SPEECH ERRORS AS LINGUISTIC EVIDENCE

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THE NON-ANOMALOUS NATURE OF ANOMALOUS UTTERANCES*

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1. In current linguistic and psychological literature a sizable number of articles have appeared dealing with 'slips of the tongue' and errors in speech (see Bibliography). This interest is not, however, of recent origin. Historically, speech errors have been a source of humor as well as of serious study. In the sixteenth century, Rabelais utilized such errors to display his pungent wit; and in the *Compleat gentleman* (1622), Henry Peacham refers to a "melancholy Gentleman" who says "Sir, I must goe dye a beggar" instead of the intended "I must goe buy a dagger".[1] 'Spoonerisms' were uttered before and after the long happy life of the Reverend William A. Spooner, who is credited as the originator of a particular kind of 'lapse'. In fact, if one assumes that the origin of man and the origin of language and speech were simultaneous, then a further assumption follows – that 'spoonerisms' began with Adam.

Speech-error data have been studied as a source of historical linguistic change (Sturtevant 1917, 1947; Jesperson 1922; MacKay 1970d); as a means for understanding the actual mechanisms of the speech production process (Lashley 1951; Boomer & Laver 1968; MacKay 1969, 1970a; Hockett 1967; Fromkin 1968; Nooteboom 1969); and to gain insight into psychological repressions (Freud 1924). Speech errors have also been investigated in attempts to show the 'reality' of phonological units and rules, and the relationship between linguistic 'competence' and 'performance' (Fromkin 1968; Green 1969). Freud, in his *Psychopathology of everyday life*, questioned "whether the mechanisms of this (speech) disturbance cannot also suggest the probable laws of the formation of speech" ([1924] 1938:71]. It is to that general question that this paper is directed.

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[1] Robbins (1966) suggests that the earliest literary example is found in Rabelais, in the following: "Il n'y a point d'enchantement. Chascun de vous l'a veu. Je y suis *maistre passé*. A brum, a brum, je suis *prestre Macé*." The contrived error of transposing the *m* and *p* in *maistre passé* (past master) creates *prestre Macé* ('priest Macé'), "a monk whose name was synonymous with simple or foolish." In the same article, Robbins (457–458) cites a 'near-spoonerism' found in the *Lives* of celebrities by John Aubrey (1626–1697), who, discussing a flirtation between Sir Walter Raleigh and a young girl, has the wench's protest "Sweet Sir Walter" changed into "swisser Swatter".

DATA

2. Every book and article which refers to speech errors is replete with examples. The most extensive collection, an estimated 8,800 errors, appears in Meringer & Mayer (1895) and in Meringer (1908). A rigorous statistical analysis of these errors is contained in a number of articles by MacKay (1969, 1970a, b, d). This corpus of German errors is augmented by errors in spoken Dutch noted by Cohen (1966), by more than a hundred errors in English tape-recorded by Boomer & Laver, and by other errors cited in various articles listed in the Bibliography.

In this paper, while taking into consideration the extensive published data, I will primarily make use of a collection of speech errors collected by myself over the past three years. More than six hundred errors were collected by myself, or by colleagues and friends who reported in detail errors which they either made or heard others produce.[2] For each error which I myself noted, I recorded the name of the speaker and the date, and where possible (particularly in the case of blends) the speaker was questioned as to what he had been thinking of saying. This is scanty information indeed when compared with the data recorded by Meringer for each error in speech which he heard. In true Teutonic style, he also included the birthdate of the speaker, the educational background, the time of day, the state of health and tiredness, the rate of speech etc. Sturtevant reports that Meringer thus became the most unpopular man at the University of Vienna; and since "no correlations between any of the above factors and the nature of the error were found" (MacKay 1970d), my own data-collecting omitted such information, in order to protect my personal reputation while maintaining the scientific accuracy of the data. It is important to note, however, that my method of data-collecting has a built-in fault, since many errors occur when it is just not feasible to note them, and unquestionably many errors made are not 'heard' at all. The data-collection method used by Boomer & Laver, in which they analysed tapes of conference discussions, psychiatric interviews etc. for the errors which they contained, is free of this fault. Fortunately, however, there were no sharp discrepancies between the kinds of errors recorded by them and by myself. There are certain kinds of errors included in my corpus which did not seem to occur among the hundred or so errors recorded by them; but I only included such errors when heard and attested by other listeners, or when the speaker himself caught the error and corrected it. I felt this precaution necessary to mitigate my own 'desire' to hear certain kinds of errors.

The aim of this paper, then, is not to treat the errors in the corpus as a random sample of all errors made, but to attempt an explanation for the errors which were recorded.

[2] Most of the examples cited in the text will be from my own data. In the citation of examples, the arrow is to be interpreted as 'spoken as'. The pronunciation of the utterance will be given in phonetic symbols, within square brackets, only when the orthography may create an ambiguous interpretation or obscure the actual speech errors. A dash represents a pause by the speaker; a series of dots (...) indicates that no errors occurred in the intended words.

DISCRETENESS OF PERFORMANCE UNITS

3. Sturtevant defines a 'lapse' or a 'speech error' as "an unintentional linguistic innovation" (1947:38). Boomer & Laver's definition echoes Sturtevant's: "A slip of the tongue ... is an involuntary deviation in performance from the speaker's current phonological, grammatical or lexical intention" (4). Because such 'unintentional' or 'involuntary' errors may result in utterances which provoke laughter, speakers and writers have also used them intentionally. Such conscious 'creations' will not be considered here, although one finds that these 'intentional errors' usually follow the same 'rules' as do non-intentional errors.[3]

Meringer was mainly interested in classifying the kinds of errors which occurred in spontaneous speech; and since his time, one finds in the literature different classification schemes and varying terminology. In Boomer & Laver's classification scheme, speech errors show a "MISORDERING of units in the string, OMISSION of a unit, or REPLACEMENT of a unit" (5). According to them, the units so misordered, omitted, or replaced may be segments, morphemes, or words. Nooteboom (1969) classifies segmental errors as "phonemic speech errors" and "non-phonemic errors", including in the latter classification "meaningless combination of phonemes", morphemes (including affixes and root morphemes), and whole words. Nooteboom dismisses the possibility that "distinctive features" behave "more or less (like) independent elements just as phonemes do", but Hockett implies the independence of such features (915).

Further classification is not the concern of this paper. The interest is rather in how particular errors shed light on the underlying units of linguistic performance, and on the production of speech. What is apparent, in the analyses and conclusions of all linguists and psychologists dealing with errors in speech, is that, despite the semi-continuous nature of the speech signal, there are discrete units at some level of PERFORMANCE which can be substituted, omitted, transposed, or added. It should be stated here that, were we to find no evidence in actual speech production or percep-

[3] Lewis Carroll, in his preface to *The hunting of the snark* (1876), discusses his 'portmanteau' words: "... let me take this opportunity of answering a question that has often been asked me, how to pronounce 'slithy toves'. The 'i' in 'slithy' is long, as in 'writhe'; and 'toves' is pronounced so as to rhyme with 'groves'. Again, the first 'o' in 'borogoves' is pronounced like the 'o' in 'borrow'. I have heard people try to give it the sound of the 'o' in 'worry'. Such is Human Perversity ... Humpty-Dumpty's theory, of two meanings packed into one word like a portmanteau, seems to me the right explanation for all. For instance, take the two words 'fuming' and 'furious'. Make up your mind that you will say both words but leave it unsettled which you will say first. Now open your mouth and speak. If your thoughts incline ever so little towards 'fuming' you will say 'fuming-furious'; if they turn, by even a hair's breath, towards 'furious', you will say 'furious-fuming'; but if you have that rarest of gifts, a prefectly balanced mind, you will say 'frumious'."

I have quoted extensively from Lewis Carroll, not only because it is always a delight to read or reread any of his comments, but because in this passage he states that his 'portmanteaus' or 'blends' are possible in natural speech and proposes a hypothesis as to how they occur. As we shall see below, however, these 'complete' blends are seldom found in just this way in 'normal' speech. That is, a blend of [fjurijəs] and [fjumiŋ] is more apt to occur as [fjumijəs] or [fjuriŋ], particularly because the first syllables are identical.

tion for such discrete units, this would be insufficient cause to eliminate discrete units in phonology or syntax. The fact that it is impossible to describe the grammars of languages without such units is itself grounds for postulating them in a theory of grammar. But when one finds it similarly impossible to explain speech production (which must include errors made) without discrete performance units, this is further substantiation of the psychological reality of such discrete units. In other words, behavioral data of the kind described here may not be necessary to validate hypotheses about linguistic competence, but they certainly are sufficient for such verification.

