictions remaining.

This description of a pattern of linguistic evolution in terms of competition between language learning and perception leaves open too many questions to count as an explanation. Rather, its value lies in articulating the explanation of the evolution into specific questions concerning the interaction of the learning and of the perception of language—questions which may be answered through further research.

(3) It is obviously premature to pinpoint specific external causes of linguistic change, although we can try to describe the *kinds* of nonlinguistic event that can trigger linguistic developments. One extra-linguistic factor that is often referred to is being conquered by or conquering a group of speakers of a different language. In addition, our claim that linguistic evolution is in part a function of the balance between learnability and perceptibility raises the possibility that certain internal cultural developments can themselves motivate a linguistic shift by changing what the language is used for. Suppose that there were a cultural change in the relative importance of the learnability of a language and its perceptibility? This would in itself place a new set of constraints on the evolution of the language since it would upset the previous balance in the culture between the language's learnability and perceptibility. For example, an increase in the relative importance of "educated forms" of sentences (e.g., sentences with many embeddings) might place a greater relative emphasis on perceptibility constraints, and motivate those linguistic shifts which increase the perceptibility of individual

sentences, even though such shifts would increase the complexity of the predictive grammar which must be learned.[34]

D. CONCLUSION

Such questions await further empirical and theoretical investigation. The main focus of this paper is to emphasize the fact that linguistic evolution is a joint function of the various systems for the use of language. Attempts to explain linguistic development as a formal function of just one of these systems are doomed to incompleteness whether the system considered is that of speech perception, production, or the grammatical prediction of new sentences. We cannot explain a linguistic restructuring as a function only of an out-of-balance perceptual load, or of a learning difficulty, or of the formal complexity of the predictive grammar. All the systems of speech behavior interact in the child and naturally constrain each other as the language evolves.

NOTES

1. For arguments that relative clauses are formed from internal structure conjoined sentences, see Thompson 1971.

2. The subscript i indicates reference; accordingly, the formula requires that the two nominal expressions mentioned make the same reference. We call these the "shared nominals." The symbols X_1, X_2, etc., are variables.

3. If the nominal containing the shared nominal is in fact just the shared nominal, then the relative pronoun is either the word *that*, or one of the interrogative pronouns *who, whom,* or *which* (the choice of the *who/whom* vs. *which* having to do with whether or not the shared nominal is assumed to designate a sentient being, and the choice of *who* vs. *whom* having to do with the syntactic functioning of the shared nominal in the relative clause).

If the shared nominal is wholly contained within a larger nominal expression, then the relative pronoun *whose* is chosen, and sentences like (i) are obtained.

(i) A man whose reputation I admire is looking for a job.

4. Here, we depart from the position of recent investigators of relative clause formation in English, according to whom relative pronoun formation is obligatory, there being also an optional rule of relative pronoun deletion. We contend that the grammar of English is simplified, and that a more unified account of the history of English is possible, if it is assumed instead that relative pronoun formation is made optional.

5. Ross's complex noun-phrase constraint and similar "derivational constraints" in grammar (Lakoff 1969) all seem to be reflections of perceptual strategies of one sort or another. To show this, however, would require extended discussion, which would go far beyond the scope of this paper. See also note 22 and Bever 1970a, b.

6. The ungrammaticality of example (10d, ii) is accounted for independently as follows. First, note that the relative clause does not modify the preceding noun, but rather that the internal structure of this sentence is also that of the sentence:

(i) The one that is responsible for this mess is the mayor.

Example (10d, i) is obtained from (i) by rules which first delete the elements *the one*, and second extrapose the relative clause to the end of the sentence, leaving behind the expletive *it*. But the rule which deletes *the one* requires the presence of a relative pronoun immediately following those elements; hence neither (10d, ii) nor (11d) will be generated. On the other hand, if the relative pronoun is not added, the relative clause will automatically be reduced, and (ii) will be obtained.

(ii) The one responsible for this mess is the mayor.

7. Modifier preposing does not, however, apply if the modified noun is an indefinite pronoun such as *someone,* etc. It also applies only optionally to a very small set of particular noun-adjective combinations such as *life eternal,* and to certain other combinations in lyrics and poetry (e.g., *fiddlers three* in "Old King Cole").

8. At least, it has none in contemporary English. We shall return to consider examples like (22) in the history of English below in Section 6.

