VERBAL DYSPRAXIA AND ITS TREATMENT

by

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ABSTRACT

The verbal dyspraxic individual experiences difficulty with oral expressive production which manifests itself in misarticulating, struggling to achieve the correct articulatory patterns and transitionalizing from one pattern to the next. Whether phonological selection errors occur is a controversial issue. Prosodic aspects of speech are often involved; however, whether as an integral part of the disorder itself or as a compensatory mechanism to preserve intelligibility is not entirely clear. General guidelines for treatment are outlined and are utilized in conjunction with a content network to comprise a therapy program. From his established baseline performance, each client progresses through the network in a step-wise fashion with a program individually tailored to meet his needs. With improvement less stimulus and response support from the clinician are required to achieve response criterion. For those who cannot achieve normal speech production, compensatory or other facilitating response variables are maintained.

The speech characteristics now associated with the term verbal dyspraxia have been described in the literature for over a century. It is recognized that Broca's 1861 description of aphemia, the loss of the faculty of articulated speech, was comparable with later descriptions of verbal dyspraxia. Credit for the first detailed description and use of the term apraxia goes to Hugo Liepmann, a German neurologist (1900, cited in Trost, 1970). However, Liepmann's interests were not specifically related to verbal material as his classification of apraxias into ideational, ideo-kinetic, and limb-kinetic types reveals.

The terms, apraxia or dyspraxia, have been used to refer to impairments in both speech and nonspeech motor movements, with consequent references to verbal dyspraxia, oral apraxia, and limb apraxia. When referring to speech, various other terms have been used, including apraxia of speech, cortical stuttering, and cortical dysarthria, etc. Verbal dyspraxia and apraxia of speech have had the most widespread usage in the literature and the impairment is usually defined as a motor speech programming disorder which occurs in the absence of paralysis, paresis, or disco-ordination of the neuromuscular system. Recent research findings have implicated involvement of the phonological system in the production of Broca's aphasics (Blumstein, Cooper, Zurif, and Carramaza, 1977) thereby suggesting that the view of verbal dyspraxia as simply a motor speech programming impairment is too narrow. This issue, discussed in detail below, is mentioned at this point to explain the adoption of a broader definition. Verbal dyspraxia refers to a breakdown in the phonological-articulatory aspects of speech-language production, resulting in articulatory errors and prosodic alterations. The disturbance is due to unilateral brain damage to the dominant hemisphere and occurs in the absence of paralysis, paresis, or disco-ordination of the neuromuscular system.

Verbal dyspraxia may be accompanied by oral apraxia or limb apraxia but can also occur independently (DeRenzi, Pieczuro, and Vignolo, 1966). Its occurrence as part of the symptom complex of Broca's aphasia is hotly disputed, with Darley and his co-workers (Darley, 1970; Johns and Darley, 1970) arguing for the independence of verbal dyspraxia from aphasia while Canter and his associates (Canter, 1969; Trost and Canter, 1974) and Martin (1973) and Martin and Rigrodsky (1974) argue for their association as features of Broca's aphasia.

Verbal dyspraxia is a disorder that occurs in both children and adults. In children, the disorder has been reported to occur in isolation or in association with language problems (Rosenbek

and Wertz, 1972). Generally, the diagnostic characteristics are superior receptive language skills compared to expressive language skills, with the latter being frequently difficult to evaluate due to unintelligible speech. Imitation skills are extremely poor and articulation is characterized by inconsistent substitution and omission errors. Consonants are more difficult to articulate correctly than are vowels and diphthongs. Phoneme production in isolation is better than in words and phrases. Articulatory diadochokinetic rates for single syllables, such as /pə, tə, kə/ are markedly better than those for a patterned sequence, such as /pətəkə/, which the child may not be able to produce correctly at all. Some children demonstrate normal prosodic aspects of speech; however, at a normal speech rate they are frequently unintelligible. Others modify prosodic aspects, using a slow rate and equalized stress. Yoss and Darley (1974a) suggest that the prosodic alterations are a compensatory mechanism used to maximize intelligibility.

The characteristics of verbal dyspraxia in adults have been described by many authors, with the work of Darley, Canter, Blumstein, and their co-workers representing three important sources. While the studies have used different stimuli, methods of presentation, and response scoring systems, researchers generally agree on the following characteristics.

1. Verbal dyspraxia differs from dysarthria and literal paraphasia.
2. There is a hierarchy of increasing difficulty for phonemes from vowels to singleton consonants to consonant clusters.
3. Phonemic substitutions are the most predominant error type. Substitutions are inconsistent.
4. Place of articulation is the most vulnerable feature to error.
5. The number of errors increases with increasing syllabic length of the word.