3.1. THE REALITY OF THE SEGMENT OR PHONE. By far the largest percentage of speech errors of all kinds show substitution, transposition (metathesis), omission, or addition of segments of the size of a phone. These occur both within words and across word boundaries, the latter case being most frequent in our corpus. Most of these segmental errors are errors of anticipation, which is in keeping with the conclusions reached in the literature. Simple anticipations result in a substitution of one sound in anticipation of a sound which occurs later in the utterance, with no other substitutions occurring. The following examples illustrate such errors:

(1) (a) John dropped his cup of coffee → ... cuff... coffee
(b) also share → alsho share [ɔlšo šer]
(c) such observation → sub – such ...
(d) delayed auditory feedback → ... audif – auditory ...
(e) week long race → reek long race
(f) M-U values [ɛm juw væljuwz] → [ɛm vjuw] values
(g) the third and surviving brother → the sird and – the bird – the third ...

Examples (1a–e) illustrate the substitution of one segment for another. In (1f), however, anticipating the [v], a segment is added where there is no segment in the intended word. And in (1g) the error is compounded: first the *s* is anticipated, and then, in an attempt to correct the error, a later *b* is anticipated.

Perseverance errors are also not uncommon, as exemplified in the following:

(2) (a) I'm not allowing any proliferation of nodes → ... proliperation
(b) John gave the boy → ... gave the goy
(c) Spanish speaking people → ... speaping people
(d) irreplaceable → irrepraceable
(e) Chomsky and Halle → Chomsky and Challe

It should be noted that one cannot unambiguously classify the error in (2c), since it could be considered an error of either perseverance or anticipation. As shown by MacKay (1970d), the probability that errors occur when there are repeated phonemes is much greater than chance, and in this case the alliterative structure of the utterance seems to add to the substitution which occurs. As will be seen, this is true of many of the errors to be discussed.

Classic Spoonerisms reveal a more complex error, in that there is a transposition or metathesis of two segments. One possible interpretation is that such errors involve an anticipation plus a perseverance, but it seems more likely that what occurs is a simple (or not so simple) switch in the linear ordering of the sounds intended. Such errors, attributed to Spooner, made him famous, as in his purported admonition to an undergraduate student: "You have hissed all my mystery lectures. I saw you fight a liar in the back quad; in fact, you have tasted a whole worm" (Robbins).

Whether or not the notorious Reverend or his students sat up nights inventing such errors, attested errors reveal the same kind of metathesis, as is shown in these examples:

(3) (a) keep a tape → teep a cape
(b) the zipper is narrow → the nipper is zarrow
(c) should serve → [sʊd šərv]
(d) for far more → for mar fore
(e) with this ring I do wed → ... wing ... red
(f) I'm going to die young but I'll die less young → ... yes lung
(g) in the past few weeks → ... fast pew [pjuw] weeks.

In a number of cases, where the speaker catches his error, we cannot be sure whether a mere anticipation and substitution is involved, or whether a transposition is caught before completed, as in the following examples:

(4) (a) Kathy can type → tathy – Kathy can type
(b) correct class of → collect – correct ...
(c) shown in the present slide → shown in the pleasant – I mean present slide
(d) greater pressure → [greyšr̩] – greater pressure
(e) delayed auditory feedback → delayed audif – auditory feedback

All the above examples reflect errors involving consonants. Vowels are also anticipated, metathesized, etc., as shown below:

(5) (a) ad hoc [æd hak] → odd hack [ad hæk]
(b) Wang's bibliography → Wing's babliography
(c) turn the corner → torn the kerner [tɔrn] ... [kərŋr̩]
(d) feet moving → [fuwt mijving]
(e) fish and tackle → fash and tickle [fæš] ... [tɪkl̩]
(f) the new Sony → the no suny [now suwnij]
(g) place the stress → [plɛs] the [strejs]
(h) dissertation topic [dɪsr̩tejšn̩ tapɪk] → [dɪsrtašn tejpɪk]
(i) available for exploitation → avoilable for ...
(j) prevailing temperature → [prejvijliŋ] ...
(k) the waterfall [wɔtr̩fəll] isn't working → ... isn't [wɔkɪŋ]

3.2. CLUSTERS AS SEQUENCES OF DISCRETE PHONES OR SEGMENTS. The above examples show errors of transposition, substitution, omission, and deletion of individual segments, which may be either vowels or consonants. The error may be either of anticipation (i.e., the interfering segment follows the error), of perservation (i.e., the interfering segment precedes the error), or of transposition (i.e., the order of sound segments is changed). Further justification for assuming that individual segments are units in speech performance is suggested by the fact that, in many errors where the intended utterance included consonant clusters, only one segment of the cluster is involved:

(6) (a) fish grotto → frish gotto
(b) fresh clear water → flesh queer water
(c) split pea soup → plit spea soup
(d) brake fluid → blake fruid
(e) no strings attached → no strings attrached
(f) at the Broadway stores the prices are → ... spores the prices are
(g) in a split second → ... slit second
(h) that's a sticky point → ... spicky point
(i) a car with a stick shift → ... [št'k sɪft][4]

As seen in (6a), the intended *fish grotto* has been pronounced *frish grotto* [frɪš gaDo] (the [D] represents a voiced flap), the addition of an [r] in the first word producing an initial cluster instead of the intended single segment. The substitution of the single [g] for the intended cluster [gr] may be explained by postulating that the cluster [gr] can be 'broken down' into individual segments, [g] followed by [r]. This being so, the individual segments can themselves be transposed. Similarly, the error cited in (6b) can be explained as an anticipation of the [l] in *clear*, causing the replacement of the intended [fr] in *fresh* by [fl]. The substitution of [kw] in [kwir], for the intended [klir], may again be explained by an anticipation of the [w] in *water*. It is of course true that (6b) may be simply an error in word substitution, since *flesh* is a word, as is *queer*. Such an explanation will not, however, explain a number of the other examples given; i.e., [frɪš] is not a word, nor is [gaDo], [plɪt], [spij], [blejk], [fruwɪd], [ətrætšt], [spɪkij] etc. If we are seeking an explanation for such errors, it seems highly likely that we have here again single segmental errors, the difference being that the segments involved occur in consonant clusters.

The omission of elements or segments in clusters also justifies the conclusion that clusters are not unitary units of performance, as in these examples:

(7) (a) two hundred drugs → two hundred [dʌgz].
(b) property that excludes [ɛkskluwdz] → property that [ekskudz]

[4] For the speaker who made this error, [š] followed by a consonant is not an unusual sequence. In fact, this might represent a word substitution, since [št'k] as a word exists in his dialect as well as *shmuck* [šmʌk], *shtunk* [štvŋk), *shmo* [šmow] etc.

Errors involving final clusters show that they are also sequences of individual segments, as in the following examples:

(8) (a) tab stops → tap [stabz]
(b) weeks and months → [wɪŋks] and ...
(c) great risk → great rist [rɪst]
(d) french fried potatoes → frend fried potatoes
(e) there's a pest in every class → ... pet ...
(f) art of the fugue → arg of the [feuwt]

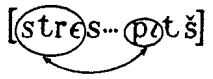
That some errors reveal the transposition of whole clusters is NOT evidence for the fact that such clusters are indissoluble units. Such errors do, of course, occur very often, as in these examples:

(9) (a) at the bottom of the pay scale → at the bottom of the [skej peyl]
(b) little island in Brittany → brittle island in litany
(c) sweater drying → dreater swying [drɛDr̩ swajɪŋ]
(d) throat cutting → coat thrutting

Such movement of whole clusters is but further evidence that the 'syllable' is not a single indissoluble unit in speech production, but is itself composed of a sequence of segments. This is attested by the fact that a CV or a VC sequence which is part of a syllable can be involved in speech errors:

(10) (a) pussy cat → cassy put
(b) foolish argument → farlish ...
(c) a heap of junk → a hunk of jeep
(d) stress and pitch → piss and stretch
(e) lost and found → [fawst] and [lɔnd]

Example (10a) shows the monosyllable [kæt] as a sequence of three segments [k+æ+t], with the first two segments transposed with the first two segments of [p+*v*+s+ɪj]. In (10d), the transposition which occurs can easily be explained as



Another explanation is that the word *piss* is substituted for *stress* (the reasons for such a substitution I leave to Freud), and *stretch* for *pitch*; or instead, that the speaker started to say *pitch and stress* and the error is one of final consonant substitutions. There are, however, numerous examples which show errors involving CV or VC sequences which cannot be so explained.

