THE ANALYSIS OF SENTENCE PRODUCTION[1]

M. F. Garrett

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE, MASSACHUSETTS

I. Introduction

When one is speaking, one is thinking;[2] the problem of language production has often been thought of as determining what necessary relations hold between the former and the latter. However, no attempt will be made here to wrestle with such hoary issues as whether the structure of language determines general cognitive structure. Rather, it is taken as a point of departure that there exists a nonlinguistic representational system in terms of which significant cognitive functions can be performed (for recent discussions of this and related issues, see Fodor, 1975; Fodor, Bever, & Garrett, 1974, Chapter 7).

Given this assumption, we may raise the more tractable problem of *sentence* production. That is, we distinguish between the general problem of language production, which must include message formu-

[1] The research reported here was supported in part by NIMH grant HD 05/68-02,03,04. Some of the work was done in collaboration with S. R. Shattuck and her contribution is gratefully acknowledged. This paper was written while the author was a Senior Research Fellow of the Australian-American Educational Foundation (Fulbright-Hayes program) at Monash University, Melbourne.

[2] Barring appeals to certain chimerical pathologies and rote recitation or reading.

lation, and the specific problem of sentence production, which may be viewed as *translation* process (Fig. 1).

We assume that somewhere in the recesses of our central nervous system an interaction takes place among our current motor and perceptual experiences, our stored information, our motivational systems, and, doubtless, sundry other variables. That interaction gives rise to what we might call a "communicative intention"—hereafter *message*. In some manner, that message must be translated into a set of instructions sufficient to guide our articulatory apparatus.

Beyond knowing that some translation exists—there is nothing so clear as that we do not think with our lips or velum—what can be said of the translation process(es)? If we first focus on the form of messages when they are uttered, we can begin to explore some aspects of the translation process.

Constraints on the form of utterances which are to count as sentences are determined by formal linguistic analyses. How does this bear on the translation process we wish to analyze? We know that whatever models of the translation process we may postulate, one thing they must do is to distinguish among all the meaningfully distinct messages. In mapping from any of the indefinitely many possible messages $M_1, M_2, M_3, \ldots M_n$ onto an utterance, the translation process must preserve the bases for computing distinctions among $M_1, M_2, M_3, \ldots M_n$ if communication is to take place. Thus, the translation process must preserve whatever aspects of the manifest form of sentences can be shown to contribute to their semantic interpretation. That is tantamount to the claim that the structural descriptions of sentences must be preserved by the translation process, for virtually all the structural features encompassed by the surface phonological description and the underlying and surface syntactic descriptions of sentences[3] can be shown to contribute in one way or another to their semantic analysis. Thus, the structural analyses assigned to sentences by an adequate grammar provide one powerful constraint on the formulation of models of the translation process from messages to utterances.

[3] Excluded from this claim are "intermediate" syntactic trees and underlying phonological descriptions. This is not because these aspects of structural descriptions are taken to be less well motivated linguistically, but only because they cannot be given a prima facie defense on grounds of maintaining distinct representation of semantically distinct utterances. The relevance of such levels of representation to the processes of producing or comprehending sentences must appeal to other empirical support, some of which is mentioned or discussed in subsequent portions of this paper.

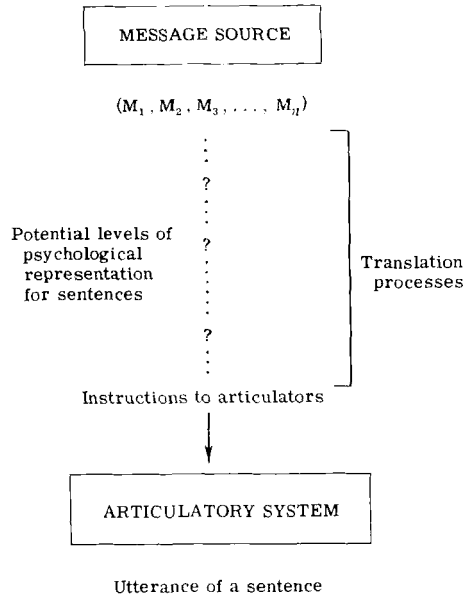

Fig. 1

But even though this constraint on the character of possible production models is a very powerful one, it tells us less than we might wish about the computational procedures which will effect the translation. For example, we know that the structural descriptions for sentences express regularities in the distribution of a variety of structural types—sounds, syllables, words, phrases and phrase types, sentences and sentence types. Such structural distinctions must be recoverable from the output of the translation process (if they are semantically relevant), but the way in which they are reflected in the information flow which gives rise to that output is an open question. We know for example that the structural analysis of sentences requires that "words" be decomposed into more elementary meaning bearing elements (morphemes); but the computational system may take account of this in a variety of ways. In particular, there may or may not be an independent, phonological representation of bound morphs in the computational vocabulary of the production system. Thus although the analysis of the word "bigger" must mark it as the comparative form of the adjective "big," that analysis may not be reflected in the existence of an element "comparative:—er" in the

processing vocabulary (though this phonetic fact would still be inferrable from the phonetic arrays assigned to "big" and "bigger"). Similarly for many other aspects of phonological and syntactic structure. One more example, of a syntactic sort, may suffice to make the point clear. If one compares certain varieties of complex nominals in English, for example, "peanut butter," "brick layer," "cast iron," "fog horn," "used car sales man," "college students," "elderly ladies," and so forth, one quickly sees, even with a rough attempt at a uniform periphrastic treatment of them, that they embody a wide range of syntactic and semantic relations, (indeed virtually the full syntactic possibilities of the language; see Lees, 1960) all of which will have to be reflected in the analysis which the production system assigns to them if their appropriate use is to be explained. But, though "elderly ladies" must be analyzed, roughly, as "ladies who are elderly" and "brick layer" as "one who lays bricks," both, either, or neither of these might be represented in the processing system by their constituent words, the stipulation of what grammatical relations hold between them and the derivational processes required to yield their surface forms. Alternatively, both, either, or neither might be entered in their derived form as elements of the computational vocabulary in the same way as words like "dog," "symbol," or "apricot." The alternatives sketched do not begin to exhaust the possibilities, of course, but for our purposes it is enough that the compatibility of structural descriptions with a variety of computational procedures be appreciated.

The final point that should be made on this aspect of the analysis of sentence production is that, even were we to have good evidence about the vocabulary of the computational system that mediates the translation from messages into their realization as instructions to the articulatory system, we would still be unsatisfied. For one would want to be able to characterize the information flow in the system in terms of interactions between the various structural types represented in the computational vocabulary. It would, for example, be important to know whether there were "stages" or levels in the processing which correspond to the distinct linguistic types characteristic of semantic, syntactic, and phonetic descriptions of sentences. It is entirely consonant with our acceptance of structural descriptions as constraints on translation models that there should be *no* stage in the processing at which the "decisions" are primarily syntactic or semantic. That is an empirical question about information flow in the system.

How does one go about assessing the behavior of speakers in order

to provide answers to the sorts of questions raised above? How do we discover what sorts of structure are computed on-line by the speaker, and in what sequence? Such questions are not easily amenable to experimental attack (although there have been a few useful efforts, some of which I will take up in the discussion section). On the one hand, we are handicapped by our inability to control or manipulate the input to the sentence production system (messages) and, on the other, by the arduousness of analyzing the experimental results (large amounts of "spontaneous" speech). The recourse for people interested in language production processes has, largely, been to "observational" techniques, and, in particular, to the study of various sorts of departures from ideal speech (e.g., nonfluencies and speech errors of a variety of types); and that is the approach adopted for the work described in this paper. This is not because I doubt the possibility or need for specifically experimental enquiry into production processes. It is, rather, because I feel both that experimental enquiry can be better undertaken against a background of empirically supported working hypotheses and that the study of speech errors is a good way to generate and support such hypotheses. For, as has often been observed, speech "errors" have a powerful claim to face validity as indicants of the on-line processing that underlies speech. Beyond this, the study of speech errors is a larger enterprise than might be imagined on initial consideration. Thus, despite the interest of several investigators past and present, much remains to be determined about the nature and explanation of the several ways in which "natural speech" departs from the idealization of prose or the precision of formal address.

II. Speech Errors: The Corpus

There are a variety of departures from normally fluent speech which could count as "errors"; for example, hesitations, changes of mind, repetition of sounds or words, and so forth. The data I will be discussing, however, concerns less common, but by no means rare, error types. Consider the entries in Table I. Each of the varieties of error listed has a single example given, and that example is, perforce, one which involves only one of the several types of linguistic elements that appear in speech errors. But each of these error patterns (e.g. addition, exchange, etc.) does have exemplars for nearly every linguistic type (e.g., sounds, morphemes, words, etc.). It is evident that the sorts of errors represented in Table I are *not* part of the

TABLE I

SOME PATTERNS OF SPEECH ERRORS

a. Addition:
"I don't see **any many** paddocks around here."
(intended either *any* or *many* but not both)

b. Deletion:
"I'll just get up and mutter _intelligibly."
(intended *unintelligibly*)

c. Substitution:
"At low speeds it's too **light**."
(intended *heavy*)

d. Complex addition:
"The one **exPosner** experiment that. . . ."
(intended *Posner*)

e. Complex deletion:
"That would be _having like Harry."
(intended *behaving*)

f. Shift:
"That's so she'll be ready in case she decide_ to hits it."
(intended *decides to hit it*)

g. Exchange:
"Fancy getting your **model renosed**."
(intended *nose remodeled*)

h. Fusion:
"At the end of todays **lection**. . . ."
(intended *lecture* or *lesson*)

i. Double whammy:
"He's a **laving runiac**."
(intended *raving lunatic* or *maniac*)

same class of events as hesitations, changes of mind, or "sloppy articulation" (as that characteristic of inebriated, hurried, or very casual speech). These sorts of errors occur (although not exclusively) in fluent speech, and although they may well be affected by changes of communicative intention on the part of speakers, they are not readily interpretable as the simple consequence of having abandoned one form of expression in mid-utterance in order to shape another nearer to intent's desire. These errors represent cases in which either all and only the intended elements of the speaker's utterance appear, but in the wrong order, or some intended element is missing, or some element not intended intrudes in one way or another.

These error types are illustrative of those in an error corpus of some 3400 errors I gathered, together with my colleague S. R.

Shattuck, principally over the past 3½ years. The errors are with minor exceptions, all from spontaneous speech, and all are (a) those observed by myself or S. R. S., or (b) those reported by our friends, colleagues, and students.[4] For most of the errors, as much was recorded (written down) of the utterance surrounding the error locus as was consonant with the preservation of friendships or the exigencies of the recording situation. In the sections that follow I will report some aspects of the analysis of that corpus (hereafter called "MIT corpus"), and an interpretation of its apparent regularities. Relatively little discussion is offered of errors of sound structure (see however Fromkin, 1971; Shattuck, 1974); the primary focus is on syntactic processes and their relation to semantic and phonological variables.