9. In order to explain the difficulty one has in understanding examples like (35a), we need recourse to another perceptual strategy besides that of (29), one which states in effect that the beginning of a sentence is the beginning of a sentence:

(i) $\# X \rightarrow \# [_S X$

The perceptual difficulty of (35a) is that strategies (i) and (29a) together assign only one left sentence boundary to that sentence, leaving the listener in a quandary as to what to do with the leftover verb *fell.*

10. In Stages 2 and 3 there were also relative clauses introduced by a string consisting of an interrogative followed by the demonstrative (*who that, which that,* etc.); quite possibly this use of *that* in second position was a continuation of *be* in second position. It is worth noting that this construction fell into disuse about the same time that subject-verb inversion began to be restricted to interrogative and a few other main clause types. The reason is that prior to this time the *that* was useful in signaling that the preceding pronoun was a relative and that the following clause was subordinate. Later, word order could be used to tell whether the pronoun was interrogative or relative, and the following clause main or subordinate.

11. Two sentences from the works of Shakespeare may be cited as counter-examples to this claim:

(i) Yet I'll move him to walk this way: I never do him wrong But he does buy my injuries to be friends, Pays dear for my offences. [A 166; Shakespeare, *Cymbeline* I, i, 105] " . . . but he [who] does buy . . ."

(ii) Those men blush not in actions blacker than the night will shun no course to keep them from the light. [C 16; Shakespeare, *Pericles* I, i, 135] "Those men [who] blush not . . ."

But, as Curme argued, we may assume that the omission of the subject relative pronoun in these cases was done deliberately and consciously by Shakespeare, and that they do not reflect the rules of English syntax which he normally followed. Besides these, we have encountered very few other examples of this sort in all of English literature; one occurs in the writings of the Irish playwright John Synge:

(iii) A lad would kill his father, I'm thinking, would face a foxy devil with a pitchpike. [V 14; Synge, *Playboy of the Western World*, (1907)] "A lad [who] would kill . . ."

Another (called to our attention by Fred Householder) is from a recent detective novel:

(iv) Anybody knows Harry'd say the same (i.e., Anybody *who* knows Harry'd . . .) [E. Livington, *Policeman's Lot,* 1968]

12. In Stages 1 and 2, omission of the subject relative pronoun in nonreduced relative clauses was largely limited to constructions involving the verbs *hatan* or *clepan* "be named," and even here because of the possibility of having the object before the verb, the result was not always that the verb came first in the relative clause. For Middle English, Mustanoja (1960: 205) refers to a dissertation by G. Winkler, in which it is observed that "the relative subject-pronoun is more frequently left unexpressed in Chaucer than the object-pronoun but the ratio is reversed in Caxton." On the next page, he cites figures from a dissertation by J. Steinki on the ratio of nonexpressed to expressed object relative pronouns in the works of various late Middle and early Modern English writers. The figures he gives are Pecock 1: 950; Capgrave 53: 1250; Cely Papers 4: 172; Caxton 8: 2800; Fortescue 1: 245; Latimer 19: 3100; Bacon 15: 490; Sidney 331: 2180. From these figures, we may conclude that both subject and object relative pronoun omission were quite rare for Chaucer, Caxton, and the other writers of the late ME period. Mustanoja claims further, however, that there was a rise in the frequency of subject relative omission early in the Early Modern English period (our Stage 4).

13. Some examples which exhibit subject relative omission in relative clauses modifying direct objects can be found in the writings of certain nineteenth-century novelists and poets, such as Keats, Mrs. Browning, Thackeray, and Meredith, but they are deliberate archaisms. The construction has also been

preserved dialectally, if we are to believe the testimony of Wright (1905: 280): "The relatives are, however, often omitted in the dialects, not only in the obj[ective] case in the lit[erary] language, but also in the nom[inative], as *I know a man will do for you*." In support of this, Visser (1963: 14) supplies a number of examples from Synge, and examples can also be found in modern detective stories, as Householder has pointed out to us.

14. According to Visser (1963: 538), in about 98% of the cases of object relative omission found in Early Modern English texts, the relative clause begins with a pronoun, rather than with a full nominal expression. That is, sentences like (i) occur about fifty times as often as sentences like (ii):

(i) John saw the man she admires.
(ii) John saw the man the woman admires.

Visser assumes this is so for metrical reasons; the omission of the object relative (*whom* or *that*) before a pronoun insures that two weakly stressed elements do not occur together. This explanation cannot be true, however, since nominal expressions also generally begin with a weakly stressed element (*a* or *the*). The explanation probably has to do with a perceptual strategy which leads one to expect that when two independent nominal expressions of the same type (i.e., both full noun phrases or both pronouns) occur next to one another, they are part of a larger coordinate structure. The omission of an object relative before a full nominal expression modifying a full nominal expression leads to a violation of that strategy; e.g., when one hears (iii)

(iii) John saw the man the woman _____

one expects that it will be completed by another nominal, e.g., "and the child," rather than by a verb, e.g., "admires."