3.3. AFFRICATES. The assumption that clusters on a performance level should be interpreted as sequences of consonants raises the question of affricates. It is interesting to note that while [str], [pl], [kr], [bl], [fr] etc., as well as final clusters, reveal the

splitting of clusters into segments, not a single example in my own data, or the English examples cited by others, shows a splitting of [tš] or [dž] into sequences of stop plus fricative:

(11) (a) pinch hit → pinch hitch, but not *[pint hiš]
(b) pretty chilly → chitty pilly [tšɪtij pɪlij]
(c) entire chapter → enchire [əntšajr] ...
(d) further surgery → furger [fərdžɻ] surgery
(e) Ray Jackendoff → Jay Rackendoff
(f) last cigarette Tim had in June → ... Jim had in tune
(g) in St. Louis John said → in St. Jouis John said

We do not find cases like "St. [duəs]", or "St. [žuis]". One may assume that the old phonemic controversy, as to whether such affricates should be considered one segment or two, is solved for linguistic performance, and that affricates should be considered single segments in the production of speech, for speakers of English.

3.4. COMPLEX VOWELS. One finds a similar situation with diphthongs. If [ey] or [uw] or [æw] are interpreted as a succession of V+*y*, or V+*w*, one could expect the non-glide section of the diphthong to be subject to substitution without a change of the particular glide. In other words, one would anticipate that *feet moving* might be articulated as [fvyt mɪwving]. The examples in 12 show that where vowel+glide or [r] is involved, the error always includes the entire diphthong, or the vowel with its 'r-quality':

(12) (a) first and goal to go → first and girl to go
(b) took part in the first → took pirt [pərt] in the farst
(c) dissertation topic → [dɪsɻtašn̩ tejpɪk]
(d) we're going to have to fight very hard → we're going to have to fart very [fayd]
(e) feet moving → [fuwt mijving]
(f) available for exploitation → avoilable for ...
(g) soup is served → serp is [suwvd]

These examples are, of course, taken only from English, and the conclusions regarding affricates and complex vowel nuclei have meaning only for English.

It is a fact that one never finds an error which results in a 'non-permissible' sequence of, for example, front vowel plus back glide (e.g. [ɪw], [ɛw]), or of back vowel plus front glide (e.g. [ʊj]); but this may have an alternative explanation, which is discussed below. One example above, (5i) available [əvejləbl̩] → *avoilable* [əvɔjləbl̩], could be interpreted as a switch only in the non-glide portion of the vowel nucleus, as could all examples of errors which involve only tense front vowels or tense back vowels. The errors involving both front and back diphthongs, along with those involving a vowel followed by *r*, cannot be explained in this way, and seem to suggest

that the complex vowels are single units, or that errors which 'violate' phonological constraints are 'corrected' after the substitution occurs. (See below for discussion on this point.)

3.5. THE STATUS OF [ŋ] IN ENGLISH. Sapir (1925) and Chomsky & Halle (1968) present arguments for deriving [ŋ] from an underlying sequence of /ng/. Their phonological analysis is justified in itself. It is of interest, however, that behavioral data, found in speech errors, indicate that, at one level of performance, [ŋ] may derive from the sequence of [n+g] – or, because of the constraints which change [n] to [ŋ] before a velar, the sequence of [ŋ+g]:

(13) (a) sing for the man [sɪŋ ... mæn] → [sɪg ... mæŋ]
(b) Chuck Young [tšʌk jʌŋ] → [tšʌŋk jʌg]
(c) shilling [šɪlɪŋ] → shingle [šɪŋgl̩]
(d) cut the string → [kʌnt] the [strɪg]

A possible explanation for the [g]'s in the actual utterances is to postulate that, prior to the execution of the articulatory commands, the following transposition of segments has occurred:

(a) [sɪŋg ... mæn] → sɪØg ... mæŋ]
(b) [tšʌk jʌŋg] → [tšʌŋk jʌØg]
(c) [šɪlɪŋg] → [šɪŋgəl]
(d) [kʌt] ... [strɪŋg] → [kʌnt] ... [strɪØg]

If this highly speculative hypothesis can be demonstrated by other experimental data, the postulated phonological rule for English, $g \rightarrow \emptyset / n - \neq$, may be validated, in that when the nasal is deleted, the [g] emerges.

The data can, however, be given an alternative explanation. Example (13a) may show persistence of the velar articulation from [sɪŋ], producing [mæŋ], and a simple loss of the nasality of the final velar in *sing*. In (13b), since in English a vowel is nasalized preceding a nasal consonant, we may have an example of a transposition of oral vowel with nasal vowel, and a concomitant non-nasalization of the final nasal:

[tšʌk jãŋ] → [tšãk jʌg]

Example (13c) may be similarly disposed of, but (13d) cannot be so easily explained. The only explanation, other than that which postulates an underlying abstract /strɪng/, is to suggest that only the nasality of the vowel is anticipated – which, as we shall see below, is certainly possible. The examples are given, however, since they permit speculation as to the reality of the *g* in utterances containing [ŋ].

3.6. THE REALITY OF PHONETIC FEATURES. Research on the perception of speech has shown that units smaller than the segment, i.e. properties or features of speech sounds, are 'perceived' and confused (Miller & Nicely 1955; Wickelgren 1965a, b, 1966).

Thirty-two cases in the present corpus can be explained by postulating that certain properties or features also constitute independent elements in the production of speech. The fact that one finds no errors in which consonants and vowels are involved (i.e., vowels do not switch with consonants, etc.) may be explained by suggesting that true vowels ([+vocalic, -consonantal]) constitute one class of segments in a performance model, as opposed to another class composed of true consonants, glides, and liquids ([+consonantal) or [-vocalic]), but that the segments which are members of these two non-intersecting sets cannot be further analysed into independent features.

As we shall see below, there are other explanations for why consonants and vowels do not 'interfere' with each other (e.g., are not transposed, anticipated, etc.) The data, however, suggest that while a HIERARCHY probably exists, other features are independently involved in speech errors:

(14) (a) spell mother → smell [bʌðɾ̩]
(b) pity the new teacher → mity the due teacher – I mean – nity the poor teacher – no – pity the new teacher
(c) bang the nail → mang the mail
(d) Did you hear what Malcolm said → did you hear what balcolm – Malcolm said?
(e) Cedars of Lebanon → Cedars of Lemadon

These examples show a change in the value of the feature [nasality], acting in many cases independent of other features. In (14a–b), the [–nasal] of [p] becomes [+nasal] (i.e. [p] → [m]). If the [m] of *mother* remained [+nasal], this example could be dismissed as merely an anticipation of the segment [m]. However, since [m] → [b], or since the value of the nasality feature in the [m] of *mother* switches from [+nasal] to [-nasal], all other features remaining the same, a better explanation for the error is that what occurred was a single feature switch. Otherwise, no explanation is provided for the [m] → [b] substitution.

Example (14b) illustrates the same phenomenon. [p], which is [-nasal], becomes [m], which is [+nasal], other features remaining intact; and [n] is changed from [+nasal] to [d], which is [−nasal].

Example (14c) shows a switch of two features. [b], which is [−nasal, +anterior, −coronal], switches to [+nasal]; and [n] switches from [+coronal] to [−coronal]. Even if one wished to explain the [m] of *mail* as a perseveration of the [m] which has occurred in [mæŋ], the substitution [b] → [m] would be left unexplained. The anticipation of the lowered velum which accompanies the following [n] is a possible explanation.

Example (14d) represents a simple substitution, in the first segment of *Malcolm*, from [+nasal] to [−nasal].