There are a number of methodological caveats to be entered before discussing the structure of the error types. First of all, there will rarely be any mention in what follows of the statistical significance of such differences as I may call attention to. There are a number of good reasons for this. For the most part, the behavior of speech elements that I have tried to interpret has virtually binary conditions—either a certain class of speech errors is conditioned by a given structural variable, or it is not sensitive to that variable at all. This is not to say that one cannot find "statistical error patterns," nor that such may not be of importance. It is only to say that I have avoided their interpretation for the most part (only occasionally succumbing to the temptation of the implications of "trends"). This fastidiousness is prompted by an appreciation of the hazards of "naturalistic" data collection and the paucity of reliable information on the frequency of occurrence of elements of the language at levels higher than sound elements or "word forms" (and even there the information is primarily orthographically based). Even if one had standards against which to assess error frequencies, one could not be assured that the corpus one has amassed provides a reasonable basis for inferring the incidence of different error types. The "sampling" must be decidedly nonrandom given the reasonable assumption that certain sorts of errors are perceptually more salient than others.[5]

[4] Errors were accepted from contributors other than myself or S.R.S. but the "source" of all errors was recorded. Subsequent analysis shows no apparent basis for distinguishing among the errors contributed by others and those observed by myself or S.R.S. so far as the generalizations discussed in this paper are concerned.

[5] For example, there is a clear difference in the sensitivity of myself and S.R.S. to vowel errors. I rarely hear them unless they are metathesized. In general, it seems likely that vowel changes will be less readily noted than consonantal changes for most listeners.

Similarly there are very likely contributions of situational and individual variability in speakers. Since a large proportion of the errors are those committed by myself and my most frequent colleagues, considerable caution is indicated in interpreting differences in the incidence of different error types. I believe that one is on somewhat firmer ground, however, in discussing the apparent interactions between structural features of sentences and a particular error type, given a fairly large number of errors and very pronounced differences within the class in its sensitivity to given structural constraints.

III. Speech Errors: The Analysis

As the preceding remarks may suggest, my approach to the analysis of speech errors departs in some measure from that of most previous investigators. This is true in two primary respects: (1) a focus on syntactic variables rather than sound structure, semantics, or motivational processes, and (2) a focus on constraints on particular error types rather than on the existence of errors involving particular linguistic types. Roughly, in what follows I will be interested in generalizations concerning limitations on the range of movement of various linguistic types, the nature of immediate environmental determinants of errors, and the relevant description of elements which are (apparently) interacting, and I will be exploring the implications of such generalizations for a characterization of sentence production as a succession of quasi-independent "levels" or stages of processing activity. We will begin by loosely characterizing some of the properties of speech errors that emerge from past research and then proceed, through emendations and exceptions based on the current data, to some working hypotheses about sentence production.

One of the most striking regularities encountered on first reading through a set of speech errors, especially those involving sound elements, is the degree to which interacting elements occur in similar environments, both positionally and, to some extent, phonetically. Errors such as the following

(1) *So while you do the cooking, Bill snovels show, does he?* (shovels snow)
(2) *The little burst of beadan is. . . .* (beast of burden)
(3) *You're not a poojin pitter-downer . . . (are you)*? (pigeon putter-downer)

(4) *That's an easer-eagy sentence.* (eager-easy)
(5) *Children interfere with your nife lite. . . .* (night life)
(6) *I think I met someone who had a spet pider.* (pet spider)
(7) *There's a lot of flee floating anxiety. . . .* (free floating)
(8) *The straight lawn drawn through. . . .* (line drawn)
(9) *We will go down to the sound roof proo. . . .* (sound proof room)

illustrate the tendency of word initial segments to exchange with, or intrude into, other word initial positions, and correspondingly for medial and final segments;[6] and they are more likely to do so when the elements preceding or following those positions are phonetically similar (Fromkin, 1971; Mckay, 1970). These examples also illustrate another powerful condition on elements that interact: namely, that they be themselves similar in certain aspects. In particular, for sound errors, identity as consonant or vowel seems crucial; consonants exchange with other consonants but not with vowels, and conversely. There are virtually no plausible exceptions to this generalization in the MIT corpus and none that I am aware of in published reports of other error corpora. So far as these varieties of sound errors are concerned, these two generalizations seem secure: interacting elements are similar to each other, and their environments are also similar. Their application to other types of errors involving other linguistic elements is, as we shall see later, sometimes straightforward, sometimes obscure.

A third general aspect of these sorts of errors is what might be termed the preservation of phonological well-formedness. Nearly every investigation of speech errors has remarked upon the rarity of error outputs which violate the constraints on sequencing of sounds in whatever language is being spoken. Thus, in English, one simply does not find movement errors which yield, for example, illegal initial clusters like /sd/ or /sg/;[7] this in spite of the fact that such clusters are perfectly pronounceable and, indeed, regularly occur in casual speech (e.g.,/sdən/for *it's done* or /sgʌnə/ for *it's going to*,

[6] This might be couched (and has been) as a syllable-position constraint. The data, however, do not really seem to distinguish between a syllable structure constraint, on the one hand, and the joint effects of constraints on word (or morpheme) position and the vowel/consonant identity of exchanged elements, on the other (see later in text). See Shattuck (1974) for some discussion of this point.

[7] Though no such errors occur in the MIT corpus, this is apparently because they are rare, not that they are "impossible"; for example Kermit Shaefer's recorded collection of TV and radio errors contains the following: . . . *forks and spoons* . . . *sforks and sfoons* . . .

etc.). There seems to be either an aspect of the articulatory program which prevents such errors from occurring or an editing function which selectively picks up errors that violate sequencing constraints before they are emitted, thus barring them from the error corpus. On the current evidence, there is not any very satisfactory way to decide which of these is in fact the correct account (although I will argue below that there are some grounds for adopting a modified editing view).

The fourth, and final, general remark I wish to make in this preliminary characterization of speech errors concerns the role of prosodic features of sentences. There is a clear relation between the involvement of a speech segment in an error and both word and phrasal stress. Boomer and Laver (1968) reported that the majority of the sound errors they analyzed[8] involved an intrusion from the tonic word of a major phrase group ("phonemic clause"). And further, they observed that the two syllables involved in an error interaction were metrically similar for at least two degrees of stress; for example, the two syllables were either both weak or both salient, usually the latter, but rarely was one weak and the other salient. McKay (1970) has observed similar sorts of effects in his analysis of the corpus of German speech errors collected by Merringer (1908). Fromkin's (1971) report of her own corpus of errors and my analysis of the MIT corpus are also consonant with Boomer and Laver's generalizations. One of the things we will explore here is the degree to which these relations between stress features and errors may be accountable in terms of planning systems at the syntactic and morphological levels.

In short, where there is an error interaction involving two elements of the intended utterance, as those in examples (1)–(9), such elements

(10) a. occur in similar environments, both with respect to word (or syllable) positions and preceding or following phonetic elements;
b. are similar to each other both phonetically and prosodically;

[8] Boomer and Laver's corpus consisted of 200 errors; 100 were tape-recorded and 100 from written records. Their errors, judging from the examples they provided, were not just exchanges, but included what I have called shifts and complex additions (e.g., their *frunds have been frozen,* would be a shift in my terminology if the second underlined element had been omitted; as it stands, it is a complex addition).

c. will very likely involve the tonic word of a major phrase group;
d. will yield from their interaction a phonologically permissable sequence.

It will be clear from a comparison of the errors in (1)–(9) with the categories given in Table I that these generalizations do not cover the full range of error phenomena, nor, it should be pointed out, do they exhaust the claims that can be made of such "interactive errors" themselves. They are, however, well-supported generalizations and they provide an initial illustration of the sorts of descriptive and environmental constraints on error interactions that we may expect to find at levels other than that of sound structure.

IV. Sound Exchange Errors

The first errors from the MIT corpus that we will examine in some detail are those like examples (1)–(5). These are *full exchanges* (i.e., enough of the utterance was completed by the speaker to allow unambiguous determination of the complementary elements and their positions) of separate segments of the intended utterance. Exchange errors of every sort (i.e., those involving morphemes, words, or phrases as well as those involving sounds) are of paramount importance in our analysis for a number of reasons. They first of all provide us with an unambiguous instance of the simultaneous existence of temporally discrete elements of the intended utterance; and second, to the extent that the error interacts with the intervening structures and elements, we may also argue for their simultaneous existence. Thus, such errors enable us to make inferences both about the size of the units over which production processes are normally integrated, and about the structural properties of those units. It is, therefore, of considerable importance to establish the character of such errors.

We remarked earlier that our results were generally compatible with those of previous analyses both with respect to the stress of interacting elements and the prominent role of the tonic word of major phrase groups; this is very strikingly the case for the pure sound exchange errors. Of the total of 137 such errors in the MIT corpus, almost all (92%) were interactions between two salient sylla-

TABLE II

SOUND EXCHANGE ERRORS

A. Stress Relations

	Exchanges within words	Exchanges between words	Total
Word stress			
Salient/salient	8	118	126
Weak/weak	0	1	1
Weak/strong	7	0	7
Indeterminate	3	0	3
Phrase stress			
Tonic word	12	94	106
Other	4	15	19
Indeterminate	2	10	12

B. Syntactic Relations

	Within clause	Between surface clauses
Form class preserved	21	2
Form class changed	89	7
Totals:	110	9

bles, and the large majority involved the tonic word (80%) of a major phrase (see Table II).[9]

At this level of description our results reinforce those of Boomer and Laver and others. There is, however, another powerful constraint on sound exchanges which may be related to the results for stress relations, and which may lead us to a reinterpretation of their significance. That constraint, as it is reported in Table II, is a

[9] The within-word exchanges are not included in the analysis of the syntactic relations. Note that the exceptions to the word stress regularity are all within-word exchanges. This may indicate that such errors are the consequence of different processing mechanisms than are other exchanges. Note further that the exceptions to the tonic word involvement are usually interactions between two modifiers of the tonic word.

syntactic one: the interacting elements of an exchange, with very rare exception,[10] are both members of the same surface clause.

