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Treatment of Dysarthria: Support by Evidence-Based Research and Expert Opinion

The term dysarthria refers to a group of motor speech disorders that vary in speech and voice characteristics, depending on the neurologic subsystems involved. Consequently, there are numerous approaches to the treatment of dysarthria, and these are also varied and can be organized in a number of different ways. Some textbooks organize treatment by dysarthria type (McNeill, 1997). Others suggest thinking in terms of speech subsystem involvement (e.g., respiratory, articulatory) and staging of disease severity (Yorkston, Beukelman, Strand, & Bell, 1999). Dysarthria treatment approaches are sometimes organized according to the treatment goal (e.g., rate control or increased loudness), or by specific method (e.g., AAC, biofeedback).

A comprehensive overview of evidence-based treatment in dysarthria is not possible within the format of the newsletter. Rather, we have chosen specific approaches from among these different organizational schemes: (a) treatment of respiratory/phonatory deficits, (b) treatment of rate control, (c) nonspeech oral motor training, and (d) augmentative and alternative communication. The four areas of intervention were chosen because they are frequently the focus of treatment in dysarthria. We have gathered a number of experienced clinician-researchers to discuss these intervention approaches. They were asked to provide an update on the treatment strategies suggested for each approach, and summarize the research evidence supporting the use of each.

Kristie Spencer leads off with an overview of intervention approaches in the area of respiratory/phonatory function. Her article comes from the larger body of work by the committee to establish Practice Guidelines for the management of dysarthric speakers. She summarizes the research evidence, as well as expert opinion available, regarding intervention of the respiratory/phonatory deficits that typically occur with dysarthria of different types. She reviews 35 intervention articles covering four general categories of treatment and summarizes expert opinion regarding these types of intervention. The combination of research evidence and expert opinion is organized by general “treatment paths” which focus intervention toward improving respiratory support, respiratory/phonatory coordination, and/or phonatory function. Kristie’s article concludes by noting that evidence-based support does exist for at least two treatment approaches in each of the three main treatment paths. Her comprehensive discussion provides the clinician guidance in clinical decision making about the management of the respiratory/phonatory deficits in dysarthric individuals.

The second article by Vicki Hammen focuses on strategies for rate control. Vicki reviews the different types of rate control discussed in the literature, factors considered in the selection of a specific rate control method, and the impact of rate control on speech production. She differentiates the impact of rigid versus rhythmic rate control strategies and provides support...
from the research literature for their use. The research support for indirect effects on rate reduction is also addressed. Finally, Vicki utilizes expert opinion to discuss criteria for selecting a rate control approach.

Megan Hodge offers a comprehensive overview of the research support for nonspeech oral motor treatment approaches for dysarthria. She begins with a definition and description of the range of activities (both nonspeech and speech-like) that are typically considered to be “oral motor treatment.” Her discussion is especially helpful given that the term *oral-motor* is used so pervasively and in different ways in the clinical literature. Megan discusses reasons for the opposing views about the effectiveness of these nonspeech oral motor approaches to the treatment of dysarthria. She then provides a comprehensive review of the literature examining the effectiveness of these techniques, pointing out that few controlled experimental studies have been published that examine the application of these techniques to either children or adults with dysarthria. Megan also provides a perspective from the occupational and physical therapy literature, noting that there has been a shift away from more traditional neurophysiological therapy approaches to ones based on task-oriented models. Her article concludes with a suggested list of questions to assist the clinician in clinical decision making regarding the use of nonspeech oral-motor treatment approaches.

The final article, by Pamela Mathy, provides a review of the use of alternative and augmentative (AAC) intervention for individuals with acquired dysarthria. Pamela describes a model for clinical decision-making that is based on stages of functioning or disease progression. The model is multidimensional in that planning for AAC intervention requires consideration of speech, language, cognitive, physical, and visual functioning. Low and high technology devices, as well as those strategies for which no external device is needed, are reviewed in this article, with examples of their use from the literature. Pamela points out, however, that most of the support for the use of AAC for individuals with dysarthria comes from case studies and anecdotal clinical evidence. She concludes her article by pointing out the need for controlled studies examining the efficacy of AAC interventions for individuals with acquired dysarthria.