The following examples represent a change of value for the feature [voiced]:

(15) (a) What does the course consist of → what does the gorse consist of
(b) referendum → reverendum
(c) clear blue sky → glear plue sky
(d) reveal → refeel
(e) define → devine
(f) big and fat → pig and vat

In these examples, only the value of the feature [voice] is changed, all other features remaining intact.

Other errors which appear to involve properties or features of whole sounds, rather than whole segments, are as follows:

(16) (a) pedestrian → tebestrian ([p] → [t] and [d] → [b])
(b) scatterbrain [skæDɻbrɛjn] → [spæDɻgrejn]
(c) spaghetti → skabetti
(d) Death Valley [dɛθ vælij] → [fɛθ ðælij]

In (16a), only the value of the feature [coronal] – i.e., only the PLACE of articulation – is changed. It is of course possible to argue that this is rather to be interpreted as segmental transposition, with [p] → [t] in anticipation of the subsequent [t]. But what of [d] → [b]? If we explain [p] → [t] as a switch of labial ([−coronal]) to alveolar ([+coronal]), then [d] → [b] is seen as the result of a change from alveolar ([+coronal]) to labial ([−coronal]).

Similar cases are seen in (16b–c). Again, one can suggest a segment transposition, particularly since the voicing feature of the [g] is neutralized after an [s]. But then how does one explain the [g] → [b] switch? If a mere segment transposition was involved, we would expect [sgəpɛtij] in (16c).

A more complex error is seen in (16d): the switch from [d] → [f] seems to be an anticipation of the subsequent [v]. The coronality of the [d] seems to influence the switch from [v] to [d], with the [+voice] and [+continuant] features remaining.

It is certainly true that errors which involve a substitution of features are rare, compared to errors involving larger units. They nevertheless require some explanation, and one can only conclude that some features appear to be independently extractable as performance units. Many segmental errors may also be examples of such feature errors; but since they can also be accounted for as errors of larger units, we are unable to conclude that individual features are independently involved in all cases. However, the following examples show that feature errors may be obscured in this way:

(17) (a) extracted → extrapted ([k] → [p], or [+back, −ant] → [−back, +ant])
(b) goofing off → gooping off ([f] → [p], or [+cont] → [−cont])
(c) call the girl → gall the curl ([k] → [g], or [−voice] → [+voice])
(d) documentation → documendation ([t] → [d], or [−voice] → [+voice])

In fact, most of the segmental errors can be so interpreted. In the transposition of *brake fluid* to *brake fruid*, one might suggest that what is involved is a transposition of the feature [lateral] or [anterior] rather than transposition of the two segments. If segmental errors are analysed as feature errors, we will find that many distinctive features other than those cited above do indeed represent a reality, in speech performance.

This suggestion is supported by the findings of Nooteboom: "In significantly more cases than is to be expected in a random distribution the two elements involved in a substitution error are phonetically similar to one another" (1969:121). MacKay found that "most pairs of reversed consonants differed in only one distinctive feature (56 percent) and very few (2 percent) differed in all four distinctive features" (1969).[5] This is in contradiction to the conclusion of Boomer & Laver "that articulatory similarity is not an important determinant" in speech errors, although they do note two exceptions: "sequences of voiceless fricatives seemed to encourage mistakes of place of articulation, and (b) alveolar consonants showed a slight tendency to interact" (p. 8, and fn.). But they were examining errors to see if any particular features were involved more often than any others. Their data were not analysed for the degree of similarity of the segments involved. It is interesting to note that an analysis of jargon aphasia errors also shows that most errors involve no more than a confusion of one distinctive feature (Green). Whether or not further analysis of substitution errors confirms or contradicts the MacKay-Nooteboom conclusions regarding the 'similarity' of substituted segments, the only conclusion one can draw from the examples of feature switching given above is that at least some of the proposed distinctive features are independent behavioral units.

But an examination of the errors, whether analysed as errors of whole segments or of independent features, definitely shows a hierarchy and interdependence of certain features. Thus, while there are errors showing just addition or subtraction of nasality, one does not find a 'nasality' switch which results in a voiceless nasal. At least for English, nasality and voicing seem to be interdependent features. This again prevents the occurrence of an 'inadmissible' sound in English.

The claim that certain features are independent units, which must be postulated as such in a model of performance, seems to contradict the earlier hypothesis that segments (or feature complexes) are 'real' performance units. Actually, there is no contradiction. Features cannot exist except as properties of larger segments (just as segments, as we shall see, exist as parts of larger units). In other words, in the generation of speech, there is a hierarchy of different-sized units. A linear ordering of the segments (discussed below) occurs, and this linear ordering may be disrupted. Since the discrete segments are specified by actual physiological properties (or neural commands), some of these properties or features may also get disordered, i.e. 'attached' to other segments. But the claim that all distinctive features (as proposed by

[5] Wickelgren's features were used by MacKay.

Chomsky & Halle) are identical with phonetic properties that can in principle be independently controlled in speech is not borne out by the data of speech errors. Unless "controllable in speech" is defined in some new strange and abstract way, it would appear that whatever the needs for certain separate phonological features may be, in actual speech performance only certain of these phonological features have their counterpart as phonetic features.[6] Thus, while the two features [consonantal] and [vocalic] very nicely divide segments into four separate classes, needed for phonology, the idea that such features have any independent phonetic reality seems highly improbable. To suggest that a substitution of a [p] for a [k] involves the PHONETIC substitution of [−anterior] for [+anterior], [−high] for [+high], [−back] for [+back], etc., is saying no more, on an articulatory level, than stating that there is a change from a velar articulation to a bilabial articulation. The motor commands to the muscles, specifying a bilabial or velar articulation, specify the part of the tongue to be raised, where it is to be raised, etc. In other words, on a phonetic level a complex of the features [−anterior, +high, +back] is indissolubly a velar place of articulation, and one does not expect to find (and indeed, one doesn't find) a simple switch of the feature [+coronal], for example, without other phonetic effects. In the example *pedestrian* → *tebestrian*, the error can be specified as a switch in the feature of coronality, but it is obvious that this feature is not 'independently controlled'. What I am suggesting is that segments as feature complexes do exist; that some of these features or properties can be independently controlled, such as nasality, voicing, place of articulation (if considered as a single multi-valued feature) etc.; but that some properties are highly dependent on the existence of other properties of the segment. It is thus that [delayed release] does not seem to be independent of affricates, and one can only suppose that, on the neuro-physiological level, there is some command for a stop closure combined with delayed release, which command cannot be split into two segments. That is, the command for the initial and final consonants of *church* at one level of the generation of speech is a command for just such an affricate. On the other hand, when one says *did you* as [dɪdžuw], in rapid speech the affrication occurs by a different process, i.e. by automatic and mechanical movements of the vocal organs. However, the results at the level of muscle movements are identical.

3.7 THE REALITY OF THE SYLLABIC UNIT. While it seems plausible to assume, as was done above, that units smaller than syllables (segments and features) have independent status as behavioral units, this does not negate the possibility that syllable-size units are also units of speech performance. In fact, all the evidence from tongue slips supports such a view. Nooteboom (1969:119) suggests that since "the distance be-

[6] Chomsky & Halle are of course concerned with the grammatically determined aspects of the signal. The occurrence or lack of occurrence of speech errors involving phonetic features are being discussed in this article as they relate to a model of linguistic performance rather than competence. However, when Chomsky & Halle talk about "the set of phonetic properties that can in principle be controlled in speech" (295), it is difficult to find the clear separation between competence and performance.

tween origin and target (or the substituted segments) does not generally exceed seven syllables, (and) since we know that the short memory span of man may contain about seven units ... we might interpret our findings as an argument for the syllable to be a unit in the phonemic programming system". Nooteboom (1969), MacKay (1969, 1970a), and Fromkin (1968) all support the statement that "segmental slips obey a structural law with regard to syllable-place; that is, initial segments in the origin syllable replace initial segments in the target syllable, nuclear replace nuclear, and final replace final" (Boomer & Laver 1968:7). Furthermore, Nooteboom points out that "when the second consonantal element of a CVC form is immediately followed by an initial vowel of the next word ... final consonantal elements do not tend to become prevocalic" (1969). In other words, in a string CVC#VC ... CV#CVC, one never finds in errors a substitution of the final consonant of the first word for the initial consonant of the final words. My own English data support the analysis of Nooteboom's Dutch data, and seem to contradict the position taken by Kozhevnikov & Chistovich (1965), where the suggestion is made that in the production of Russian utterances a CVC#VC sequence is reorganized into articulatory programs for each CV sequence. This does not seem to be the case in English or Dutch. The evidence for the syllable suggested by Nooteboom can, of course, also be used as evidence for the reality of the unit 'word', which will be discussed below.