This fact relates most obviously to another conclusion reached by Boomer and Laver. They analyzed their error corpus in terms of tone groups (or "phonemic clauses") which are units defined by a single tonic center and certain junctural phenomena characteristic of the boundaries of major phrase groups. Boomer and Laver found not only that the tonic word was usually involved in the errors they analyzed, but that it usually interacted with a word from its tone group, and hence, the results in Table II would be seen in their terms as an effect of tone groups. Thus, the findings of stress involvement at word and phrase levels coupled with the limiting effects of tone group boundaries conspire to suggest a prosodically defined encoding unit, and at the same time, an account of these sound errors in terms of neural correlates of the physical differences representing stress variations. Boomer and Laver's remarks are certainly in this spirit, [11] "but McKay (1969, 1970) has been most explicit on this point. He attributes the intrusion of error elements to the level of activation of speech motor units, with " . . . stressed elements taking a higher level of subthreshold activation than unstressed ones [McKay, 1970, p. 40]." If this sort of account is correct, it is important, for it suggests both a hypothesis about the planning in speech and it provides a mechanism which accounts for a significant error type. There is, however, an alternative account of these same facts, as the classification in Table II suggests; namely, that they are a consequence of the syntactic and morphological structure which underlies prosodic features. What can be done by way of discovering which of these levels of description is the preferred one for accounts of error interactions, and by hypothesis, for the existence of particular varieties of planning in the sentence production system?

Two preliminary points might be made. First, the account of errors in terms of stress-correlated levels of activation in the motor system would lead one to expect only errors of anticipation to occur.

[10] The sound exchange exceptions to the clausal constraint are usually clause adjuncts (e.g., *Did you get yoursev socks, Clease*?") or idioms; e.g., *With this wing, I thee red.* (Surprisingly, Fromkin reports an error in a variant of the same idiom, *With this wing, I do red.*) In these respects the clause exceptions for sound errors differ from those for word exchanges.

[11] My interpretation of Boomer and Laver's remarks may be too strong. They speak of "neurophysiological prominence" of stressed elements, and of the "strength" of representations. These remarks do not necessarily commit them to a motor level of representation.

Though we have yet to discuss them, there are numerous nonexchange sound errors that appear to be perseveratory, for instance, example (9) and (f) in Table I), and a different account would be necessary for them. Similarly, one would expect that in exchange errors the higher stressed element should follow the lower stressed one in the intended output. Though this tends to be true by the report of most investigators, and it is true of the MIT corpus (62% of the cases where stress of the exchanged elements differs are anticipatory), it is by no means so impressive a regularity as the other constraints we have been discussing.

Second, if physical level of stress is the significant variable in precipitating speech errors, one might expect to find a greater incidence of errors in sentences with emphatic or contrastive stress than in sentences with normal stress, for normal stress variations are much less impressively reflected in actual acoustic energy differences than are emphatic and contrastive stress. It is difficult properly to evaluate this expectation since one has no good idea of the relative incidence of the relevant sentence types in normal conversation. In any event, there is no striking support for this prediction in the MIT corpus.

Though these sorts of observations might give one pause, they are, of course, by no means sufficient to render untenable the interpretation that motor correlates of physical stress differences are a major causal factor in these sorts of speech errors. There is, however, another set of observations which does seem to conclusively rule out that sort of explanation. We need to recall another of the strong generalizations about errors which was noted above; namely, that the result of an error interaction is phonologically well formed. This constraint is, in fact, a good deal more general than the examples used to present it might suggest. For not only are the sequencing constraints honored, but so too are various stress regularities and phonetic accommodations of elements to their error-induced environments.[12] To illustrate briefly:

(11) a. Vowels are restored or reduced when the deletion or addition of an intended element requires; e.g.,

easily	*easy*
/isɬli/ *enough*	→ /izi/ *enoughly*
	easuh
	↛ /izɬ) *enoughly*

[12] Examples of one or another kind of accommodation are reported by most observers. In the MIT corpus there are about 20 cases where an accommodation is clearly demanded by an error and in every case it occurred.

b. The phonetic form of an indefinite article accommodates to its environment; e.g.,

an aunt's money → *a money's aunt*
↛ *an money's aunt*

(see also Fromkin, 1971)

c. The phonetic forms of tense and number morphemes are appropriate to the stems to which errors attach them; e.g.,

. . . add/z/ up to → *add up/s/ to*
↛ *add up/z/ to*

(see also Fromkin, 1971)

d. Word stress is appropriate to the error forms resulting from syllable movements, additions or deletions; e.g.,

treméndously → *trémenly*
specíficity → *specífity*
compúted → *cómputated*
marsúpials → *musárpials*

e. Phrasal stress is preserved; e.g.,

. . . stop beating your heád against a brick wall
→ *. . . bríck against a head wall*
. . . avoid the trée pruning → *trúe preening*

(see also Boomer and Laver, 1968).

These examples and those given earlier all indicate a late condition on output which insures that the actual uttered form will be phonologically acceptable (although it may depart markedly from "sensibleness" or syntactic well-formedness). This conditioning of the output must occur *after* the level at which the errors occur, and must be either prior to or identical with the level at which particular phonetic forms are being translated into motor commands.[13] But that fact presents an insupportable problem for the view that it is interactions among the motor elements underlying utterances which account for errors, and, in particular, for the prominence of stress factors in error regularities.

It is undeniable that there is a level of representation of speech events in the motor system at which there is a reflection of physical differences of output energy in levels of neural activity; subglottal air pressure does rise prior to the emission of a stressed syllable, and thoracic and laryngeal muscle groups will reflect this. But, it is

[13] The suggestion of an ordering of error types by ordered levels of processing can be taken as an "editing" explanation of accommodations, as opposed to a view that they are somehow antecedently prevented.

equally certain to be fatuous to look for such a correspondence at much higher levels; my intention to speak softly surely does not have a notably lesser level of neural excitation than does my intention to speak loudly. One may legitimately wonder at what point the isomorphisism breaks down between these two extremes. One thing we can be confident of, however, is that for speech, that point must fall somewhere before the level at which accommodations like those of (11) (*a*)–(*e*) take place, for all those are cases in which errors have demonstrably occurred prior to the realization of the particular phonetic form of the elements involved in the error.

Put another way, if the neural correlates of physical differences between stressed and unstressed speech elements were the primary causal factor in movement errors, one would expect those differences to appear as features of the emitted error elements. But that is precisely what we do not find. Rather, it appears to be the position which an element occupies within an independently specified structure which endows it with the detail of its physical form.

We may regard the foregoing discussion as the first step in a contrast of the notion of "forcible intrusion" with that of "descriptive error" as ways of accounting for speech errors. The former notion stresses the physical concommitants of structural features and exploits their differences of "strength" in explanations of the etiology of errors. The latter notion relates structural differences to planning differences and the consequent opportunities for interaction among similarly described elements of the ultimate speech event. The evidence that we have so far considered indicates that the regularities of stress involvement in errors should not be accounted for by an appeal to a notion like forcible intrusion, and that we should consider them further aspects of the importance of similarities in the description of interacting elements, that is, as intimately related to the generalizations in (10) (*a*) and (*b*). Two things suggest that we should look to syntactic descriptions for the relevant analyses. One is the fact that prosodic features are determined by surface syntactic descriptions, and the other is the powerful constraint exerted on sound exchange errors by surface clausal structure. What one needs is additional independent evidence both for the operation of the clausal constraint and for the existence of a specifically syntactic processing level which could give rise to it.

V. Word and Morpheme Exchanges

The most obvious place to begin looking for such evidence is with exchanges involving elements that have themselves syntactic features:

TABLE III

WORD AND COMBINED FORM EXCHANGES

	Within clause	Between clause
Form class preserved		
Independent words	67	17
Combined forms	13	3
Form class changed		
Independent words	13	0
Combined forms	29	1
Totals:	122	21

morphemes, words, and phrases. Very little can be made of phrase exchanges, for they are too rare; exchanges of words and morphemes, however, are relatively frequent. In the MIT corpus there are 143 such errors that are unambiguously exchanges between words or parts of words that are morphemes. There are an additional 72 errors in which the words are in incorrect serial order, but because the misordered elements are adjacent, one cannot determine whether an exchange has taken place, or simply a shift in the location of a single word. These three classes of word movement errors (exchanges of independent forms, exchanges of combined forms, and "exchanges" of adjacent forms) turn out to have quite different properties, and these differences provide us with a basis for evaluating the role of syntactic factors in sentence production.

Table III presents the distribution of the first two of these three error types with respect to clausal structure and form class; examples (12)–(19) are typical of these error categories.

(12) *Slips and kids–I've got* **both** *of* **enough**.
(intended: *enough of both*)

(13) *I broke a* **dinghy** *in the* **stay** *yesterday*.
(intended: *stay in the dinghy*)

(14) *Although* **murder** *is a form of* **suicide**, . . .
(intended: *suicide is a form of murder*)

(15) *I've got to go home and give my* **bath** *a hot* **back**.
(intended: *back a hot bath*)

(16) *McGovern favors* **push***ing* **buster***s*.
(intended: *busting pushers*)

(17) *I hate working on two-***word letters***.*
(intended: *two-letter words*)
(18) *It just* **sound***ed to* **start***.*
(intended: *started to sound*)
(19) *Oh, that's just a* **back truck***ing out.*
(intended: *truck backing out*)

If one simply looks at the total frequencies of between- and within-clause errors, it is apparent that the clausal constraint we observed for sound exchanges is also present for word forms. There are, however, differences in the behavior of sound errors and word errors with respect to that constraint.

We note first of all that even though the word exchanges are predominantly between members of the same surface clause, this restriction is not quite so sharply drawn as for the sound errors (7% sound exceptions versus 15% for word exceptions). But what is more interesting is that these exceptions to the clausal constraint appear to be disciplined. In particular, such exceptions are almost invariably interactions between words of the same form class. If one compares Table II with Table III, one finds no apparent form class effect for sound exchanges, but a strong one for word exchanges that span clauses (and perhaps for those within clauses as well). This immediately suggests two things: (a) though both sound and word exchanges show sensitivity to clausal structure, they may do so for somewhat different reasons, and (b) the description which governs interactions between words in different clauses is one that includes at least their form class designation, while that for sound interactions does not. There are a number of aspects of these two possibilities which deserve exploration.

The most obvious first question is whether the form class constraint so evident for the between-clause errors is, in fact, restricted to such errors and, hence, whether we are entitled to infer that form class designations are only relevant to a level of planning at which elements of more than a single clause are being manipulated. A look at Table III suggests that this is very likely not true, for there is indication that form class is preserved both between and within clauses for exchanges between independent words. Of the 80 such within-clause exchanges, 84% preserve form class. This contrasts sharply with the pattern for those exchanges in Table III which involve combined word forms, as well as with the pattern for sound

errors. For the combined form exchanges, within-clause errors show the reverse tendency; 70% of these errors violate form class (this is similar to the pattern for sound exchanges—see Table II).