A more detailed delineation of characteristics can be obtained by referring to the bibliographical references.

Certain controversies about verbal dyspraxia can affect the treatment plan adopted by the speech-language pathologist and are therefore presented prior to the discussion of treatment.

The first controversy deals with the question of whether verbal dyspraxia is exclusively a motor problem — one of sequencing the neuromotor patterns for speech. Some advocate that sensory aspects, such as proprioception, are also involved (Hunter, 1975). Hunter argues that, in children, abnormal proprioceptive feedback interferes with the normal motor learning of articulatory gestures. However, she fails to provide empirical data to support her claim or to indicate the prevalence of proprioceptive deficits in children with verbal dyspraxia. Certainly, if its presence can be demonstrated, consideration should be given to it in a treatment plan. Because of her theoretical view of verbal dyspraxia as both a sensory and motor impairment, Hunter (1975) emphasizes oral proprioceptive and oral stereognostic experience during the early treatment phases of developmental dyspraxia. Since its usefulness was based on a subjective report, empirical validation of its effectiveness remains to be demonstrated.

Treatment of verbal dyspraxia has frequently included another sensory approach, training auditory perception. Despite its widespread use, Yoss and Darley (1974b) reported that the approach has met with little success when used with children.

In adults, Luria (1966) and Schuell et al. (1964) have described some production problems with impaired proprioceptive feedback as their basis, specifically afferent kinetic aphasia and simple aphasia with persisting dysarthria. Some authors (Chappell, 1973; Aten, Johns, and Darley, 1975) also noted auditory and/or oral perceptual deficits in some dyspraxic patients. However, these impairments are not present in the majority of adults (Trost, 1970) and are not considered as an integral part of the disorder.

In summary, most individuals demonstrating verbal dyspraxia do not evidence sensory impairment. However, should sensory impairment accompany verbal dyspraxia, the speech-language pathologist should account for its presence in the treatment plan.

The independence of verbal dyspraxia from language involvement serves as the subject matter of the second controversy. This issue is very important since it affects the very definition of verbal dyspraxia and can have a considerable impact on treatment programs. The question that obviously arises is: Is it important to consider linguistic variables when planning treatment for the verbal dyspraxic individual?

If linguistic variables do not influence motor speech programming, the error rate in verbal dyspraxic individuals should not be related to the meaningfulness of the stimulus material. However, Martin and Rigrodsky (1974) and Hardison, Marquardt, and Peterson (1977) found that subjects had more difficulty producing nonsense syllables than monosyllabic words. Level of abstraction of the words also influenced performance, with abstract words occasioning more production errors than concrete words (Dunlop and Marquardt, 1977; Hardison et al., 1977).

Length of stimuli, both in words and sentences, affects accuracy of production (Darley, Aronson, and Brown, 1975; Trost, 1970) in an inverse relationship. Degree of propositionality affects the dyspraxic individual in a similar manner (Darley et al., 1975). Position has been demonstrated to affect production, both with initial phonemes occasioning more errors than final (Trost, 1970; Dunlop and Marquardt, 1977) and with the initial noun phrase in a sentence occasioning more errors than the final one (Hardison et al., 1977).

More complex syntax increases the number of errors made by dyspraxic persons as Hardison et al. (1977) reported for passive versus active sentences. Finally, the stress placed on a word can influence its production. This phenomenon was first reported by Goodglass, Fodor, and Schulhoff (1967) and recently has been confirmed by Tonkovich and Marquardt (1977) with dyspraxic individuals who produce fewer errors on words with primary stress.

This evidence leads to the conclusion that several linguistic variables influence the accuracy of production in verbal dyspraxia with the implication that it is important to account for this in treatment. Failure to do so is a drawback to approaches such as the Rosenbek, Lemme, Ahern, Harris and Wertz (1973) eight-step approach or the Dabul and Bollier (1976) approach using rapid production of CV combinations.

A third controversy concerns whether therapy should employ meaningful material. Researchers do not agree on this point, with both sides of the coin being presented in both the child and adult literature. While Rosenbek, Hansen, Baughman, and Lemme (1974) advocated the use of meaningless material with children to avoid the interference from overlearned automatic meaningful productions, Chappell (1973) stressed using meaningful material as soon as possible. By contrast, for adults, Rosenbek et al. (1973) used meaningful material to establish early communication while Dabul and Bollier (1976) used nonsense syllables to initiate their program.

