A Comparison of Apraxia of Speech, Slips of the Tongue, and Tongue Twisters as Faulty Motor Speech Programming

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As you all know, apraxia of speech is generally regarded as an impairment of motor programming during volitional connected speech utterances. I fully realize that there is a great deal of controversy surrounding the concept of apraxia of speech, and that there are people in the audience here who have written on both sides of the issue. Is apraxia of speech a distinct clinical entity, or is it merely a variant of other forms of speech and language breakdown? Is it purely a motor disturbance, or is it an impairment of linguistic encoding? The arguments continue along these and other lines.

I suspect that probably all motor tasks during speech are induced, initiated, or mediated by a verbal "command," if you will. Thus, to isolate completely motor functions from verbal or linguistic functions is at best arbitrary and much too simplistic. However, if we consider apraxia of speech to be indeed an impairment of motor programming, then by all logic this means that there must be some normal motor programming for speech which exists among all speakers. We should study the latter in order to understand the former. In other words, it makes sense that to appreciate any abnormal function, you certainly ought to know how that function occurs in the normal individual.

As far as speech is concerned, we can introduce a number of variables into the situation which will create impaired motor programming. For example we are all aware of what happens to speech output (that is, motor control) under conditions of delayed auditory feedback. However, of interest to this particular paper, is the effect on speech production when the speech sample requires articulatory agility which is beyond the capabilities of the motor programming system. Such is the case when the subject is asked to produce various tongue twisters at a fairly rapid rate. The speaker exhibits several unique kinds of speech production errors, some of which are not too dissimilar from those seen in patients with apraxia of speech.

Normal speech does not mean perfect speech - it is demonstrably imperfect. As we talk in normal conversation, we inevitably show pauses, hesitations, false starts, misarticulations, self-corrections, and other irregularities (Boomer and Laver, 1973). These aspects of the so-called "speech pathology of everyday life" are examples of the transient malfunctions of the neural command system, as many authors would suggest. The study of these phenomena of speech production reveals some of the properties of normal motor programming. By examining what people do on tongue twisters and what happens in slips of the tongue, we ought to be able to make some inferences about the nature of the breakdown in organic impaired motor speech programming, as in apraxia of speech. The question then is whether apraxia is a similar form of disrupted motor programming or not. Another way of stating the question is this: is apraxia of speech a separate, distinct, and unique type of neurogenic disturbance, or does it simply represent a severe form of poor motor control along the same general continuum as seen in tongue slips and tongue twister data? I'm certainly not

going to be able to answer these questions, but I would like to shed some light on the issue. I am surprised that in the extensive literature on slips of the tongue and tongue twisters there is really no mention of apraxia of speech. Likewise, in the many published articles on apraxia there is very little if any reference to the data on slips of the tongue and tongue twisters. Yet both groups of authors ascribe the speech breakdowns as motor programming dysfunctions.

An audio tape recorded sample of a patient who might be identified as having apraxia of speech was played. We could certainly argue about whether he should or should not be diagnosed as having apraxia of speech. But let's not quibble over it. The point is that he exhibits many of the cardinal features as described, for example, by Deal and Darley (1972), namely, inconsistent errors of phonemic accuracy, self-corrections and re-trials, difficulty with initiation of speech, hesitant and groping speech productions, etc.

A recorded sample was played for the audience of a normal speaker attempting to say the two tongue twisters "the Leith police dismisseth us" and "rubber baby buggy bumpers." Such behaviors were noted as false starts, disruptions of speech rate, pauses, vowel prolongations, speech sound errors, groping and struggling, etc. That is, speech behaviors which are not all that different from an apraxic patient.

Incidentally, I for one find the two-word combination, "dismisseth us" to be extremely difficult. The only way I can handle it is to produce it syllable-by-syllable, with a slow rate, prolonging the continuant sounds, and with a deliberate attention to tongue placement: dis-miss-eth-us. This is almost the kind of process the apraxic patient goes through in his attempts to compensate for his difficulty.

One might inquire about other pathologies of speech. For example, Hamre and Harn (1977) have compared and contrasted apraxia and stuttering as basically similar dysfunctions. Furthermore, one only has to listen to cluttering to recognize some of the characteristics of other types of motor programming disorders. Cluttering is considered to be a disorder of accelerated speaking rate in which speech becomes precipitous and repetitious with groping articulatory effort. Luchsinger and Arnold (1965) state, "The clutterer's speech gives the impression of being hasty, slurred, inaccurate, and disturbed by frequent elisions, transpositions, substitutions, or intrusions of parasitic sounds." In a more picturesque description, these same authors write "...the clutterer's speech sputters and tumbles in disrupted spurts of half-swallowed words." Clutterers, by the way, typically dread words with difficult consonant clusters. An audio sample of a clutterer was played, and the audience was asked to consider whether it is an example of impaired motor programming. Interestingly enough, in their book, Luchsinger and Arnold briefly mention some of the similarities in behavior between slips of the tongue and cluttering.