In a limited way, these results provide what we were looking for, namely, an indication that elements (words) with specifically syntactic properties (e.g., form class) show a clausal constraint, and thereby justify the attribution of both the clausal limitation on the excursion of sound exchanges and their prosodic involvement to a syntactic level of sentence production processes. This resolution of the apparent facts is, however, unsatisfactory in a number of respects. Most glaringly, it does not countenance the existence of a class of word exchanges (the combined forms) which do not observe the form class restriction. To this must be added the difference in the behavior of sound errors with respect to clause boundaries and form class. When sound errors do transcend the clausal limitation, there is no indication of a change in their respect for form class (seven of nine such errors change form class). This distinguishes them from the word exchanges, where the form class restriction on interclause errors is virtually absolute (extending even to the combined forms, although there are really too few cases to make a firm judgment).[14] Thus, simply to attribute limitations on sound exchanges to the manifest existence of a syntactic level of processing would be to ignore an inconsistency in the behavior of the putatively syntactically organized elements with respect to our diagnostic variable, form class.

The inference that one is tempted to make from all this is that the very strong form class constraint observed for between-clause errors is, in fact, not solely the consequence of the distinct clausal membership of the elements involved, but is instead a characteristic of the level of processing at which most word exchanges take place. But this suggests that the combined forms are exchanged at a different level of processing than are the independently occurring word forms, and *that* is surprising, for, as the examples in (12)–(19) indicate, these errors are, barring the differences which define their initial classifica-

[14] It should be obvious that the error classifications that are being explored are classifications in terms of superficial properties (e.g., the presence of a bound morph) that may be reasonably supposed to be *diagnostic* of syntactic processes. The absence of such a diagnostic variable does not preclude the occurrence of a given error at a different level than the typical one. Hence, the frequencies of the error types are not "pure," but reflect some potential overlap in levels.

TABLE IV

FREQUENCY OF EXCHANGE ERRORS BY CHANGE IN FORM CLASS AND DEGREE OF SEPARATION IN WORDS

Error type		Degree of separation				
		0	1	2	3 or more	Σ
Sound exchanges	Form class same	6	15	2	0	23
	Form class diff.	45	41	7	2	96
Combined-form Exchanges	Form class same	9	5	1	1	16
	Form class diff.	20	8	2	0	30
Independent word exchanges	Form class same	–	37	30	17	84
	Form class diff.	–	12	1	0	13

tions, seemingly very similar. Indeed, the combined forms are almost always free forms, that is, the permuted elements are not bound morphemes but forms that can occur grammatically as independent words.

The theoretical seat becomes, at this point, uncomfortably warm. We seem well on the way toward claiming not one, but two syntactically organized levels of sentence production processes. The empirical thread from which these speculations depend is admittedly a slender one, but there is one immediately available property of these errors which suggests that we ought not resist this particular proliferation of theoretical entities.

It appears that, though all are clause limited, sound exchanges, and combined and independent word exchanges nevertheless "span" different intervals. So far, our discussion has been in terms of the interactions between errors and certain structural variables and in terms of the type of interacting elements. We now add to those variables the notion of degree of separation in the intended utterance. This might be expressed temporally (a measure for which we have no data at present), or in terms of the number of intervening elements—phones, syllables, morphemes, or words; since we will be comparing the three error types, discussion here is in terms of word separation.[15] Table IV provides the frequencies of errors for each of

[15] A distance measure in terms of syllables would not change the comparison except to magnify the distance of the word exchanges. This is because the words that intervene between the elements of a combined form or sound exchange are closed class (and almost always single syllables) while those intervening between independent word exchanges are often open class (although not often multisyllable).

the error types at varying degrees of separation. The comparison is vexed by the fact that the number of independent word exchanges is indeterminate for 0 degrees of separation. I will argue below that, in fact, Table IV represents the frequencies of these types fairly well as it stands (i.e., that there are very few 0-degree exchanges of independent words). But for the moment, we may simply confine our attention to those errors of 1 degree or more. It is very clear that the likelihood of an error spanning two or three elements is greater for the word errors than for the sound or combined form exchanges ($p < .05$, χ^2 for both the word versus sound and the word versus combined forms comparisons). What seems equally clear is that these longer error spans are confined to elements of a common form class for word exchanges.[16]

I have ventured onto dangerous ground in this comparison of the spans of different error types—and been properly punished by the necessity of resorting to a statistical defense of the distinction. Nowhere is one more at the mercy of the undoubted vegaries of sampling in this research than in comparisons of the incidence of different error types.[17] Nonetheless, in this case, the risk may prove justified by the conclusions I will argue for subsequently. I believe the clear implication of the differences among the error types we have been discussing, with respect to form class and error span, is the existence of two processing levels for word forms, one under "real

[16] The effect of distance on form class might be taken to explain the failure of combined form and sound exchanges to honor form class. That would, I think, be mistaking a symptom for the disease. Consider: (a) even at 1 degree of separation the word exchanges are predominantly form class preserving, and (b) clause-spanning errors of 0 and 1 degree are form class preserving. What appears likely is that the form class constraint and the clausal constraint are diagnostic of processing levels, and so too are the types of error elements involved (sounds, combined forms, and words); but none of these are definitionally related to a processing level. Thus, for example, we may reasonably expect some errors which involve combined forms (especially those which cross clause boundaries) to occur at the level characteristic of word exchanges and vice versa.

[17] This is particularly true for the present argument since I am using differences in error spans as an indication of differences in processing. For example, one might reasonably expect an "editing" function to catch long span errors more often than short span errors, thus excluding most of the latter from our analysis (which is based on completed errors). It is certain that there is such an editor, for incomplete exchanges/anticipations (one cannot tell which it might have been) are much more frequent than are complete ones. But though one might readily grant that an editor would be "length sensitive," it would still be left open why such an editor would more often pass long word exchanges than long combined-form exchanges. Similarly, why should both the long and the short-word exchanges show the same properties? Most important, however, is the fact that an analysis of the *in*complete exchange/anticipations shows the same patterns as the analysis of the complete ones (making the best guess one can about the likely nature of the completed error).

time" constraints and, hence, affected by adjacency of elements in the intended output, and one under "functional" constraints, and, hence, primarily sensitive to the structural relations upon which form class distinctions among the words of the intended output are attendant. These points may be more elaborately stated as follows:

(20) a. Exchanged words that are (relatively) widely separated in the intended output or that are members of distinct surface clauses will serve similar roles in the sentence structures underlying the intended utterance and, in particular, will be of the same form class. These exchange errors represent interactions of elements at a level of processing for which functional relations are the determinant of "computational simultaneity"; similarity of the descriptions that govern the selection among elements at this level is assumed to determine error interactions.

b. Exchanged elements that are (relatively) near to each other and which violate form class represent interactions at a level of processing for which the serial order of the elements of an intended utterance is the determinant of computational simultaneity. Similarity of left and right adjacent elements both phonetically and syntactically, as well as similarity of the elements themselves, is assumed to determine the likelihood of error interactions.

The facts about production errors which we have discussed to this point are not by themselves sufficient to sustain the claims of (20) (*a*) and (*b*). There are, however, a variety of other regularities of production errors which indicate the truth of something like these generalizations. We turn now to a systematic discussion of such additional properties of errors as bear on (20) (a) and (b) and on related claims.

VI. Stranded Morphemes, Shifts, and Exchanges

A somewhat unexpected consequence of the preceding analysis has been the postulation of two levels of nonphonological structural processing. That postulation rests primarily on the failure of words that are combined with bound morphs to show the same error behavior as independently occurring words, both with respect to form class and span of error movement. In (20) (a) and (b), these facts have been interpreted as the reflections of a planning level in which structural relations among words are being manipulated, as

opposed to one in which the serial deployment of lexical and grammatical formatives is being worked out. (We leave open for the moment the question of how sound errors fit into this system.) The data we wish to consider now strengthen the basis for claiming the existence of these two processing levels and provide some further indication of their character.

We will begin by a closer examination of the structures in which the various error types occur. We note first of all that a striking regularity of the sound errors converges with a "definitional" property of the combined forms: they are both restricted to open-class elements (primarily to nouns, verbs, and adjectives). Since, barring some pronouns and elements of the auxiliary expansion, closed-class words are not inflected or combined, the combined form errors will necessarily involve only open-class words. It is significant that sound exchanges are similarly restricted, but in one particular respect, word exchanges are not. Only two of the 137 sound exchanges in the MIT corpus involve closed-class items (a qualifier, "few," and a subordinate conjunction, "until"); twenty of the 97 word exchanges involve closed classes. The most interesting for present purposes are the ten that exchange prepositions (the remaining ten such exchanges are distributed: six between pronouns, two between determiners, one between the elements of a complementizer, and one between a negative and a temporal qualifier). Their interest lies not simply in the closed versus open contrast, although that has its significance, but in the fact that these closed-class elements of word exchanges, like the open-class ones, come from corresponding positions within their respective structures. But the open-class items of sound and combined-form exchanges do *not* show any such parallelism of structure; they are typically interactions between the head of a construction and one of its modifiers. (For this contrast, see the earlier examples (1)–(9), (12)–(19), and (21)–(28), following; the elements that have been permuted are boldfaced.

(21) *I have to fill up the* **gas** *with* **car**.
(22) *Prior to the operation they had to shave all the* **head** *off my* **hair**.
(23) *She donated a* **library** *to the* **book**.
(24) *Older men* **choose** *to* **tend** *younger wives*.
(25) *. . . which was parallel* **to** *a certain sense,* **in** *an experience. . . .*
(26) *Everytime I put one of these buttons* **off**, *another one comes* **on**.
(27) *she* **sings** *everything she* **writes**.
(28) *. . . read the newspapers,* **watch** *the radio, and* **listen to** *T.V.*

The parallelism of structure is most strikingly evident for the word exchanges that cross clause boundaries, but even the within-clause exchanges show strong correspondence, usually involving two similarly placed words from distinct phrases. These phrases are quite often, for example, the noun phrases (NPs) of direct and indirect objects, or the NPs from a direct object and an adverbial phrase, or from successive adverbial phrases. This contrasts with the dominant pattern for sound or combined-form errors, in which the interacting elements are members of the same phrase. These differences in the structural features of the error types are summarized in Table V.

There are two aspects of this contrast which bear on the characterization given in (20) (a). One, the similarity of structural roles played by exchanged words, speaks for itself. The other turns on the fact that both verbs and prepositions are (relatively) frequently involved in the word exchanges. The prepositions are of particular interest since they do not enter into sound exchanges at all (nor, obviously into combined form exchanges). Both prepositions and verbs are important determinants of the relations between phrase types. It seems fairly clear that the sorts of structures typically involved in a sound or combined-form exchange are different from those of word exchanges, and that the nature of this difference is consonant with a characterization of the processing level at which word exchanges take place as one in which the functional relations between the words within constructions, and of the relations between the constructions themselves, are paramount.