MacKay (1969) found that the "syllabic position of reversed consonants was almost invariably identical". The only examples in my data which do not support this finding are two examples of metathesis occurring within words of two sequential segments:

(18) (a) whisper → whipser
(b) ask → aks

It has been suggested (Peter Ladefoged, personal communication) that we should note the rarity of such examples, and the fact that all such errors seem to involve the sibilant *s*. In a number of perception tests, the hiss (such as occurs with [s]) is often 'misplaced'; i.e., it is difficult for subjects to judge where the noise occurs in an utterance. This perceptual difficulty seems to be reflected in production errors of the above kind.

All other examples of errors occurring within the same word show sequential ordering of segments within syllables, as in these examples (a hyphen represents a syllable division):

(19) (a) harp-si-chord → carp-si-hord
(b) ma-ga-zine → ma-za-gine
(c) phi-lo-so-phy → phi-so-lo-phy
(d) e-le-phant → e-phe-lant
(e) a-ni-mal → a-mi-nal
(f) spe-ci-fy → spe-fi-cy

(g) Ra-be-lais → Ra-le-bais
(h) pan-cakes → can-pakes
(i) neural mo-de-ling → neural mo-le-ding

Because of the co-articulation effects of segments within a syllable, it is impossible to omit the syllable as a unit of articulation, even if one were to ignore the evidence of the fixed order in the reversal, anticipation, or perseveration of segments (Fromkin 1968).

There are of course many errors which involve the substitution, omission, replacement, addition etc. of one or more whole syllables, which further substantiates the claim that syllabic units are real performance units:

(20) (a) Morton and Broadbent point → Morton and Broadpoint
(b) revealed the generalization → reeled the generalization
(c) tremendously → tremenly
(d) which I analyse as the following → which I analyse as the follow
(e) butterfly and caterpillar → butterpillar and catterfly
(f) opacity and specificity → opacity and specifity
(g) we want to reveal all the facts → we want to feel all ...

In many of the above, several factors are at work. Some of these examples are what are commonly called 'blends', as are the following:

(21) (a) Did you bring your clarinola (a blend of *clarinet* plus *viola*)
(b) switch and changed → swinged [swindžd]
(c) importance of [ədžɔjsṇt] rules (a blend of *adjacent* plus *adjoining*)
(d) my data consists [monlij] – [mejstlij] (a blend of *mainly* plus *mostly*)

THE REALITY OF PHONOLOGICAL AND MORPHOPHONEMIC CONSTRAINTS

4. The speech of jargon aphasics, as well as errors made by non-pathological speakers, reveal that 'normal' slips of the tongue and aphasic jargon utterances are constrained by the linguistic system. One does not find 'phonemes' (or more correctly, 'phones') which are not found in regular utterances. For example, an English speaker does not substitute a rounded front vowel in anticipation of a rounded back vowel, nor a lateral click for a lateral liquid. Furthermore, only permitted segmental sequences occur. Wells (1951) stated this as his "First law" of tongue slips: "A slip of the tongue is practically always a phonetically possible noise." It is obvious that Wells meant a 'phonetically possible noise' in a particular language. As I have stated in an earlier article (Fromkin 1968): "The segments constituting each syllable must have sequential ordering, so that only initial consonants, vowels, and final consonants may interchange, IF AND ONLY IF THE TRANSPOSITIONS ARE IN KEEPING WITH THE PHONOLOGICAL RULES OF THE LANGUAGE" (64). This 'First Rule' appears to explain a 'Spoonerism' attributed to Spooner:

sphinx in moonlight → minx in spoonlight.

What is of interest here is the transformation of the [sf] in *sphinx* to [sp] when the cluster is transposed with the [m]. While [sf] does occur in words like *sphincter*, *sphere*, and *sphinx*, such words (and the dozen or other 'technical' words listed in Webster's Third) are 'exceptions' to the regular morpheme-structure rule in English which permits only voiceless stop obstruents after an initial *s*. [sfuwn-light] would thus not be a permitted sequence, and consequently [f] → [p].

All the examples already cited include only permitted English sequences. Further examples will support the 'reality' of such constraints:

(22) (a) play the victor → flay the pictor
(b) tab stops → tap [stabz]
(c) plant the seeds [sijdz] → plan the seats [sijts]
(d) bloody students [blʌdij stuwdənts] → [blʌdənt stuwdijz]

There are two ways of interpreting the error shown in (22a). One might suggest that it is simply the manner of articulation (stop vs. fricative) which is switched. If such an interpretation is given, one must also add that, when the [v] is changed to a stop, the place of articulation changes from labio-dental to bilabial. Another possible explanation is that the two segments switch ($p \leftrightarrow v$), and that since [vl] is not a permitted sequence in English, the [v] is devoiced. This suggests that these phonological constraints, when learned, become behavioral constraints which occur AFTER the segmental transpositions occur.

A similar example is shown by (22b), in which the final consonant (or just the voicing feature) of the first word is transposed with the penultimate consonant of the second word (or the final stem consonant, prior to the plural morpheme addition). Again, the intended [ps] is changed not to [bs] but to [bz], in keeping with the phonological (and morphological) constraints of English.

Examples (22b–d) represent another phenomenon. In these errors, the original syntactic structure of the phrases remains intact, in that the intended plural nouns occuring as the last words of the phrases remain as words with plural endings, despite the errors which occur; but the phonetic realization of the plural morpheme changes, as well as the preceding segments. Thus [stabz] and [sijts] can be explained simply as due to phonological or phonetic constraints, since [bs] and [tz] never occur as final clusters; but the error in (22d) is more complex. [js] can occur in English as in *Reese* [rijs], *mice* [majs], *feast* [fijst], *face* [fejs] etc. But [ij+s] cannot occur when the final sibilant represents the plural morpheme. One can then suggest that the phonetic representation of the plural morpheme is specified prior to the automatic phonetic specifications which serve as the units for articulatory commands. If this were not the case, one could not understand the change of the [s] to [z] in [stuwdijz].

Further examples of the reality of morphophonemic rules are evidenced in errors which include the alternation of the non-specific determiner *a/an*:

(23) (a) a current argument [ə kʌrn̩t argjumənt] → an arrent curgument [ən arn̩t kʌrgjumənt]
(b) an eating marathon → a meeting arathon
(c) a history of an ideology → an istory of a hideology
(d) an ice cream cone → a kice ream cone

The changes *a* → *an* and *an* → *a* indicate that, in the generation of speech, the segmental errors or transpositions must take place PRIOR to the actual neural muscular commands, since there are possible sound sequences of [ə] plus vowel, as in *America is* [əɪz].

Such errors show the separation of morphophonemic rules and phonological rules. In other words, it is not a phonological rule which changes the *a* to *an*, since there is no general restriction on vowel sequences like those of *America is, Rosa and I.* Thus the ordering of events must be as follows: (1) segmental errors, (2) morphophonemic adjustments, (3) P-rules.

The reality of the P-rules is attested by many of the errors cited above, e.g. (8a) [tæb staps] → [tæp stabz]. The transposition of the /b/ and /p/ must have occurred prior to the rule which constrains final clusters to be voiced or voiceless. In (8b), [wijks ən mʌnθs] → [wɪŋks ...] can only be explained by the following sequence: /wīks/ → /wīnks/ → [wiŋks]. The tense /ī/ is not diphthongized because it occurs before a nasal, and the /n/ is made homorganic with the following velar stop by a general rule.