15. If we were to remain with our earlier decision to have the rule follow relative pronoun formation, we would find that the rule would have to be stated differently for each of the last two stages. We shall not discuss developments concerning the rule of modifier preposing.

16. An explanation for these facts about shared nominal retention is given in the next section.

17. Notice that in the examples in (47a) and (47e) the relative clause without an introducer modifies a subject nominal that has been inverted with its verb.

18. See note 17.

19. Examples (52b) and (53d) are not to be interpreted as containing complements, according to the secondary sources.

20. Jespersen (1927: 145) points out that a number of authors who use the accusative of the predicate nominal pronoun in simple sentences like:

(i) 'Tis me.

use the nominative (as in (53f)) when the pronoun is followed by a relative clause with the subject relative pronoun omitted. This observation provides

additional independent evidence for the interaction of strategy (29) on grammar.

21. The traditional analysis of the verbal inflections would appear to show that there were many different idiosyncratic kinds of verb inflections among both strong and weak verbs. These complexities have been shown to be more apparent than real. The interested reader should consult Bever (1963) and Keyser (1966) to see the demonstration that there was actually an extremely small number of underlying classes in the strong and weak verb systems, respectively.

22. This sort of restriction on the surface structure expression in internal relations could be interpreted, following Perlmutter 1968, Lakoff 1969, Ross 1967, and Langendoen 1969, as an example of an "output constraint," which restricts the kind of derivation which is possible from an internal relative clause to an external form, and which explicitly marks that clause as relative. We see nothing wrong with such a formulation except that it merely restates the facts at issue. Our quest is to explain such features of sentences rather then enumerate them. For example, Bever (1970a) has suggested that it is characteristic of such "output constraints" that they reflect general perceptual processes which are true of the perception of stimuli other than language.

23. It is interesting to note that in all the cases of unmarked relative clauses in OE that we have found in the texts in which the object noun is the object of a finite verb and confusable with a nominative, the relative clause verb is either a form of *be* or a modal. That is, the allowed ambiguity may have been restricted even further than we claim by actual grammatical rule or simply by conventions of usage. This interpretation of the constraint would be further supported if it is true that sentences which began in initial nouns in the objective case could have a relative clause following with verb initial but without any relative clause marker, e.g., (i):

(i) Him likes me nobody likes.

Cases like this would not have run afoul of the segmentation strategies in (29) since the fact that the first noun is not in the nominative case shows that it cannot be the subject of any following verb. So far we have not found any data that would decide this question.

24. All the intuitions in this section of our discussion are relatively evanescent. We suggest that the reader compare the two versions of each sentence, with and without the relative clause marker, in order to convince himself that our statements are correct, at least about the *relative* acceptability of the sentences. For example, in our dialects the difference in acceptability between (56a) and (a′) is greater than the difference between (56b) and (b′). Indeed, while it is clear that (a′) is more acceptable than (56a), it is not at all clear to us that (b′) is more acceptable than (56b).

(a′) {It's / There's} a boy {who / that} wants to see me.

(b′) Who is {it / there} {who / that} wants to see me?

25. Notice that the cases with expletive *there* and *it* ought to have caused trouble in OE as well, since the initial noun is in the nominative case and therefore should have been segmented as the subject of the following verb. However, as we are arguing for Modern English, this segmentation would not have involved a semantically inappropriate segmentation of the first clause.

26. We have no data on this kind of construction in OE.

27. J. Thorne has pointed out to us some evidence that suggests that "who/which" is an inflected relative clause-marker, even in Modern English, which would account for the continued presence of some inflections. In relative clauses prepositions can precede "who/which" but not "that," as shown below.

(a) The room in which we stayed was small.
(b) *The room in that we stayed was small.
(c) The man with whom we spoke was small.
(d) *The man with that we spoke was small.

Thorne suggests that if we view a noun phrase with an initial preposition as "case marked" then (b) and (d) are inadmissible because "that" is undeclinable; prepositions may *precede* "who/which" if they are viewed as being the modern form of an inflected clause introducer.

28. Similarly, we get in Current English the paradigm:

(i) Anyone who owns a fleet of six cars deserves to be taxed at the highest rate.
(ii) Anyone owning a fleet of six cars deserves to be taxed at the highest rate.
(iii) *Anyone owns a fleet of six cars deserves to be taxed at the highest rate.

Note that (iii) is ungrammatical, even though, as it turns out, the initial subsentence anyone owns a fleet of six cars is not a possible English main clause. What this example reveals is that the constraint in question is a grammatical one and not merely a perceptual one, since if it were merely perceptual, (iii) would be both grammatical and acceptable. We have not investigated the question whether, in earlier stages of English, sentences like (iii) were acceptable. If they were, we would still be faced with the question whether they were ungrammatical, but acceptable because of their usability, or fully grammatical.