It should be recognized that the facts about the error types we have just been discussing are not independent of the earlier observations about form class and error span. Though it is perfectly possible for adjacent element exchanges, or exchanges of one degree separation, to involve different phrases, it is clear that an increase in the separation of error elements will increase the likelihood of distinct phrases being involved. And, similarly, the likelihood that an error will involve elements of the same form class is decreased if both are members of the same phrase. Thus, one should see the error span and form class properties of exchanges on the one hand, and the structural properties in Table V on the other, as different, but closely related reflections of the same causes.

In the discussion thus far, we have focussed most attention on the level of processing described in (20) (a). There remain two principal issues to be dealt with before attempting to relate the predominantly syntactic processes now under examination to the more general framework of sentence production. These are (a) the character of the

TABLE V

STRUCTURAL SUMMARY FOR EXCHANGES[a]

Types of structures in which exchanges occur	Error class (n=119) Sound	(n=46) Comb. form	(n=97) Word
Within NPs (or Pred. Phrase)	85	19	19
Names (e.g., *Sen Diago, Jahn Honcock,* Treato Seaty)	13	4	–
N and N (e.g., *cheeps and twirts*)[b]	9	2	4
Nominal Compounds (e.g., *skay pale*; *pre-truning*)	25	6	1
Adj (Adj) N (e.g., *stilthy finking drunk*; *sollow hound*)	25	5	–
N of *N* (e.g., *bate of dirth*)[b]	10	2	15
Pred. Phrase: (Adv Adj)	3	–	–
Between NPs	6	7	45
NP V NP	2	4	8
V NP (prep) NP	4	3	37
Between V and Pred. (or Subj. Phrases)	19	16	4
V NP, or V Adj Phrase or Adv Phrase (e.g., *he was slowing shides; that would pick in steoples mind*)	14	9	3
NP V (e.g., *you should have your brekes chācked*)	5	7	1
Between closed classes *not* in NPs	–	–	12
V *Prep* NP *Prep* NP	–	–	10
V (VP) *Adv Adv*, or V *comp.* NP*comp.* VP	–	–	2
Between clauses	9	4	17
Relatives	2	1	2
Complements	3	3	4
Conjunctions	–	–	11
Clause adjuncts (e.g. *Helf, Helf, the wolp is after me*)	4	–	–

[a]The errors used as examples consist mostly of sound errors simply because the other error types have ample numbers of illustrations in the text.

[b]May be better analyzed as *NP* and *NP* or *NP* of *NP* in some cases.

level of processing outlined in (20) (b) and (b) the relation of the levels in (20) (a) and (b) to sound exchanges. We first take up the evidence relevant to (20) (b).

The errors we have been referring to as "combined form" exchanges are errors of a rather remarkable sort. They might, as a matter of fact, have been more aptly designated as "morpheme

stranding" errors, for not only are the permuted elements nearly always free forms, but the elements that are left behind are as often bound morphemes, as examples: (16)–(19) and (29)–(32) show (permuted elements boldfaced).[18]

(29) . . . *but the* **clean***'s* **two***er.*
(30) . . . *I'm not in the* **read** *for* **mood***ing.*
(31) . . . *he made a lot of money in* **telephon***ing* **stall***s.*
(32) *She's already* **trunk***ed two* **pack***s.*

Moreover, as the examples also attest, not just any bound morph gets stranded; it is, rather, those we might term "syntactically active" affixes; for example, tense and number morphemes, possessive morpheme, comparative morphemes, the *-er* of noun formation, and so forth. There are also a very few nonderivational morphemes and a nonmorphemic maverick or two which are intermixed in a fashion discussed below. Table VI provides a summary of these errors in terms of the sort of elements stranded by the exchange. Of the 46 errors classified as combined form exchanges, 33 involve only the bound morphs I have called "syntactically active," that is, the morphemes that are directly involved in syntactic rules (as, auxiliary elements, or possessives, or comparatives), or that affect the form class of the stem to which they are attached (as the *-er* of noun formation). Of the remaining thirteen errors, a further six also involve syntactically active bound morphs, but include as well a nonmorphemic segment (e.g., the *er* in *shoulder*), or what might be called "moribund" affixes, that is, those of dubious productivity and very likely not semantically analyzed (as, the prefixes in *along, install,* and *intend*).

[18] It will be apparent that the basis of classification of errors as "combined form errors" is crucial to any evaluation of the nature of stranded elements. If only errors which result in the movement of a morpheme are included, then, of course, only morphemes can be stranded. Such a classification does not require, however, that the moved elements be potentially free forms, nor that the stranded elements be bound morphs of a particular subvariety. In fact, the classification used was more conservative: an error was counted as a combined-form error just in case the permuted elements had the *form* of morphemes (i.e., could have been morphemes in a different environment), and the shorter of the two forms created by the error was the one which maintained its serial position. Thus the actual description of the elements involved in these errors is not dictated by the basis of the classification. Errors like, *errples of examors* (examples of errors), or *chainse playges* (place changes) *would* have been included had they been in the corpus. It simply turns out that no such errors were observed.

TABLE VI

SUMMARY OF STRANDED ELEMENTS IN COMBINED FORM ERRORS

No. of such errors	Type of stranded elements	Examples
9	Number only	*Make it so the tree has less apples* → . . . *apple has less tree*s; also (17) above
8	Tense only	*It just started to sound* → . . . *sound*ed *to start*; also (18) and (19) above
2	Tense and number	. . . *Windows rolled up* → *roll*s *window*ed *up*; also (32) above
6	Tense and/or number, and a derivational suffix	*All the starters scored in double figures* → . . . *score*rs *started*. . . .
4	Gerundive	*O.J. is thirst quenching* → . . . *quench thirst*ing. . . .
3	Comparative and/or possessive	*the Cognitive Center's study of* . . . → . . . *Cognitive study's Center* . . . ; also (29) above
1	Tense and a free form	. . . *the flashlight he smashed* → . . . *smash* light *he flash*ed
	A syntactically active bound morph and	
4	(a) a "moribund" morph	*I had intended staying* → . . . in*stay*ed *tend*ing; also, (g) in Table I and (31) above
2	(b) a nonmorph	*My shoulders are frozen* → . . . *froz*ers *are should*en
2	Two free forms	*Paperback Booksmith* → *Paperbook backsmith*
1	A nonmorph and a free form	*get ready for bedtime* → . . . *bed*y *for red* time
3	Nonmorphs only	*Cambridge Fenway* → *Fen*widge *Cāmway*, *Seato Treaty* → *Treato Seaty*, *Lackner and Goldstein* → *Gold*ner *and Lack*stein
1	Moribund morph only	*He didn't get along so well* → . . . *a*well *so long*

It is a striking fact that involvement of a moribund morph or a nonmorph in these errors is usually accompanied by a syntactically introduced morpheme. A possibly related fact is that even among the affixes I have dubbed syntactically active, the derivational affixes also do not appear alone in stranding errors, but nearly always in conjunction with a morpheme introduced by a syntactic process; the syntactically introduced morphs, on the other hand, often appear singly in errors. It almost appears that the bound morphs in the domain of syntactic rules "catalyze" the involvement of other affixal elements or of elements that have the phonetic shape of affixes (e.g., the *er* in *shoulder*, or the *y* in *epitome*). At any event, it is true that 85% of the stranding errors involve syntactically introduced bound morphs (and the exceptions are of limited sort: three could be sound errors and four of them are proper names).

It would be unwise to conclude from the preceding that strictly derivational affixes *cannot* appear alone in stranding errors. The sample of stranding errors that we have is, after all, rather small. None the less, it is surprising that when morphemic decomposition of a word occurs in an exchange, it should be so nearly restricted to cases in which that decomposition implicates syntactic processes. This suggests two things. First, the level of representation at which stranding errors take place—by hypothesis, the level described in (20)(b)—is one for which the computational vocabulary is of morphologically complete types. Thus, at this level words like *compassion, inept, unwieldy, preamble,* and so forth, that are undoubtedly represented in the lexicon as sequences of morphemes, are single vocabulary units, coming apart at their morphemic seams only when an error in the integration of such an element with its syntactic frame occurs. Second, as the just preceding remark in fact assumes, the nature of the stranded elements in the combined-form errors indicates that we are, in fact, dealing with a processing level for which the syntactic organization of the sentence is at issue. This is important, for without this evidence the basis for imputing specifically syntactic significance to level (20)(b) is weak. We have only the fact that *word* forms are involved in the errors to go on, coupled with the clausal restriction on the error span. On the other hand, there is a clear failure of these errors to honor the sort of structural features we have taken as diagnostic of the syntactic processes for level (20)(a).

Why should the presence of a syntactically active bound morpheme be associated with an error at the level described by (20)(b)? Precisely because the attachment of a syntactic morpheme to a particu-

lar lexical item reflects a mapping from the "functional" level to the "positional" level of sentence planning. Why should stranding errors fail to honor form class? Because that is exactly the nature of the error being made; a given pair of free forms is assigned to the wrong position within the syntactic "frame" which determines the order of their surface appearance and their form class.

Finally, why should the elements we have called syntactically active bound morphemes be stranded? Not simply because their morphemic analysis is represented at (20)(b), for after all, so too is some sound structure, and the structure of some other morphemes. A stronger claim seems required, and it is suggested by the earlier observation that the stranding errors are restricted to open class items. That might be taken not as a definitional consequence of the error classification, but as a substantive claim about processing at this level; namely, that the open class elements are being "inserted" into a grammatical framework defined by closed-class elements, including syntactically active bound morphs. Such an assumption makes a good deal of sense in light of the sort of observations we made in discussing the phenomena of accommodation, particularly the preservation of phrasal stress. For as Boomer and Laver pointed out (1968, p. 12), the appearance of appropriate phrasal stress on misplaced elements requires that the sentence processing system provide for an independent (of lexical items) specification of that stress. A syntactic frame which specifies the serial order of content words would provide a vehicle for such an independent specification. A "list" of such frames might be thought of as a part of a heuristic system for mapping from an underlying functional representation of sentences onto a representation constrained by the real time occurrence of the words.