The differences of opinion on this point might partially arise from the initiation point of therapy. If the child or adult cannot produce isolated consonant (C) and vowels (V) and C-V transitions, then material must, of necessity be nonmeaningful. However, as soon as the dyspraxic individual has voluntary control of CV and VC productions, efforts should switch to meaningful combinations since both the child and adult need a functional communication system.

Keeping the controversies and their resolutions in mind provides relevant input to the design of treatment plans for the dyspraxic individual. The treatment approach outlined involves applying some general principles to a therapy content network. The general principles arise from our knowledge of verbal dyspraxia and from the clinical behaviour of dyspraxic clients. Because the client has difficulty calling up and/or co-ordinating the articulatory gestures for speech production, efforts are made to imprint the correct patterns and to have the client remember those patterns by using tactile, proprioceptive, visual or other imagery. With the patterns established, on subsequent occasions the correct ones will be produced. To accomplish this requires repetition and drill, practice in producing the correct pattern over and

over again. Because normal conversation requires retention of the correct pattern the subject needs to be able to produce it not only immediately following a model but also following a delay. Therefore, multiple productions emphasizing imprinting the pattern and ability to call up the accurate pattern on one's own are some initial principles.

The client's behaviour serves as the guide to the treatment program. The clinician starts at a level at which the client experiences some success. From here, the difficulty is increased by altering one variable in the content network. Mastery of each step is the signal to proceed to the next one. In this way, the client is always striving to reach a goal and is working at his maximum level. For all clients, totally normal speech production may not be a realistic goal. In these cases, compensatory mechanisms can be invoked. These can take the form of altering the articulatory patterns themselves, such as introduction of an intrusive schwa in consonant clusters (bəlu/blu). Alternatively, the prosodic aspects of speech production can be altered to tax the production system less. Possibilities include using a slow rate of speech and/or equalizing stress across syllables.

The content network to the verbal dyspraxia treatment plan consists of five areas: stimulation presentation method, stimuli, responses, facilitating response variables, and response criteria. By using the general guidelines and proceeding from the easiest or the most facilitating to the hardest and the most spontaneous context the goal is to establish, on a volitional basis, the appropriate gestures for phones, to sequence them into words, and to incorporate them into propositional speech.

Through baseline testing, the clinician determines where the client is performing. He then selects the appropriate stimulus presentation method and establishes an appropriate response criterion. Appropriate levels of stimuli and responses are selected from the difficulty hierarchies, accompanied by as many facilitating response variables as necessary. Progression occurs both within and across areas with the program being altered one step at a time, until normal speech production is achieved or until the client has progressed as far as possible.

Stimulus presentation methods (Table 1) use three input avenues separately or in combination: auditory, visual, and tactile. Auditory methods include providing an auditory model of the target production or providing auditory instructions for phonetic placement. Visual presentation can incorporate the client watching the clinician demonstrate the target and/or the client watching himself in a mirror. Graphic presentation of material can be via written words as a target for the model or via anatomical charts to represent articulator placement. Tactile presentation involves what has been called the motokinesthetic method in which the clinician manipulates the articulators into the correct position. Various combinations of these modalities can be used and the auditory-visual method has been advocated by some researchers. As much stimulus support as is necessary is used to initiate the program and, as the client can function with less stimulus support, it is reduced.

It is well known that some stimuli are easier for the dyspraxic individual to produce than others. Consequently, stimuli are organized in a hierarchy from easy to difficult (Table 1). Single vowels and diphthongs define the easy end of the continuum. Single consonants are next in line and, within this category, some are easier than others. Table 1 indicates how some of the consonants are ordered. Consonants are then combined with vowels, at first varying only the vowel, then only the consonant, and finally both. This leads to the selection of CVC, monosyllabic words which should start out as highly functional (for example, *bed* versus *tun),* high frequency (for example, *goat* versus *ram*); and concrete words (for example, *map* versus *more*). As the client improves these parameters can be altered to increase difficulty. Consonant clusters can then be incorporated into the monosyllabic words. Bisyllabic words or two word phrases are then introduced, initially with both portions having primary stress and later with various stress patterns. Syntactic units are then introduced, these stimuli obviously approaching sentences used in everyday communication. At the outset they are short and simple in structure, with a gradual increase in length and complexity.