One of the goals of this volume of *Perspectives* has been to bridge current research with clinical practice by providing articles related to evidence-based intervention. Providing clinicians with a summary of support for particular treatment approaches as well as calling for prudence in others may help speech pathologists in clinical decision-making. The group of articles in this issue illustrates that, although speech-language pathology is moving in the direction of evidence-based practice, we still have a way to go. There is still limited treatment efficacy evidence for many treatment approaches commonly used in treating dysarthric individuals.

The Academy of Neurologic Communication Disorders and Sciences (ANCDS) is moving forward in the development and publication of evidence-based practice guidelines for the management of neurologically based communication disorders. This work began consequent to the 1997 Joint Leadership Conference, which was co-sponsored by Division 2 and ANCDS. The initial focus was to establish practice guidelines for the management of speakers with dysarthria. Please refer to publications completed to date (Golper et al., 2001; Yorkston et al., 2001), as well as the ANCDS Web site (www.ancds.duq.edu) for updated technical reports.

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**References**


Evidence for the Treatment of Respiratory/Phonatory Dysfunction From Dysarthria

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Respiratory and phonatory subsystem disruption is a common manifestation of dysarthria, and can have a formidable impact on speech production. Treatment of respiratory and phonatory subsystems is often given priority, because improvements at this level are believed to generate improvements in other aspects of speech as well (Hayden & Square, 1994; Netsell & Daniel, 1979; Ramig, 1992; Rosenbek & LaPointe, 1985; Yorkston, Beukelman, Strand, & Bell, 1999). The management of respiratory/phonatory dysfunction, therefore, is often a fundamental element of the therapeutic process when providing services to speakers with dysarthria.

The clinical decision-making required when treating speakers with respiratory/phonatory deficits can be quite complex, particularly given the often concomitant involvement of the other speech subsystems and the heterogeneity of speakers with respiratory/phonatory dysfunction from dysarthria. Guidance for management decisions can be provided, in part, from knowledge of the support available for various treatment options. The support for a particular management technique may come from research evidence or from expert opinion. Evidence-based support from the research literature implies that positive outcomes have been reported for a minimum of one intervention study for at least one person with dysarthria. Conversely, support from expert opinion suggests that while data-based evidence was not available for that particular technique, support was derived from the training or experience of an expert. These techniques are acknowledged in textbooks or review articles by experts in the field of speech-language pathology.

The delineation of the types of support for specific management strategies is not intended to dictate or limit the management decisions made by clinicians. Rather, this information is intended to offer guidance for clinicians and researchers alike who are interested in the existence and nature of support for management options.

This article emerged from a larger effort by an Academy of Neurologic Communication Disorders and Sciences committee to establish evidence-based practice guidelines for the management of speakers with dysarthria. It is meant to highlight the research evidence and expert opinion available for the behavioral management of respiratory/phonatory dysfunction from dysarthria and is by no means a conclusive set of guidelines for practice. Readers may refer to the technical report (http://www.ancds.duq.edu/guidelines.html) or pertinent articles (Spencer, Yorkston, & Duffy, submitted; Yorkston, Spencer, & Duffy, submitted) for more detailed and comprehensive information.

Research Evidence

Searches of electronic databases (PsycINFO, MEDLINE, and CINAHL) and books in the field of dysarthria and voice disorders yielded 35 studies of behavioral intervention for respiratory/phonatory dysfunction in at least one person with dysarthria. Although this intervention research began in 1979, the majority of studies were conducted in the last decade. Tables 1 through 5 (on pages 13-16) provide general information on each study, including the experimental design, psychometric adequacy, level of experimental control, and types of outcomes measured. The psychometric adequacy of each study was assessed by indicating whether information was provided regarding reliability and stability of the measurement of the outcomes (e.g., inter- or intra-rater reliability). Evidence for experimental control also was noted—that is, evidence that the intervention rather than other factors was responsible for the change. Additionally, the outcome measures of each study were grouped according to levels of disablement, specifically, whether the outcomes were measured at the level of impairment, activity, or participation restrictions (World Health Organization, 2001).