29. The critical question here, to which we cannot give a completely satisfactory answer, is "How large is large?" As we have already seen, whenever a perceptual difficulty is grammatically codified into a grammatical restriction, certain sentences which are structurally parallel to the difficult sentences but which are themselves not so perceptually difficult are also rendered ungrammatical (see, for example, the discussion above in connection with the examples in note 28). However, it is apparent that the class of ruled-out sentences which are not difficult is small compared with the class of ruled-out difficult ones. In the situation under discussion (reduced relative passive clauses) the opposite situation obtains: The class of perceptually difficult sentences is small compared with those structurally parallel ones which are not

difficult. The task remains, of course, to give a more precise meaning to these remarks about relative sizes of classes of sentences, but their import should be clear.

30. Note that the potential ambiguity of (77a, b) could be resolved by blocking their derivation from (78a, b), rather than from (71b, c). However, such a mechanism would involve the same sorts of complexities as those discussed in the text in connection with the problem of blocking the derivation of (35a) by relative-clause reduction.

Also observe that the fact that the markers *for* and *'s* may be (and in the case of *for* generally are) deleted when the subordinate clause is an object complement, as in examples (i) and (ii),

(i) I expect the man to introduce the speaker.
(ii) The coach approved of the boy winning the race.

is in conformity with our expectations, since if there is temporary ambiguity as to whether the verb phrase is to be taken as part of the complement of the main verb or as a modifier of the object noun phrase, it would be resolved by what follows, as in (iii) and (iv):

(iii) I expect the man to introduce the speaker to come late.
(iv) The coach approved of the boy, winning the race, taking a shower.

Or, the ambiguity involved has to do with lexical ambiguity of the main verb itself, as in (v):

(v) I know the man to be the hero in tomorrow night's play.

31. That this is the correct generalization can be seen from other types of sentences, for example, cleft sentences, in which the preposition is also stranded:

(i) It was Marsha (that) I $\left\{\begin{matrix}\text{(a) mentioned}\\\text{(b) said}\end{matrix}\right\}$ it to (that) Frieda was crazy about Harvey.

(ii) *It was Marsha (that) I $\left\{\begin{matrix}\text{(a) mentioned}\\\text{(b) said}\end{matrix}\right\}$ to (that) Frieda was crazy about Harvey.

32. It is interesting to note that the grammar of English does not simply constrain *that*-deletion to accomplish the objective of separating a stranded preposition from a following noun phrase which is not its object. Apparently the presence of *that* as in:

(i) *Who(m) did you mention to that Frieda was crazy about Harvey?

is insufficient in itself to prevent confusion (perhaps because of its homophony with the demonstrative pronoun). Note, in this connection, the grammaticality of both variants of (ii), i.e., with or without the *that:*

(ii) Who(m) did you learn from (that) Frieda was crazy about Harvey?

We have no explanation for the failure of the expletive object *it* to appear in cases like (ii).

33. Such a view allows us to interpret the occurrence of particular developments in one language and their non-occurrence in a closely related language. For example, German is highly inflected, such that singular nouns are uniquely marked as being in the objective case if they are not the internal structure subject of their verb. Yet relative pronouns may not be dropped in German sentences analogous to those in (7) above. This would seem to be at variance with our explanation that deleting relative pronouns in those positions in Old English is allowable because of the presence of noun inflections at the time. That is, while Old English had a rule for deletion of relative pronouns in certain positions German has no such rule. Thus to delete a relative pronoun in German even in positions which would not create perceptual confusions would be to change an exceptionless rule into a variable one. (Note that the argument has the same form if one takes the view that relative pronouns are transformationally introduced in German since there is no rule that deletes them.) That is, if an adult or child makes a slip of the tongue in German and produces a relative clause without a relative pronoun it tends not to be picked up as a productive neologism since it is too much at variance with the existing linguistic structure. It would be tempting to argue for a principle like (a) as a specific subpart of (86), but the evidence is far too scanty to do any more than suggest it as a hypothesis for further investigation.

(a) Changing an ungoverned (universal) rule into a governed rule (optional or restricted to certain environments), is not a minimal grammatical change.

Also, at present we cannot explain why relative pronouns could be omitted in the older Germanic languages generally, e.g., Old High German, Old Saxon, etc., but not in Modern German.

34. The reader may have noticed that we do not discuss the putative effects of the interaction of structure learning and perception with the system of speech production. This is not because we think that such effects do not exist, but because the system of speech production has been largely unstudied.

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