STRESS

5. MacKay, Boomer & Laver, and Nooteboom (1969) all investigate the influence of stress on errors in speech. Boomer & Laver conclude that "The origin syllable and the target syllable of a slip are metrically similar, in that both are salient (stressed) or both are weak (unstressed), with salient-salient pairings predominating" (7). Nooteboom agrees with this conclusion, stating that "In significantly more cases than is to be expected in a random distribution the elements involved in a speech error belong to stressed syllables" (1969). He disagrees, however, with Boomer & Laver's finding that "Slips involve the tonic (primary stressed) word, either as origin or as target, with tonic origins predominating." But from Nooteboom's own data, the disagreement seems to be the result of a misinterpretation of the difference between primary stress (tonic word) and salient stress. Differences between English and Dutch may also be relevant. MacKay finds that transpositions occurring within words appear in syllables with different stress, while in between-word reversals his findings corroborate those of Boomer & Laver.

What seems to be of greater interest is that, when vowels or syllables or parts of

syllables or whole words are substituted or transposed, there is no change in the stress pattern or contour of the sentence. Boomer & Laver cite an example in which a speaker, instead of saying *how bád things were*, said *how thíngs bad were*. It is evident that there was no transposition of the stress, despite the transposition of the words. The following examples show the same phenomenon (an acute accent [ˊ] represents primary stress, as does '1' above the vowel; a grave accent [ˋ] represents non-primary stress – secondary or tertiary; a '2' above the vowel represents secondary stress, and a '3' tertiary stress).

(24) (a) $\overset{3}{\text{hammer}}$ and $\overset{1}{\text{sickle}}$ → $\overset{3}{\text{sickle}}$ and $\overset{1}{\text{hammer}}$

(b) $\overset{3}{\text{peoples}}$ $\overset{1}{\text{park}}$ → [$\overset{3}{\text{park}}$ļz $\overset{1}{\text{pijp}}$]

(c) $\overset{2}{\text{verge}}$ of a $\overset{3}{\text{nervous}}$ $\overset{1}{\text{breakdown}}$ → $\overset{2}{\text{nerve}}$ of a $\overset{3}{\text{vergeous}}$ $\overset{1}{\text{breakdown}}$

(d) he's been $\overset{2}{\text{around}}$ a $\overset{3}{\text{long}}$ $\overset{1}{\text{time}}$ → he's been $\overset{2}{\text{long}}$ $\overset{3}{\text{around}}$ $\overset{1}{\text{time}}$

(e) a $\overset{2}{\text{computer}}$ in our $\overset{3}{\text{own}}$ $\overset{1}{\text{laboratory}}$ → a $\overset{2}{\text{laboratory}}$ in our $\overset{3}{\text{own}}$ $\overset{1}{\text{computer}}$

(f) $\overset{2}{\text{examine}}$ the $\overset{3}{\text{eyes}}$ of the $\overset{1}{\text{horse}}$ → $\overset{2}{\text{examine}}$ the $\overset{3}{\text{horse}}$ of the $\overset{1}{\text{eyes}}$

(g) $\overset{3}{\text{broke}}$ the $\overset{2}{\text{crystal}}$ on my $\overset{1}{\text{watch}}$ → $\overset{3}{\text{broke}}$ the $\overset{2}{\text{whistle}}$ on my $\overset{1}{\text{crotch}}$

(h) in the $\overset{2}{\text{theory}}$ of $\overset{1}{\text{phonology}}$ → in the $\overset{2}{\text{phonology}}$ of $\overset{1}{\text{theory}}$

Examples (24e) and (24h) show that, while the word position of primary stress in the phrase is not transposed, the stressed syllable of the word in isolation is the syllable which receives the sentence stress. That is, if the primary stress is to be placed on *laboratory*, it is placed on the first syllable; and if it is to be placed on *computer*, it is placed on the second syllable.

Thus it seems that two aspects of stress must be accounted for: first, the word stress moves with the word itself (i.e. the syllable of the word which receives main stress in isolation also receives the primary stress when the word is moved); second, the stress contour of the phrase is fixed by the syntactic structure of the phrase itself, and must be generated independently of the word order in the utterance.

One may then suggest that the word stress is stored as part of the articulatory specifications of the stored unit 'word', but that the sentence or phrase stress and over-all intonation contour is generated separately, as part of what Boomer & Laver call the "tone-group". I would therefore agree with them that "The pivotal role of the tonic word in slips suggests that its phonological, syntactic and semantic prominence is matched by an analogous neuro-physiological prominence, coded in the brain as a part of the articulatory programme" (8), and further that "the tone group is handled in the central nervous system as a unitary behavioral act, and the neural correlates of the separate elements are assembled and partially activated, or 'primed' before the performance of the utterance begins" (9). However, in the construction of a model of linguistic performance, it is necessary to specify the nature, i.e. the

syntactic structure, of this tone group, for the 'priming' of the 'tonic' syllable depends on the syntactic structure of the utterance.

The suggestion that the stress placement on words is fixed in the lexicon does not mean that one cannot, or should not, attempt to generalize stress assignment rules in the phonology of English. In fact there may be some evidence from speech errors that not only in a grammar of competence, but also in the actual stored lexicon, words (or perhaps formatives) are stored in a more abstract form than by their actual articulatory specifications. There are speech errors which display a movement of stress, and in certain cases a change in the vowel qualities depending on where the stress is placed:

(25) (a) This can viewed altérnately – altérnatively – no – álternately
(b) símilarly → [similérəlij]
(c) homogéneous → [homàdžəníjəs]
(d) in favor of [həmádžə – homodžíjniəs]
(e) syllabíf – syllábification [sɩləbíf – sɩlæbəfəkejšn̩]
(f) opácity and specifícity → opácity and spécifity

One may speculate (perhaps wildly) that in the generation of speech a word is selected, stress is assigned, and then the articulatory program is assembled to produce the sounds, reducing unstressed vowels etc. By this hypothesis, the changes [ər] → [ær] in (25b), [o] → [a] and [ij] → [ə] in (25c), are 'explained' by the suggestion that the words are stored as stems plus endings, and with their unreduced vowel qualities. While such a suggestion cannot be entirely ruled out, alternative explanations can be provided for all the examples in (25) above, which, from the performance viewpoint, seem more intuitively satisfying. In (25b), for example, the speaker might have begun to say *similarity*, or in Carroll's terms have had *similarly* and *similarity* in mind at the same time, just as he clearly had both *alternately* and *alternatively* in mind in (25a). It should be clear, without laboring the point, that all the above examples of errors involving stress can be similarly explained. Before one can seriously put forth the hypothesis that the stress of words is generated by phonological rules, and not stored as part of the specification of the word (in one's performance lexicon), a crucial experiment must be found.

THE REALITY OF SYNTACTIC WORD CLASSES AND SYNTACTIC PHRASES

6. Nooteboom (1969:130) found that "a mistakenly selected word always or nearly always belongs to the same word class as the intended word [indicating] that the grammatical structure of the phrase under construction imposes imperative restrictions on the selection of words." In my own corpus of errors, a similar conclusion can be drawn. When words are switched, nouns transpose with nouns, verbs with verbs, etc.:

(26) (a) a computer in our own laboratory → a laboratory in our own computer
(b) that no English manufacturer could name these projects – products
(c) naturalness of rules → nationalness of rules
(d) bottom of page five → bottle of page five
(e) I have some additional proposals to hand out → hang out
(f) book of sixes → book of twos
(g) chamber music → chamber maid
(h) a speaker doesn't go through all the worlds – rules he has in his head
(i) while the present – pressure indicates
(j) How come if you're a Scorpio you don't read – wear oriental spice?

The fact that in many cases the substituted word has some phonetic (or phonological) similarity to the target word was also noted by Nooteboom. This suggests that our stored lexicon is ordered in some dictionary-like fashion, and any crossword puzzle addict can confirm this fact. But there must be a complicated addressing system in the computer-like brain mechanism, since each listing must be specified under semantic features, phonological features, number of syllables, syntactic features etc. Thus, in (26h), the phonetic similarity of [wərldz] and [rulz] is based on two identical segments – which, however, do not have the same sequenced ordering in the words. Of course, this may be a chance error.

The reality of the word as a unit is evidenced by the above. Furthermore, speech errors show that derivationally complex items may be stored as combinations of separate formatives, i.e. stems and affixes. Example (26c), above, *natural+ness* → *national+ness*, attests this, as do the following examples:

(27) (a) infinitive clauses → infinity clauses
(b) grouping → groupment
(c) intervening node → intervenient – intervening node
(d) and so in conclusion → and so in concludement

Example (27d) suggests again that *conclusion* may be stored as *conclude+ion* with rules for *d* → [ž]. It is, however, possible and highly probable that we have here a blend of *concluding* and *conclusion*.