TABLE 1

CONTENT NETWORK FOR VERBAL DYSPRAXIA TREATMENT PROGRAM

Stimulus Presentation Method	Stimuli	Responses	Facilitating Response Variables	Criterion Response
A. Auditory Auditory Model Phonetic Placement B. Visual Watch Clinician Mirror Use Provides Visual Feedback to Client Graphic Presentation written words Anatomical Charts C. Tactile Motokinesthetic Method D. Multimodal Auditory-Visual Auditory-Tactile Visual-Tactile Auditory-Visual-Tactile	Hierarchy from Easy to Difficult A. Vowels, Diphthongs B. Single Consonants Nasals m,n Glides l,r Plosives p,t,k Fricatives h,s,z,f + ʃ, ʧ, ʤ Dentals θ,v C. CV, VC Combinations C + Different V Different C + V Vary C and V D. CVC Monosyllabic Words Functional Words High Frequency Concrete Words E. Single Words with C Clusters F. Bisyllabic Words, Two Word Combinations Both syllables or words with primary stress G. Syntactic Units Short Simple	A. Clinician-Initiated Number Single response Multiple responses Time Unison Immediate repetition Delayed repetition Propositionality Automatic drill context Responsive response to question sentence completion Spontaneous B. Client-Initiated Spontaneous Short Simple phonologically syntactically	A. Slow Speech Rate B. Altered Prosody C. Compensatory Movements Approximations D. Associated Responses Body movement Tapping Rhythmical Activity	A. Qualitative Correct Intelligible B. Quantitative 80% Correct over 20 Trials Cumulative 80% Correct

More than one stimulus level might receive attention at a given point in therapy. One might work on easy bisyllabic words with more stimulus support from the clinician simultaneously with monosyllabic words containing consonant clusters on a spontaneous basis. The hierarchy in Table 1, based on research results (Johns and Darley, 1970; Trost, 1970; Trost and Canter, 1974) serves as a guideline for the treatment program rather than as an invariant prescription. Since every dyspraxic person will show some individual characteristics, the hierarchy for any client is structured according to his behaviour.

Responses can be dichotomized into two classes: clinician-initiated and client-initiated (Table 1). The easier class is the clinician-initiated, which provides a direct model or a facilitating context for the client's response. Variables such as the number of responses required, a single response or multiple productions following the stimulus, and the time relationship between the clinician's model and the client's production, from unison to immediate repetition to delayed repetition, scale responses from easy to more difficult. Propositionality is another relevant variable to consider since verbal dyspraxic individuals experience more difficulty as the level of propositionality increases. Progression occurs from an automatic level with drill activities, to responses to the clinician's questions or sentence completion and terminates when the client can spontaneously produce a response once the clinician has introduced a conversation or topic. Client-initiated responses are more difficult since they occur without a model and are highly propositional. They vary in linguistic complexity (phonological and syntactic), starting with short, simple responses and increasing to longer and more complex ones.

Facilitating response variables include responses used in conjunction with speech or speech alterations which will facilitate accurate speech production. These can be used during the initial phases of treatment with the idea of fading them out as the client no longer needs the response support. Of course, these facilitating conditions and compensatory mechanisms can be maintained if normal speech production does not appear to be a realistic goal. A slow rate of speech suggested here has been advocated by Darley et al. (1975) and others. Although a reduced rate concomitantly alters prosody to some extent, equalizing stress may be of additional assistance. To the extent possible, prosody will be returned to normal as the client is able; however, a realistic strategy is to sacrifice prosody for maintained intelligibility. Compensatory movements may alter the manner in which some phonemes are produced. The sequences of phonemes may also be altered, such as introducing the schwa into consonant clusters when C-C transitions are not possible. Sometimes a motor response which accompanies speech can facilitate initiation of production. In our clinic we have used rhythmical activities, such as finger tapping, clapping, or marching as facilitators. Of course, the latter two activities are more appropriate for children.

Criterion responses are classified as qualitative and quantitative. Respectively, they refer to the clinician's definition regarding what constitutes an acceptable response and what criterion level must be attained before advancing to the next level in the treatment plan. Of necessity, the clinician decides these issues based on sound clinical judgment. However, once the criteria are determined, it is the client's performance rather than some arbitrary decision which determines when to advance. There is no magic formula but the choices are important since they affect how rapidly a client can advance. Achievement of 80 percent correct over two blocks of 10 trials would seem to be a reasonable quantitative criterion. Note that this would be obtained considerably more rapidly than a cumulative 80 percent correct criterion, especially if the client had several sessions with few correct responses as is so frequently the pattern with these individuals. Not advancing until the client has achieved 100 percent correct, while advocated by some programs, seems to be an unduly stringent criterion, which may impede advancement rather than facilitate it.