Four general categories of treatment focus emerged from the 35 intervention studies. Various forms of biofeedback were utilized as a primary form of treatment in 10 of the 35 studies. Six studies reported the use of devices to address respiratory/phonatory impairment (two of these were included in the biofeedback category as these particular studies examined more than one treatment approach). There were 16 studies of the Lee Silverman Voice Treatment. Finally, three studies examined the efficacy of group therapy (i.e., the use of the same treatment strategies with two or more clients concurrently) for respiratory/phonatory impairment. Two studies did
not conform to these general categories: the Murry and Woodson (1995) investigation of voice treatment after Botox injections and the Cerny, Panzarella, and Stathopoulos (1997) study of expiratory resistive breathing. For each treatment category, we will review the primary clinical populations studied, the experimental designs used, the level of methodological rigor, and the dispersion of outcome measures based on the World Health Organization's levels of disablement.

Biofeedback techniques were used in the respiratory/phonatory intervention studies to provide participants with feedback on the physiologic variables of intraoral air pressure, chest wall movements, lung volume, and pitch. Treatments were implemented in speakers with flaccid and mixed dysarthrias from traumatic brain injury (TBI; n=4 speakers), hypokinetic dysarthria from Parkinson’s disease (n=39), and spastic, flaccid or mixed dysarthrias from stroke (n=3). Case studies and single subject designs were most common (8/10 studies). These designs are consistent with the need to tailor biofeedback to the physiologic variables that are appropriate for individual speakers. The psychometric adequacy was satisfactory for 7/10 biofeedback studies, and experimental control was evident in 9 of 10 studies. Thus, the reported results from this category can be accepted with a fairly high level of confidence. In Figure 1, outcomes from biofeedback studies typically were measured at the level of impairment. Measures of activity and participation were less common. Frequently, the relationship between changes at the level of the impairment and changes in activity/participation was unclear. In one case, physiologic measures changed in the desired way, but perceptual assessment suggested unremarkable progress in speech production (Murdoch, Pitt, Theodoros, & Ward, 1999). In other cases, measures of activity or participation were not systematically obtained, so a comparison between changes in impairment and changes in activity/participation could not be made.

Six studies focused on the therapeutic benefit of devices such as delayed auditory feedback (DAF), voice amplifiers, and masking devices. Treatments were implemented primarily in speakers with dysarthria from Parkinson’s disease (n=15), as well as one speaker with progressive supranuclear palsy and one speaker with basilar artery stroke. All of these studies were case reports or single subject designs. Psychometric adequacy was established in 5/6 studies. All studies demonstrated adequate experimental control by comparing performance with and without use of the device. As shown in Figure 1, outcomes were frequently measured at the level of impairment, often in conjunction with measures at the level of activity, such as speaking rate and speech intelligibility. Communication participation was not studied systematically.

The Lee Silverman Voice Treatment (LSVT) was the most extensively studied form of respiratory/phonatory intervention. Treatments were implemented primarily with speakers with Parkinson’s disease (total subjects equal 90+), but also have been applied to speakers with Parkinson’s Plus syndromes (n=3), multiple sclerosis (n=2), and traumatic brain injury (n=1). Studies were either group designs (n=9) or case reports (n=7). Outcome measures were psychometrically sound in 13/16 studies, and experimental control was satisfactory in all studies. It should be noted that among these studies, those published later improved upon earlier methodological limitations, such as reporting only pre- and post-treatment measures without control groups. Outcome measures of impairment included a broad range of acoustic variables along with aerodynamic and kinematic measures in some studies. As shown in Figure 1, outcome evaluation frequently included activity/participation variables, using both formal measures (e.g., the Sickness Impact Profile, described by Bergner, Bobitt, Carter, & Gilson, 1981) and informal measures (e.g., patient reports of confidence during social situations).