Hockett's analysis would relegate such affix substitutions to what he calls "analogy". Unfortunately, this label does not explain how the process takes place. One possible explanation is there are rules of word formation, plus a vocabulary of stems and a vocabulary of affixes which, as the above examples show, can be manipulated to create neologisms which do not occur in the language, such as *groupment*. MacKay's finding (unpublished) that affixes are involved with a probability greater than chance, among syllable errors, would support the hypothesis that affixes do form a separate sub-set of the lexicon.

The constancy of the syntactic structure, and the reality of performance units larger than words, morphemes, stems, etc., is seen in the following:

(28) (a) I wouldn't buy macadamia nuts for the kids → I wouldn't buy kids for the macadamia nuts
(b) A fall in pitch occurs at the end of the sentence → an end of the sentence occurs at the fall in pitch
(c) He's a far better man than anyone here → he's a farther man than anyone better here

The displacement of *better* in (28c) also results in an adjectival ending added to the adverb *far*, maintaining a correct and intended syntactic structure.

In structures such as $_{NP}[_{ADJ}[macadamia]\ _{N}[nuts]\ ]$ (or, this may be a compound noun), $_{N}[\ _{N}[fall]\ _{PP}[in\ pitch]\ ]$, and $_{N}[\ _{N}[end\ _{PP}[_{PREP}[of]\ _{NP}[\ _{DET}[\ the]\ _{N}[sentence]\ ]$, syntactic phrases can interchange as entire units; similar word classes can also interchange. Furthermore, when (as in 28c) an intended adverb+adjective+noun is involved in an error, a shift of the adjective to another place in the sentence seems simultaneously to change the remaining adverb *far* to an adjective, thus maintaining the over-all structure. Such facts seem to point to the reality of syntactic phrases and of syntactic features of words.

SEMANTIC FEATURES

7. Blends occur in which non-existent words are produced as the result of composites of two words with similar semantic features. These are indeed common errors, not only invented by Lewis Carroll, but occurring naturally. In the examples given in (29) the speaker was questioned as to what he had in mind, or as to what he thought the reason for the blend was. The subject's answers are given in parentheses:

(29) (a) My data consists [mownlij] – [mejstlij] ... (mainly/mostly)
(b) I swindged [swɪndžd] ... (switch/changed)
(c) It's a lot of [ba] – [brʌðl̩] (bother/trouble)
(d) She's a real [swɪp] chick (swinging/hip)
(e) it's a [spajrətɪv] (spirant/fricative)
(f) a tennis [æθlər] (player/athlete)

Such errors seem to support Carroll's assumptions. A speaker has in mind some meaning which he wishes to convey. In selecting words, it appears that he is matching semantic features. Where there are a number of alternative possibilities, rather than making an immediate selection, he brings them both into a buffer storage compartment, with their phonological specifications. Either a selection occurs at this point, or the words are blended, resulting in the above kind of errors.

The literature and my own data attest the fact that, besides the phonological similarity in substituted words, errors often involve semantic features in common, or substitution of antonyms, i.e. words having the same features with opposite values:

(30) (a) I really like to – hate to get up in the morning

(b) It's at the bottom – I mean – top of the stack of books
(c) This room is too damn hot – cold
(d) the oral – written part of the exam

Nooteboom presents a number of examples which seem "to involve a semantic switch from the space to the time dimension" (1967:14) as in the following:

(31) (a) the two contemporary, er – sorry, adjacent buildings
(b) during the apparatus, er – behind the apparatus
(c) the singular, sorry, the present time

Evidence from aphasia studies also show that substituted words often fall into the same semantic class, as in cases where patients will read *tree* for *flower*, *night* for *dark*, *spoon* for *fork*, *liberty* for *democracy* etc. (Marshall & Newcombe 1966; Luria & Vinogradova 1959; Jakobson 1966). Such errors provide important evidence as to the storage of vocabulary and the generation of speech.

IMPLICATIONS OF SPEECH ERRORS FOR A MODEL OF LINGUISTIC PERFORMANCE

8.1. THE LEXICON. When one learns a language, he learns among other things a vocabulary. Judging both from errors of speech and from speakers' ability to form new words by adding derivational affixes to stems (e.g. *He's a real computerish type*) and by inflecting newly coined words in keeping with the rules of the language (e.g. 22d, [stuwdijz]), it seems plausible to assume that the stored lexicon consists of stems and affixes, as well as idioms, compounds, whole words etc. Given the higher than chance probability that prefixes and suffixes are involved in syllable errors (McKay, unpublished), one can further assume that, even if words are stored with their affixes, the stem and affix have a separate status. Thus it is not unlikely that *grouping* is stored as *group+ing*, which permits a substitution of *ment* for the affix *ing*. The fact that one does not find stems substituting for or transposing with affixes further justifies their separate status.

Since phonological or phonetic specifications, semantic features, and syntactic word-class features all play a role in the speech errors that occur, it is obvious that vocabulary items must be stored with such features indicated. But we cannot simply assume that there is one dictionary-like storage starting with all words beginning with A and ending with all words beginning with Z, with other features given. Semantic errors show that words are selected to convey certain meanings as specified by their semantic features. And for literate speakers the listing must also specify the orthography, to account for the ability of people to play 'geography', a game in which one must name a country, river, city, etc. beginning with the same LETTER with which the previous word ended: thus, *Passaic* ends with the letter *c*, pronounced [k], and the next player can offer *Charleston*, which begins with *c*, pronounced [tš]. The relationship between orthography and sound must be accounted for. Crossword puzzles, double-

crostics, and the 'tip of the tongue' phenomenon (Brown & McNeil 1966) also attest this fact. For example, it is often the case that in trying to remember someone's name, forgotten at the moment, a speaker will say, "I know it begins with a C." The name may be *Cohen*, which begins with a C pronounced [k]. And of course a game like 'geography' is further evidence for the storage of words in semantic classes.

One may then suggest that the vocabulary is stored in a thesaurus-like lattice structure. It is possible to conceive of this network as a listing of all the stems and affixes in some fixed phonological order, each one with all of its feature specifications, and each one with a particular address. The separate semantic section of this lexicon may then be divided into semantic classes, with semantic features under which are listed, not the particular vocabulary item, but the addresses of those items which satisfy the features indicated. One might suggest also that the listings under the semantic headings are grouped under syntactic headings such as [+noun], [+verb] etc., to account for the proper grammatical selection in the generation of utterances.

Since the 'tip of the tongue' phenomenon suggests that speakers recall the number of syllables – the metrical beat of the word – a further division under the full phonological listing is suggested. In other words, it is not impossible to assume that all monosyllables beginning with the same phonological segment constitute one block, followed by disyllables, etc.

The error cited in (30a) might then occur in the following way: the speaker wishes to say (at least on a conscious level – we leave the unconscious motivations to be explained by others) *I really hate to get up in the morning.* At the point in the generation of the utterance prior to the selection of the words, in the 'slot' representing *hate*, the features [+verb, −desire ...] occur, and an address for a word is sought from the semantic class which includes [±desire]. But either because of unconscious wishes or due to a random error, the address for a verb with the feature [+desire] rather than one specified as [−desire] is selected, and the item at that address called forth with its accompanying phonological features turns out as [lajk] rather than [hejt].

The complexity of the stored lexicon is enormous, and it is obvious that there are too many lacunae in our knowledge to suggest anything more than the kinds of subparts or components it must contain. I have suggested an 'indirect-addressing' system above with nothing to justify this except a vague appeal to storage simplicity. It seems plausible to assume, however, that any model of a lexicon must include the following sub-parts:

(a) A complete list of formatives with all features specified, i.e. phonological, orthographic, syntactic, and semantic.

(b) A subdivision of the phonological listings according to number of syllables. This is necessitated by the fact that speakers can remember the number of syllables of a word without remembering the phonological shape of the syllables. It is also suggested by the fact that one can get a subject to produce a list of one-, two-, or three-syllable words.

(c) A reverse dictionary sub-component, to account for the ability of speakers to produce a list of words all ending in a particular sound or letter.