This separation of "form" and "content" items into distinct aspects of the processing system is attractive, for it provides not only for the facts discussed above, but also accounts in a natural way for the very strong restriction on *all* exchanges that has not yet been mentioned. That restriction precludes the interchange of open- and closed-class items (even when form class is violated, this restriction is not). Further, if we assume that the syntactic morphs are parts of such structural frames, it accounts for another feature of their behavior—they do not themselves exchange. It would, of course, be perfectly possible for stranded morphs to have the characteristics we have so far described and still undergo exchange; for example, it is logically possible to have an error like *the boys shouting disturbed us* → *the boying shouts disturbed us,* but no such errors appear in the

MIT corpus. The rarity of exchanges between the final portions of words makes the firm evaluation of this "error lacuna" difficult, but, the frequency with which these elements occur as the terminal portions of words, coupled with their behavior in stranding errors and their involvement in "shift" errors (mentioned later), makes their complete absence from the corpus of such final position exchanges noteworthy. Rather than prepare a table, I have simply listed all the cases of final position exchanges in the MIT corpus (permuted sequences boldfaced).[19]

(33) a. *Jill and Mike* → *J***ike** *and M***ill**
b. *Howard and Claire* → *H***aire** *and Cl***oward**
c. *Structure and function* → *stru***nction** *and fu***cture**
d. *expect and persuade* → *exsp***ade** *and pers***wect**

(34) a. *I'm about to spill beer* → . . . *sp***eer** *b***ill**
b. *I won't hit the ball hard* → . . . *b***ard** *ha***ll**
c. *you should have your sholders forward* → . . . *shol***wards** *for***ders**
d. *in the next ten minutes* → . . . *ne***n** *te***xt**
e. *listen to me give* → . . . *li***ve** *me gi***ssen**
f. *night life* → . . . *ni***fe** *li***ght**

(35) a. *the girl who called* → . . . *g***all** *who* **curl***ed*
b. *a monkey's uncle* → . . . *monk***le's** *unk***ey**

(36) a. *the single biggest problem* → . . . *sing***est** *bigg***le**
b. *Singer Sewing Machine* → *Sing***ing** *Sew***er** *Machine*
c. *passive usage* → *pass***age** *us***ive**

Note first of all that most of these segments do not have a morphemic analysis at all, and of the cases, (36), where a morpheme is involved, it exchanges with a nonmorph, suggesting that the morphemic status of the element is irrelevant and that these are in fact sound errors. The errors in (35) (a) and (b) are especially instructive, for these are cases where the final portion of two words *does* permute, but one of them is inflected; the inflection stays behind.

[19] The four errors in (33) are suspect cases since either output order of the nouns is grammatically acceptable, and there is therefore no basis for classifying these as word final exchanges, rather than word initial, other than the speaker's report of his intention.

Note further that (36) (*c*) *might* have been classed as a morpheme-stranding error since both *-age* and *-ive* are morphemes (although it seems unlikely that *passive* should be so analyzed—i.e., it is a moribund morph in this case). If (36) (*c*) were so classified, it would then constitute the single case of a morpheme-stranding error which moved the final rather than the initial or medial portions of a word, and which moved bound rather than free forms.

This suggests not only that syntactically active bound morphs do not permute even when a sound exchange involving their word position occurs, but also that perhaps sound-exchange errors may be conditioned by the syntactic frames we have been discussing. (I will return to this point momentarily).

The final observation about syntactically active bound morphs concerns their involvement in what I have called "shifts"; for example, Table I, entry (f) and examples (6) and (9). Shifts in the location of a sound seem to fall into roughly two classes: those that involve nonfinal sounds and usually result in the formation or destruction of a cluster, and those that involve final sounds and are almost exclusively confined to syntactically active bound morphs. That is, one does *not* find errors like: *final sound* → *fina soundl,* or *tax restriction* → *tak restrictions,* or *end run* → *en rund*. One *does* find errors like (37)–(40), however.

(37) *they get wierder every day* → . . . *wierd everier* . . .
(38) *he gets it done* → . . . *get its done*
(39) *he goes back to* → *go backs to*
(40) *pull its genes down* → . . . *gene downs*

This difference could be a "sampling error," and claims about the nonoccurrence of a given error type have a dismaying way of being disconfirmed by the next sleepy speaker one encounters. At any event, of the 25 cases of a word-final sound shift, 25 are syntactically active bound morphs (this includes both derivational and syntactic morphs, but principally the latter). It is clear that one cannot explain this by an appeal to phonologic constraints or to a prohibition against producing nonwords. There *are* final clusters in English (if shifts were restricted to cluster formation), and sound errors yield nonwords as often as they yield word forms. There are also numerous end-ryme errors in the MIT corpus (e.g., *Wenatchie is the appital capital of the world*; . . . *and sol did Tolman*; *half a cuff of coffee*; etc.), so it cannot be a "constraint" against distortions of the ends of words that restricts such shifts to bound morphs. The obvious inference is that these are not sound errors at all—their status as bound morphs is related to their appearance in this error pattern.

If this is the case, it would make sense in light of the notion of a syntactic frame, of which these morphs are features. One would not expect exchanges of such morphs at the same level as exchanges of the elements (words) being fitted into the structural framework of which the bound morphs are a part. Hence, the stranding errors. But, one might very well expect to get errors of placement of these

syntactic features when they are phonetically realized and attached to particular lexical items. Further, these morpheme shifts, unlike the stranding exchanges, frequently involve closed-class words—e.g., (37)–(40); 16 of the 25 shifts are between an open-class and a closed-class word, or between two closed-class words. This provides a convincing independent argument against considering these shifts as exchanges between a "zero" morph (phonetically unrealized) and a phone; for, of course, the words to which the shifts attach the bound morphs are often not capable of inflection. This involvement of closed class words in the bound-morpheme shifts is also typical of word shifts. I will presently argue (in discussing word shifts) that the shifts of bound morphemes and of free forms arise from similar processes, and that both are distinct from exchanges.

What we have discussed of the behavior of stranding exchanges and of morpheme shifts to this point seems to support the characterization offered in (20) (b) of a processing "level" constrained by the serial deployment of the lexical items in a sentence, and indicates that this is accomplished through the integration of two computationally distinct types of information—that connected with the open-class 'content" items on the one hand, and that connected with the closed-class structural elements which "define" the surface form of sentences on the other.

In the preceding discussion, I have used the behavior of sound exchanges as a touchstone of contrast with word exchanges, but have not explicitly addressed the question of how sound planning in general, and sound exchanges in particular, relate to the processing levels of (20)(a) and (b). Such comment as can be made is limited, but I will take up that issue now and at the same time summarize some of the contrasts discussed so far.

It will have been obvious that, by the diagnostic variables we have been using, sound exchanges are more akin to the combined-form exchanges than to the word exchanges. It should be emphasized that this is an empirical consequence of the error data and *not* a necessary condition on sound errors. There is no a priori reason why sound errors should not occur at any level of processing for which there exists some specification of phonetic information about lexical items. On the current evidence, one cannot rule out the possibility of sound errors at the level of word exchanges, as in (20)(a); but the assignment of morpheme-stranding exchanges and some sound errors (exchanges) to a common level is not only indicated by the facts we have, it makes a certain sort of sense as well. Consider the "facts" first, and then the sense:

	Sound	Combined form	Word
Phonetic similarity:			
of exchanged elements	Yes	(Possibly)	No
of environment	Yes	(Possibly)	No
Structural similarity:			
of exchanged elements (form class)	No	No	Yes
of environment (structural role)	No	No	Yes
Closed-class words involved	No	No	Yes
Error spans open-class words (error span frequently exceeds 1 word)	No	No	Yes
Clausally constrained	Yes	Yes	Yes

I have not commented previously on the phonetic relation between exchanged words, although the phonetic similarity of exchanged sounds and their environments has been mentioned. It is clear, however, that in this respect as in the others word exchanges contrast with sound exchanges. (There is also an indication that the combined-form exchanges are more likely to be phonetically similar than are exchanged words, especially at their final segments, i.e., the point of their attachment to stranded morphs. It is not a powerful constraint, however, if it does exist at all.) In every respect, save that of the clausal constraint, the sound exchanges and combined form exchanges are similar to each other and contrast with the word exchanges.

To this list of similarities in the behavior of sound and combined form exchanges we might also recall the pair of examples in (35). We were examining the behavior of syntactically active bound morphs, and we noted that (35)(a) and (b) were cases of word-final sound exchanges which stranded morphemes. This strongly suggests that at the point where sound exchanges occur, the bound morphs are still

marked for their syntactic status. In terms of our earlier discussion, that would entail that they are still features of the "nodes" of the syntactic frame to which lexical items are attached. One other aspect of the sound exchanges which deserves stress in this connection is their apparent restriction to open-class words, especially since most other sound errors *do* include closed-class words as sources. This is somewhat surprising, barring some reason for "insulating" closed-class and open-class sound elements from interaction in exchanges. But the assumption that sound exchanges take place at the point of inserting lexical items into their "surface" structural frames, just as we have argued combined-form exchanges do, provides such a reason.

Finally, if we assume that the phenomena of phonetic accommodation cannot take place at the same level as sound exchanges and stranding errors, we need to postulate two levels at which sound-structure errors can occur. Under the current suggestion the first such level is coincident with the planning for the serial deployment of lexical items—that is, (20)(b)—and would be the point at which the phonetic consequences of syntactic variables are accommodated. Detailed phonetic regularities that are the consequence of the phonetic environment of a sound segment would be worked out at a subsequent level of phonological processing, and that level would be the locus of sound errors other than exchanges (barring the possibility of a fourth category arising out of motor interactions—like "tongue twisters" and some common word-internal errors of similar ilk; e.g., *tachistoscope* → *taskistoscope*).

This reconstruction of the role of sound exchanges also accommodates the clausal constraint displayed by such errors. It should be noted, however, that it is not necessary to assign these errors to a specifically syntactic level of processing in order to rationalize their sensitivity to a syntactic variable. For example, both their error span (an open-class word never intervenes between the source words) and the character of the constructions they occur in (see Table V) suggest that sound exchanges may very well take place in a system with units smaller than clause size. One might suppose, on these grounds, that sound-exchange interactions take place when the sound structure of the lexical items to be inserted into the hypothesized syntactic frames of level (20)(b) is specified in a limited capacity store and that store has a length of two content items. The *input* to this store might be clausally constrained such that two elements from different clauses are never simultaneously present in it. This would preclude the occurrence of interclause errors even though the size of the

sound planning system was itself smaller than a clause and, indeed, even quite insensitive to syntactic processes in its internal operation. Given that combined form errors have so much in common with sound exchanges, in fact, one might even suppose that the stranding errors arise because of a misassignment of the output of the words from such a store to their positions in the syntactic frames that specify their surface order. This is no more than speculation, of course, for we have no grounds in the present error data to decide matters of such detail. It is sufficient to emphasize the point that the decision to assign sound exchanges to the level (20)(b) is compatible with the clausal constraint but not demanded by it.

There remains one more class of syntactic errors that bears in an interesting way on the issues we have been considering. Those are the "word shifts" we referred to earlier in our discussion of word exchanges. Errors such as those in (41)–(44) are evidently ambiguous as to their status–exchanges of adjacent elements, or shifts in the position of a single element.