By using the content network outlined and advancing in a step-by-step fashion, the client is led toward spontaneous production of propositional speech. The support from the clinician is gradually reduced as the client, through achieving estabished performance criteria, demonstrates his ability to function more independently. Although normal speech production is

TABLE 2

VERBAL DYSPRAXIA TREATMENT PROGRAM FOR RO

Step	Stimulus Presentation Method	Stimuli	Responses	Facilitating Response Variables	Criterion Response
I	Auditory-Visual	Bilabial and tip-alveolar consonants Bisyllabic words in isolation	Clinician-Initiated Single unison response of stimulus	Slow rate (1 syllable/second) Tapping (1 fingertap/ syllable)	Correct production of stimulus 70% correct over 2 blocks of 10 trials each
II			Single immediate repetition of stimulus		
III			Single delayed repetition (2 second delay)		
IV		Bisyllabic words in phrases	Single unison response		
V			Single immediate repetition		
VI			Single delayed repetition (2 second delay)		
VII		Bisyllabic words in sentences	Single immediate repetition		
VIII			Single delayed repetition (2 second delay)		
IX	Auditory	Incomplete subject-verb-object sentences requiring completion with a word containing bilabial or tip-alveolar phonemes	Sentence Completion Repetition of initial portion plus a spontaneous completion		

not an attainable goal for all clients, the treatment plan seeks to bring each person to his maximum level of functioning.

To illustrate how the proposed content network can be implemented clinically, two case studies are reported. RO, a 68 year old woman, became aphasic and right hemiplegic as a result of a stroke in 1977. When first assessed, she demonstrated severely impaired expressive language and severe verbal dyspraxia, with only mild to moderate impairment in auditory comprehension. By 1979, after two and one-half years of therapy, RO's auditory comprehension had recovered and she was able to formulate simple grammatically complete sentences. However, she continued to demonstrate word-finding difficulties and verbal dyspraxia. The degree of dyspraxia significantly interfered with her ability to communicate her ideas. If she could not produce the word(s) she would abandon her attempts to communicate by saying, "I don't know" or "Never mind." Improving dyspraxia became the focus of therapy and the program designed followed the principles and content network described previously. Therapy proceeded according to outlined steps with progression contingent upon reaching criterion at each step. Table 2 shows the therapy program. In Step I, all aspects of the content network are described. In subsequent steps, only the aspect(s) altered for that particular step is described. RO progressed from requiring an auditory-visual model to an auditory model alone. Stimulus difficulty increased from isolated words to incomplete sentences. Responses increased from unison repetition with the clinician to spontaneous completion of a sentence, with the first portion comprised of repetition. The facilitating response variables of a slow rate accompanied by simultaneous finger tapping were not altered since she was not able to maintain correct production without these facilitators. In fact, their continued and consistent use was stressed since this was associated with a higher rate of successful communication.

CR is a six year old boy who demonstrates moderate delay in his language skills, accompanied by verbal dyspraxia. Results of an interdisciplinary evaluation reported a normal clinical neurological evaluation, an abnormal EEG, fine motor co-ordination difficulties, and mild cognitive impairment. His articulation test performance was characteristic of verbal dyspraxia with frequent omissions, particularly in intervocalic and postvocalic positions. His phonemic substitutions were inconsistent and involved place and manner errors. Articulatory diadochokinetic rates for single syllables were in the low normal range, but he was unable to sequence the pattern /pətəkə/. He experienced greater difficulty with consonant clusters and/or as syllabic length of words increased. Because the verbal dyspraxia reduced his intelligibility, a program was designed to improve this area of functioning. The program proceeded in much the same format as that outlined for RO.

Stimuli in the program were initially monosyllabic words terminating in the /p, b, m/ phonemes, which CR could produce pre- and inter-vocalically. Phrases were introduced when criterion was met at the monosyllabic word level. Response difficulty increased from immediate imitation to spontaneous production. CR was able to carryover his progress such that he was producing the correct postvocalic phoneme in phrases 95 percent of the time in the clinical setting at the end of training. Since CR had difficulty with the syllabic units in words and phrases, frequently omitting syllables, a second aspect of the program emphasized awareness of and production of the correct number of syllables in these contexts. A facilitating response of clapping was used for CR to identify and produce the appropriate number of syllables in any utterance. He progressed from imitating the clinician's clapping to her stimulus to clapping spontaneously the correct syllable pattern for his own utterances (nouns, verbs and noun phrases). As well as the specific gains, general improvement was noted in his overall intelligibility which increased from 60-75 percent at the initiation of treatment to 85 percent, when the context was known to the clinician.

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