(d) A sub-component of phonologically grouped final syllables, to account for the ability of speakers to form rhymes.

(e) Formatives grouped according to syntactic categories, to account for the errors noted above, and the ability of speakers to list nouns, or verbs, or adverbs on command, as well as the more important ability to form grammatical sentences.

(f) Formatives grouped according to hierarchical sets of semantic classes.

(g) Words listed alphabetically by orthographic spelling.

Furthermore, it seems plausible to assume that all these components must be intricately linked in a complicated network.

This highly speculative, oversimplified model of the lexicon is suggested as a first approximation to what must be a most complicated storage mechanism. What seems certain, however, is that any model of the lexicon must account for the observed types of errors, which require the specification of various kinds of properties which we have called phonological, syntactic, and semantic features; no lexicon consisting of a single listing of items can explain what occurs.

8.2. THE GENERATION OF UTTERANCES. It seems quite evident from all the examples of speech errors cited above that, in the production of speech, it is not true that 'anything goes', or that speech performance obeys no rules, or that the errors are totally random and unexplainable (see discussion of this in Fromkin 1968). While we may not be able to explain as yet the exact mechanisms involved in speech errors, the errors made are not only highly constrained, but provide information about speech performance which non-deviant speech obscures. In other words, if we had no record of errors in which consonant clusters are split into segments, we would not be able to justify the assumption that clusters in performance are strings of individual discrete segments.

Any model of speech performance must therefore account for the kinds of errors which do occur. Such a model must account for the following:

(a) that features, segments, syllables constitute units in the production of a speech utterance;

(b) that segments are ordered within a syllable, and that only segments similarly ordered are involved in the same error;

(c) that "root morphemes may be interchanged but root morphemes and an affix cannot take each other's places" (Nooteboom 1967:16), or that words of the same syntactic or morphological class usually interchange with each other;

(d) that intonation contours (including the placement of primary stress) remain fixed, and are generated separately from the individual word stresses;

(e) that morphological constraints and phonetic or phonological constraints must occur at different times in the production of an utterance;

(f) that non-permissible phones or phonetic sequences do not occur;

(g) that errors may be semantic in nature, as in the case of blends or word-substitutions involving similar semantic features; and

(h) that the similarity of the phonological form of words appears to play a role in word substitutions.

To account for such phenomena we may suggest the following (over-simplified) order in the actual generation of an utterance:

STAGE 1. A 'meaning' to be conveyed is generated.

STAGE 2. The 'idea' or 'meaning' is structured syntactically, with semantic features associated with parts of the syntactic structure. For example, if a speaker wishes to convey the fact that 'a ball' rather than 'a bat' was thrown by a boy, the utterance *A ball was thrown* or alternately *He threw a báll* is structured at this stage. If he uses the second structure, part of the features specified for the final nouns must include [+emphasis] together with the features selected for 'ball', i.e. [−animate, −human, +count, +round, +used in games etc.] This suggests that the STRUCTURE itself is put into buffer storage prior to actual articulation of the utterance; this would account for the switching of noun for noun, verb for verb etc., when such transpositions occur.

STAGE 3. The output of Stage 2 is thus a syntactic structure with semantic and syntactic features specified for the word slots. In order to explain the fact that "the tone group is handled in the central nervous system as a unitary behavioural act" (Boomer & Laver 1968:9), one can suggest that the intonation contour, with the placement of primary stress, occurs at this stage. Since a transposition of words in the utterance will cause a transfer of primary stress to the main stressed syllable of the word in a given position, one can posit that only the position of the primary stress is indicated at this stage, and not the particular syllable. That is, the generation of the sentence intonation contour must occur prior to the selection of the words themselves.

STAGE 4. We now have in the buffer a syntactic phrase with semantic features indicated, and with sentence stress assigned. A lexicon look-up now occurs; the semantic class sub-section of the lexicon is first consulted, with features being matched, and the direction is obtained to go to a certain address in the over-all vocabulary. The item in the specified address is then selected, this word being specified as to its phonological segments, which are identified and ordered into syllabic units. At this stage in the process, errors resulting in a choice of a 'wrong' word may occur. Such errors may involve the matching of values of semantic features, resulting in a wrong address being specified. Or the correct address may be specified, but a different address substituted which is 'in the vicinity' of the intended address. Thus, if the intended word is *like* and the produced word is *hate*, the error occurs in the selection of the wrong address in the semantic component of the lexicon. But if the intended word is *pressure* and the produced word is *present*, the correct address is obtained, but the wrong address selected, given that *pressure* and *present* have addresses in the same section of the vocabulary. This would be due to the phonological similarity of their first three segments. This process thus results in a string of phonological segments, each segment specified by certain features or properties and also specified as to

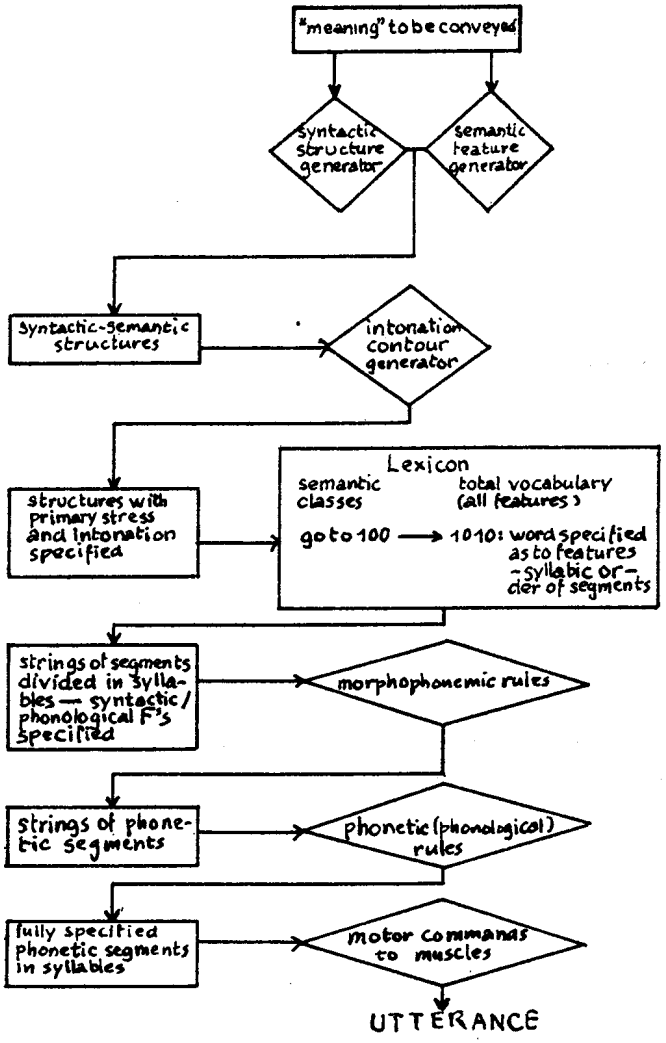


Fig. 1. Utterance generator.

syllabic order, with the syntactic bracketing remaining intact. But it is at this stage, when the string of phonological segments is put into the buffer, that a mis-ordering of segments may occur. In other words, as the segments are 'sent' into the short-term memory buffer, segment 1 of syllable 1 may be substituted for segment 1 of syllable 4. I am not concerned at this stage with an explanation of why and how this occurs, but with the fact that it can occur at this stage without disturbing the syllabic ordering. It is also here that whole syllables or parts of syllables may get transposed or misplaced. These errors must occur before Stage 5, which is where the morphophonemic rules or constraints take over.

STAGE 5. The morphophonemic constraints of the language at this stage change,

if necessary, or perhaps 'spell out', the phonological shapes of morphemes. The segmental errors must occur before this stage to account for the alternations of *a/an* and *s/z* of the plural.

We have now reached the stage where automatic phonetic and phonological rules take over, converting the sequences of segments into actual neuro-motor commands to the muscles in the articulation of the utterance.

The above stages may be diagrammed as shown in Figure 1. It must be emphasized that the various 'black-boxes' are highly schematic, and what actually occurs in them is outside the concern of this paper. Rather, the attempt is to show a possible ordering of events in the production of an utterance which can account for non-deviant utterances, as well as for utterances containing errors in speech.

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