There is an extensive body of literature on normal speech errors. Undoubtedly, the most comprehensive publication is the volume edited by Fromkin (1973). It is a collection of papers dealing primarily with the slip of the tongue phenomena. The Appendix to the book includes a corpus of over 4,000 observed slips of the tongue, showing the wide variety of errors which occur in normal speech utterances. There are at least three types of tongue slips, namely, phonologic, semantic, and psychological. An example of a semantic slip would be the speaker who was heard to say, "You could use that juice

for your soup." He meant to say "broth" instead of "juice." For some reason, he made an erroneous selection from the lexicon. Freud (Fromkin, 1973), of course, would suggest that many slips of the tongue are of psychopathologic orgin with unconscious psychic motivations. The present paper is not really concerned with the semantic slips of the tongue or with those which might have a psychopathic basis to them. It will be limited instead to the so-called phonologic errors that seem to reflect disturbances of motor programming. I would venture to say that the greatest number of tongue slips are of this type. For example, a radio announcer was heard to say "/rɛoə/ report" instead of "weather report." This is an anticipatory error in which the /w/ of "weather" is changed to /r/ in anticipation of the /r/ in "report." Or the speaker who said "/θæŋksgɪzɪŋ/" for "Thanksgiving." This is a perseverative error of the /v/ changing to /z/ because of perseveration of the earlier cognate sibilant, /s/. A Spoonerism is another type of motor programming error in which there is "an interchange of two nonadjacent parts" but which follows normal phonotactic rules and habits (Fromkin, 1973, page 105).

The speech errors noted in slips of the tongue and in tongue twisters are not random. They are predictable and follow orthodox rules and patterns. These are well described in the literature. The interesting question is whether the errors of apraxia of speech, which are also not random, but follow generally predictable patterns, conform to the same trends as described for slips of the tongue and tongue twisters. For example, in both apraxia of speech and slips of the tongue, anticipatory errors far exceed perseverative errors. However, more detailed comparison is not as easy as might at first seem.

Most of the studies of apraxia of speech have used frequency counts of sound substitutions, omissions, distortions and additions as the criterion measure. This type of analysis tends to overlook some of the nonphonemic errors, such as the groping and struggling behavior, the sound prolongations and repetitions, the false starts and pauses, the disturbed prosody, and so on. In other words, when there is a dysfunction of motor speech programming, there are more disturbances than simply phonetic substitutions, distortions, etc. Analysis of slips of the tongue tend to be simply a description of the utterance and the target elements, that is, what was intended and what was produced.

There is even more difficulty in describing the errors of normal speakers under conditions of producing tongue twisters. Kupin (1977) noted basically three types of errors in his study of tongue twister speech behavior. In a large proportion of the errors, each syllable is correctly formed, but the ordering is faulty. The second most frequently occurring type of error is an inappropriate substitution of one segment for another, and the third type of error is phonetic additions. An interesting research project would be one in which the errors in apraxia would be analyzed in the way that Kupin did to see whether the pattern follows the order as in tongue twister errors.

As an entirely different issue, it is extremely interesting that writings on the history of the English language may have some relevance to the topic of this paper. There is considerable evidence to suggest that a number of systematic phonetic changes have existed during the evolution of our language. For example, the English vowel shift was a modification in the pronunciation of certain vowels which differentiates

Old English from Modern English and which culminated in the fifteenth century. Other sound changes have not been as dramatic, but have occurred nevertheless in an orderly manner. The different types of changes are listed by historical linguists under various descriptive categories. There is progressive, regressive, and partial assimilation; dissimilation; anaptyxis; simplification of consonant clusters; prothesis; metathesis; apocope; malapropisms; etc. Some of these very same terms are used to describe the speech errors of apraxic patients. Furthermore, the literature on slips of the tongue and tongue twisters also employs these terms to characterize some of the speech errors of normal speakers. It is particularly intriguing that at least one author (Wise, 1957) had partially attributed these evolutionary sound changes to "the fading of the neurograms or neuromuscular patterns" (page 151). This view almost resembles the concepts of some type of neurologic command schema. Is it possible that we can explain the results of tongue twisters, slips of the tongue, natural historical phonological changes of a language, cluttering, and apraxia of speech all on the basis of motor programming systems?

Permit me now if you will to be overly simplistic in describing the process of motor speech programming. It is a very feeble-minded approach, but one which I have used with my students in trying to explain a very complex system in some concrete fashion. We seem to function as though there is a large bank of toggle switches in our brain, and we throw the switches in a particular sequential order, and the switches are activated some time prior to the actual utterances. I don't know what each individual toggle switch controls or how they are labeled, but I assume they have some relation to phonetic features, or something like that. The operator of the console occasionally lands on the wrong switch, or the switch is hit too early or too late. At any rate, I suspect the console is arranged so that switches which control similar articulatory elements are adjacent to or near each other. Thus, when the operator of the console has to reach quickly for a switch, the switch is missed by only one or two places or cells. This is why the speech errors tend to resemble in many ways the phonemes of the intended targets.

My concept of a bank or matrix of toggle switches might correspond to MacNeilage's (1970) "space coordinate system" or Kupin's idea (1977) that the speaker utilizes a computational system, in which he "computes" a part of the articulatory program of the utterance. The speaker uses a phonetic controller (what I refer to as a "console") which is assigned a set part of the phonetic task.

The data of Ladefoged, et al. (1972) show that perceptually similar vowels may be produced by different articulatory gestures. This suggests a variety of stored motor program units for a single acoustic output. If we can continue with my notion of a consóle or bank of toggle switches, this means that each switch controls a particular articulatory gesture, although it is possible a single acoustic output can be generated by using several different switches.

I wonder how this idea of motor programming might relate to apraxia of speech? Are the switches on the console simply rearranged in a different way for the apraxic patient? Maybe the switches are properly arranged, but the encoded instructions are confused. Maybe, on the other hand, the labels to the switches are erroneously placed. Laver (1973) suggests that for the normal speaker the planning function activates more items from storage

than it finally selects for the neurolinguistic program in such a way as to specify the timing and sequence of muscle actions. Perhaps in the case of apraxia of speech, there is a temporary loss of memory of a particular movement pattern from storage. The operator has forgotten what each switch controls.

Whether this naive description of the process of motor programming is accurate, I have no idea. But it does lend itself to an interesting way of thinking about it. I hope I have stirred some controversy, and that we can have some comments and reactions.

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