(Elements that would be involved if an exchange is assumed are bracketed; the element presumably moved if a shift is assumed is boldfaced)

(41) *Who* **(else)** *(would) like one?* → *Who would else . . .*

(42) *There's (something)* **(very)** *peculiar about this* → *There's very something . . .*

(43) *They (might)* **(not)** *be too closely glued together* → *They not might be . . .*

(44) *I'll bet you (that)* **(what)** *he said was . . .* → *I'll bet you what that he . . .*

More than a terminological quibble is at issue here, for I wish to argue that word exchanges are typical of a level of processing at which the functional relations between vocabulary elements is at issue, while shifts are a consequence of the operations which map from a level that captures such functional relations to one that represents the serial constraints on vocabulary items, that is, that word shifts are more related to the processes of (20)(b) than those of (20)(a).

Though we cannot tell about cases like (41)–(44), we can, I believe, safely consider (45)–(50) as shifts for several reasons. Eighteen of the 72 shifts errors are like (45)–(50) in that an analysis of them as exchanges would require an exchange between a single word

and a word sequence. An inspection of the properties of these errors (which I will refer to as "word/string" shifts) may help decide the unclear cases.

(45) *When the number of letters (in common) (gets) to be large* → *. . . letters gets in common to . . .*
(46) *I've got something (to tell you)* (**all**) → *. . . something all to tell you*
(47) (**Little**) *(beads of) blood will pop out on my brow,* → *beads of little blood will . . .*
(48) *If you can't figure* (**out**) *(what that) is,* → *. . . figure what that out is*
(49) *Who* (**else**) *(did I think) had left?* → *Who did I think else had left*
(50) *(This place is)* (**hardly**) *well run* → *Hardly this place is well run*

Consider what we would be required to claim if these were taken as exchanges. We would first of all have to accept that words may exchange with phrases, and presumably, therefore, that at some level they have similar descriptions. In principle, there is no bar to this move, and if it could be sustained for a putatively syntactic level of sentence processing it would be of considerable theoretical interest independent of our current concerns.[20] There are a number of grounds for rejecting this sort of account, however. For example, if words are exchanged with phrases in the same fashion as words are exchanged with other words (if they are, in other words, typically at the same level of description for the sentence processor), one might expect the phrase types that are exchanged with words to fulfill structurally similar roles, just as do the words in word exchanges. And, indeed, for those very few cases of clear exchanges where a single word is exchanged with a construction, this is true (e.g., *Did you ever go to the F & T with Bob* → *. . . to Bob with the F & T?*). Moreover, in the MIT corpus, all such cases proper names or idioms. Neither of these properties is true of the putatively exchanged elements in (45)–(50) or of the other similar cases. Even more telling, in (47)–(50) the word string that must be assumed to exchange is not even properly analyzed as a phrase. Indeed, much of the earlier discussion of bound morphemes can be seen as bearing on

[20] There are independent grounds for doubting that lexical and syntactic structures should be interchangeable within a given language (see Fodor, Fodor, & Garrett, 1975).

the relevant generalization here: exchanges do not take place between elements at significantly different levels of linguistic description, words do not exchange with bound morphs, sounds do not exchange with words, words do not exchange with phrases, We will thus consider the sort of errors in (45)–(50) to be shifts in the position of a single word or phrase, usually the former.

It is immediately apparent that the word/string shifts have properties (other than those just discussed) which distinguish them from exchanges and, further, that these are properties which they have in common with most of the 54 cases, like (41)–(44), that misplace single adjacent words. Consider the prominence of closed-class words. These errors more than any others seem to involve closed-class items: fourteen of the eighteen word versus word/string shifts involve apparent movement of closed-class words, and 42 of the 54 single-word cases. By contrast, only the word exchanges showed any closed-class involvement at all, and it was in a substantially smaller proportion of the errors, confined to elements in structurally similar roles. Thus, in both proportion (24% of word exchanges as against 77% of shifts) and structural role, the closed-class items of shifts contrast with those of word exchange. But it is in the contribution of adverbs to shift errors that the sharpest difference emerges. Adverbs are conspicuously absent (both open and closed class) from all exchanges, but in the shifts, 40 of the 72 errors involve misplaced adverbs or abverbials (nine of the 18 word versus string cases, and 31 of 54 single word cases). As all the preceding would suggest, form class is not preserved between the putatively exchanged adjacent words, and neither are they parts of the sort of structures typical of exchanges (e.g., noun phrases of various sorts). On every count save that of the clausal constraint (discussed later) they contrast with word exchanges.

At this point, it would seem that a prima facie case has been made for assigning all the 54 ambiguous movement cases to the shift category established by the 18 clear cases. But one may do a bit better than that if one takes seriously the arguments from diagnostic variables that we have used in the preceding several sections. We can "purge" the ambiguous 54 of just those cases which could reasonably be exchanges—of either level (20)(a) or (20)(b)—on grounds of form class and structural role. There are, in fact, twelve such cases; (51)–(54) give four that are typical.

(51) *It's just* **plain heavy** *stop-and-go traffic down there* → *. . . just heavy plain stop . . .*

(52) *Though the long* **Labor-day** *weekend . . .* → *. . . long day-Labor week . . .*
(53) *I'd like to make a credit-*card call → *. . . a credit-call card*
(54) *You're not allowed to* **mix meat** *with milk* → *. . . to meat mix with . . .*

The contrast of these with the errors of (41)–(50), and their similarity to the errors of word and, especially, combined-form exchanges is obvious.[21] Whether one confines one's attention to the presumably pristine remainder of 60 shifts or contemplates the entire set of 72, the account of this error pattern is transparent. They are predominantly instances in which a word in the surface positional string must intervene between two words that are in immediate construction at the functional level. Another way of reflecting this is to note the frequency with which movement transformations are involved in the linguistic derivation of the structures in which shift errors take place. As the frequency of adverbial involvement indicates, adverb placement will figure in the majority of the shift cases. Note, too, that these are almost entirely closed-class adverbs (qualifiers and quantifiers like *so, very, really, quite, all, else,* etc.). Moreover, the adverb-placement transformations very often occur in conjunction with other movement transforms (e.g., "*wh-* fronting," "particle movement," "question," "extraposition of relatives," etc.).

There are several very important aspects and implications of these errors which should be stressed. Note first of all the parallel between the word shifts and the bound-morpheme shifts discussed earlier. Both types of shifts seem to be strongly restricted to *syntactic* morphemes. The interpretation of the bound morphemes as features of the syntactic frames which organize the serial order of the open-class lexical formatives might thus quite reasonably be extended to the closed-class syntactic elements of word shifts as well.[22]

[21] If one wished to carry this bootstrap operation further, of course, the obvious move would be to sort out those combined form errors that arise at the functional level and those word exchanges that arise at the positional level. Though one is filled with an ineffable sense of tidiness when this operation is performed on the data, it does not shed any new light on the mechanisms underlying the error classes.

[22] The similarities of the bound morpheme shifts and the word shifts are perhaps stronger than I have suggested in the text. Jackendoff (1969) has argued that the bound morphs I have referred to as "syntactic" are, in fact, the only vehicles for *transformationally* altering word form. Thus, *all* the morpheme shifts, both bound and free forms, would implicate transformational placements by this argument.

Second, note that these sorts of word shifts reflect an aspect of the relations between the functional and the positional levels of representation that was hinted at in the discussion of differences among the error types in terms of error span. Elements which are near to each other in the surface form of a sentence need not be adjacent at underlying levels and conversely. If adjacancy is an important determinant of the occurrence of sound exchange and combined form exchanges, one might expect to find grammatical formatives and "movable" open-class elements as the only types of elements which intervene between the source words of an exchange between sounds or combined forms. That appears, in fact, to be true. Error spans of one or two words are found for sound exchanges, but the intervening elements are closed class, grammatical formatives, or movable elements like adverbs. This is not true of independent word exchanges, for which open-class words frequently intervene between the two error positions. When this difference is taken account of, the differences in the error spans of word exchanges and sound and combined forms are even more striking.

Closely related to the preceding observation is the obvious implication that the surface position of words does not predict their "position" at the functional level of representation. Consider the error in example (41) where the actual utterance was, *Who did I think else would come?* The position occupied by the word *else* corresponds to the location it would have in an underlying description of the sentence prior to *wh-* movement in the question form. One might almost think of this error and a number of very similar ones as "failures" of movement transformations (but see later). In this same vein, we might reconsider the matter of structural parallels between the two elements of a word exchange. When the main verb and the verb of an infinitival complement change places, the parallelism of structure at the surface level is not readily apparent; but when one considers an underlying, functional level of description, the parallelism is obvious. For example, (24) would have, very roughly, the representation: *Older men tend* (for *to older men choose younger wives*).

Finally we should explicitly note that the shift errors do not violate the clausal constraint: 64 of the 72 cases of shifts are intraclause errors. Thus, it is clear that the involvement of movement operations in the processing system is very likely defined over clause-length units, just as are the operations of inserting lexical elements into their structural frames.

One should not assume that because transformations figure in the linguistic derivation of the structures in which shift errors occur that, therefore, the linguistic transforms are part of the information processing that underlies these sentences. Having noted that, however, the evidence of these errors strongly indicate that the "movement" of lexical items is involved in the mapping from the "functional" level of representation that is the result of processing referred to in (20)(a), to the "positional" level of representation that results from the processes of (20)(b).

We should at this point take explicit notice of a systematic and heretofore harmless ambiguity in the way I have used the term "level." Clearly, it may refer to both a structural representation and to the processing activity presumed to give rise to it. The shift errors simply provide the most obvious demonstration of this distinction. If we restated the implications of the preceding several sections in terms of that distinction, we would characterize the error processes of (20)(a) as attendant upon the mapping from the message level of representation to a functional level of representation; the error processes of (20)(b) would be assumed to arise from the mapping of that level onto the surface positional level given by the "syntactic frames" we discussed earlier. I will argue in the next section that there are other errors which should be assigned to the message-to-functional level mapping.

VII. Fusions and Substitutions: Semantic Errors

This discussion of semantic factors in production will be limited; it is presented primarily for purposes of contrast with the preceding discussion of errors I have deemed syntactic. The first thing of import to note is the absence of any indication that specifically semantic factors influence the exchange errors of various sorts.

One may look for semantic relations between the two words involved in a sound, combined form, or word exchange just as one looks for phonetic and syntactic relations.[23] But while the evidences

[23] The phonetic and semantic "indices" of similarity are my own judgments. They are conservative, and will err on the side of ignoring any "subtle" involvements of sound or meaning. Unless there was an obvious phonetic overlap (e.g., *Did you know you have a* sole *in the* hole *of your shoe*?), the case was counted as phonetically unrelated (e.g., *I left the* briefcase *in my* cigar.) Similarly for semantic cases; unless there was near synonomy or antonymy (e.g., *lion/tiger* or *car/truck*; *start/stop, on/off*) cases were counted as semantically unrelated (e.g. *car/gas, barns/cats, idea/guy* etc.)

for involvement of the latter factors are plentiful, no suggestion of a semantic relation (that is not exhausted by correlated syntactic features) is to be found. The many examples of the various error types given in the preceding discussions are quite typical in this respect. The only place where there is a hint of semantic regularity appears in the cross-clausal word exchanges. There are, however, too few such cases to make an effective assessment, and even within the small set available there are exchanges that are hard to rationalize semantically. It thus seems very likely, not only on the positive grounds of syntactic and phonological involvement in exchanges and related error types, but also on the negative grounds of no apparent semantic effects, that we are dealing with syntactic processes in exchanges.

One has only to turn to errors like those of (53)–(62) to see what a "semantic involvement" yields (see also Table I). These errors are of two sorts: *fusions,* in which two expressions destined for the same functional role are in competition, and portions of both are output, and *substitutions,* in which roughly the same circumstance yields a different word than that intended by the speaker.

(53) *I just* **snabbed** *it* (intended *nabbed it* or *snapped it up*)
(54) *Nobody gets very* **upcited** *about that . . .* (intended: *excited* or *upset*)
(55) *I don't want to* **intervere** (intended: *intervene* or *interfere*)
(56) *I don't know what the* **outshot** *of that is* (intended: *outcome* or *upshot*)
(57) *Do you want to try just a* **tab** *. . . uh, a* **dad,** *uh, Jesus! Do you want a dab or a tad of this stuff?* (speaker intended only one of the two expressions initially)
(58) *I'm chronically on the* **fringe** *of . . . on the verge of making a break.*
(59) *Now that's what I call a full* **cup** *of tea.* (speaker was commenting on an overflowing **pot** of tea)
(60) *What I've done here is torn* **together** *three . . . uh, torn apart three issues that . . .*
(61) *I have to leave in at* **least** *. . . in at most an hour.*
(62) *I would like to see it now that I've* **written** *the book—uh, read the book.*

The fact there are semantic relations between the conflated words is very clear. A discussion of the precise nature of those relations

would take us beyond the scope of this paper. Two or three comments are in order, however.

First of all, recall the discussion of shift errors, in which I argued against the assumption of equivalence between words and phrases at the syntactic level of processing. In the fusion errors, however, we find fairly frequent cases like the one in (53). Thus, one might wish to argue that where semantic (message level) selection among expressions is concerned, there is a word–phrase equivalence. The indications from the errors in the MIT corpus are, however, that this is of a very limited sort. Nearly all the cases of such a conflation involve idioms or very highly practiced "formula phrases."

Second, we note that a very large percentage of the substitutions involve outright antonyms or "pragmatic" opposites (e.g., *write/read, speak/listen, see/hear* etc.),[24] while the majority of the fusions turn on a rough sort of synonomy (e.g., *athlete/player, grip/fist, bet/guess, bottles/jars, shout/yell*). And related to this, most of the cases of word/phrase conflation arise as fusions. This, plus one further point raised later, suggests that though the fusions and substitutions ought both be considered a consequence of mapping operations from messages onto the first syntactic level, they may nevertheless arise from rather different aspects of that process–roughly, that the substitutions arise from outright errors of lexical selection, while the fusions may arise from failures of an evaluation or checking procedure which determines the appropriateness of the mapping from messages to the functional level.

It is worthwhile commenting on the fact that it is a loose sort of synonomy that connects the two expressions involved in a fusion. But that approximateness is a bit deceptive in one respect: *within the context of the intended utterance,* the two words almost invariably have equal currency. That is, they will equally well convey the communicative intent of the speaker. This would seem to rule out

[24] The tendency for substitutions to be between opposites is true for cases (most of those in the MIT corpus) for which there is no apparent "motivational" account of the error or its direction. The so-called "Freudian" interpretations of word substitutions (e.g., *Who said that liars . . . uh that lawyers make a living by shoveling smoke?*) and sound errors (e.g., *We can make passionate love while the bed breaks, . . . I mean, while the* bread *bakes!*) should perhaps be tempered by such facts. For, if there is a general tendency to substitute opposites, it dictates caution in interpreting cases of such substitution where one has, antecedently, an expectation of a motivational account of some particular person's error. Similarly, for sound errors, there really does not seem to be any particular evidence that sound errors which yield words (let alone situationally apposite words) are more likely than sound errors which yield nonwords. There undoubtedly are "Freudian slips," but they may be a good deal rarer than might be supposed.

the possibility that the representation of messages consists, in part, of the vocabulary items of the language. For it is hard to see how one could accommodate the sort of situationally apposite confusions so evident in fusion errors. If messages are framed in words, all the fusion errors ought, as most of the substitutions are, to be very closely related semantically, and in particular, that relation ought to be context free.

The last point I wish to raise is one that further indicates that these errors are not message-level interactions, but are a part of the process of moving from that level to the representation level of (20)(a). Both fusions and substitutions are strongly constrained by their ultimate form class role: nouns substitute or fuse with other nouns, verbs with other verbs, and so forth. This constraint on the word substitutions seems to require an interaction at the level where syntactic relations have been at least partially formulated.

The comments I have made on the semantic errors are meant to be little more than suggestive. Their proper evaluation requires, I believe, both a clearer understanding of the syntactic processes of production and more information concerning the organization of our stored lexical information. A good deal of experimental interest in this latter area has been manifest in recent years and the evaluation of errors like those of (53)–(62) within the context of, for example, proposals for the organization of the lexicon which arise out of lexical access studies (e.g., Conrad, 1972; Rubenstein, Garfield, & Millikan, 1970) would be worthwhile.

VIII. Summary

We can conveniently draw together the several threads of the sections on the various error types in terms of Fig. 1. We might now replace some of those question marks as in Fig. 2. In the figure the various error types that have been used to motivate the postulated levels of representation are indicated.

At several points in the preceding pages I have gone beyond the data to speculate on the possible character of the processing systems under discussion. Those matters aside, it seems clear that a satisfactory reconstruction of the error data requires the postulation of two distinct levels of syntactic analysis, and that these levels will differ in that one is sensitive to the functional grammatical relations among words and phrases, while the other is primarily responsive to the integration of grammatical formatives with the serial ordering of

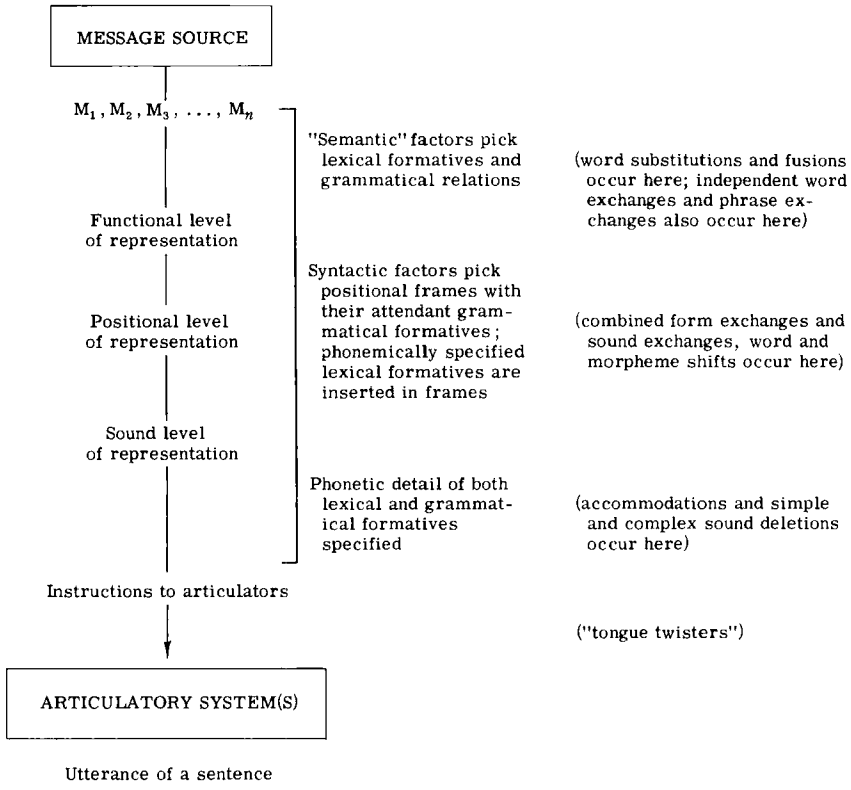

Fig. 2

"content words." Further, there is strong indication that this second level involves certain aspects of sound structure. Finally, it is clear that the clausal restriction on sound errors first suggested by Boomer and Laver is, in fact, a very much more general constraint on errors of a variety of types, and that it arises out of specifically syntactic processes. Such clausally constrained syntactic processes seem most likely to be connected with the mapping from the functional level of sentence planning to the positional one.

These and related observations about the role of motor integrations in error patterns will, I hope, prove amenable to experimental investigation. Ultimately it is only upon the results of such experimental work that detailed answers to the nature of the sentence production process can be worked out.

REFERENCES

Boomer, D. S., & Laver, J. D. M. Slips of the tongue. *British Journal of Disorders of Communication*, 1968, 3, 2–12.

Conrad, C. Cognitive economy in semantic memory. *Journal of Experimental Psychology*, 1972, 92, 149–154.

Fodor, J. A. *The Language of thought*. New York: Thos. Y. Crowell, 1975.

Fodor, J. A., Bever, T. G., & Garrett, M. F. *The psychology of language*. New York: McGraw-Hill, 1974.

Fodor, J. D., Fodor, J. A., & Garrett, M. F. The psychological unreality of semantic representations. *Lingusitic Enquiry*, 1975, in press.

Fromkin, V. A. The non-anomalous nature of anomalous utterances. *Language*, 1971, 47, 27–52.

Jackendoff, R. S. Some rules for semantic interpretation for English. Unpublished doctoral dissertation, Massachusetts Institute of Technology, 1969.

Lees, R. B. *The grammar of English nominalizations*. Publ. No. 12. Bloomington: Indiana University Research Center in Anthropology, Folklore, and Linguistics, 1960.

McKay, D. G. Forward and backward masking in motor systems. *Kybernetik*, 1969, 2, 57–64.

McKay, D. G. Spoonerisms: the structure of errors in the serial order of speech. *Neuropsychologia*, 1970, 8, 323–350.

Merringer, S. M. *Aus dem Leben der Sprache*. Berlin: Behr's, 1908.

Nooteboom, S. G. *Some regularities in phonemic speech errors*. Annual Progress Report No. 2. Eindhoven: Institut voor Perceptie Onderzock, 1967.

Rubenstein, H., Garfield, L., & Millikan, J. A. Homographic entries in the internal lexicon. *Journal of Verbal Learning and Verbal Behavior*, 1970, 9, 487–494.

Shattuck, S. R. Speech errors: An analysis. Unpublished doctoral dissertation, Massachusetts Institute of Technology, 1974.