Figure 1. The dispersion of outcome measures based on the World Health Organization’s (2001) levels of disablement.
Three studies addressed group therapy for respiratory/phonatory dysfunction in dysarthria, and each focused on speakers with Parkinson’s disease (n = 38). Interventions included one case series, one group design with control participants, and one group design without control participants. The psychometric adequacy and experimental control of the studies were generally lacking, suggesting a more cautious acceptance of findings from this research category. For the few studies available, outcome measures were fairly evenly distributed between measures of impairment and activity/participation.

Combining Evidence-Based Research With Expert Opinion

Our knowledge of treatment for respiratory/phonatory dysfunction from dysarthria stems from more than research evidence. A wealth of information also exists in the opinions of experts in the field of speech-language pathology. It is the combination of research evidence and expert opinion that forms the foundation of our knowledge of treatment for speakers with respiratory/phonatory dysfunction. One way to conceptualize this corpus of information is by general treatments paths, specifically, treatments to improve (1) respiratory support, (2) respiratory/phonatory coordination and control, and (3) phonatory function. If respiratory/phonatory functioning is impaired, it is apt to stem at least in part from one (or more) of these three areas. Despite the natural coupling of the respiratory and phonatory systems, this theoretical separation encourages clinicians to approach treatment methodically. For each treatment path, information will be summarized regarding (a) general candidacy issues, (b) the evidence-based support for a particular approach, and (c) expert opinion regarding that treatment approach. Techniques lacking support from either experts or the research literature also will be noted.

Improving Respiratory Support

The term decreased respiratory support is broadly defined as insufficient breath support for speech. Lack of appropriate breath support would likely manifest as reduced loudness, short phrases, and reduced pitch and loudness variability. This constellation of signs from weakened respiratory drive is most often found in persons with flaccid dysarthria, but can result from other forms and combinations of dysarthria. Depending on the abilities, needs, and stimulability of an individual patient, clinicians may opt to use one or more of the following treatment approaches to address reduced respiratory support: (a) nonspeech tasks, (b) postural adjustments, (c) prosthetic assistance, and (d) speech tasks.

Nonspeech Tasks

Generally, intervention focusing on nonspeech activities is limited to speakers unable to generate adequate subglottal air pressure to support phonation. Nonspeech tasks are typically inappropriate for patients who can perform speech exercises to accomplish the treatment goal (Duffy, 1995). The following techniques have evidence-based support from the dysarthria intervention literature for improving respiratory support:

- Breathing against resistance through a simple water manometer or blow bottle (Daniel-Whitney, 1989; Hixon, Hawley, & Wilson, 1982; Netsell & Daniel, 1979; Workinger & Netsell, 1992), or a resistive mask (Cerny, Panzarella, & Statopoulos, 1997)
- Pushing and pulling techniques (Workinger & Netsell, 1992)
- Biofeedback of chest wall movement, to help increase abdominal movement and overall lung volume (Thompson-Ward, Murdoch, & Stokes, 1997)

There are several nonspeech tasks that are not substantiated by dysarthria intervention research, but are instead supported by expert opinion. Some of these techniques arise from a similar physiologic rationale for improving respiratory support as the above methods, and include:

- Maximum inhalation and exhalation tasks (Ramig & Dromey, 1996; Ramig, Pawlas, & Countryman, 1995)
- Controlled exhalation tasks (Brookshire, 1992; Murry & Woodson, 1995; Ramig & Dromey, 1996; Ramig, Pawlas, et al., 1995)
- Breathing against resistance through pursed lips (Solo-mon & Charron, 1998)
- Using an air pressure transducer with feedback from an oscilloscope or computer screen
- Sustaining phonation with feedback from Visipitch or the VU meter on a tape recorder

Techniques lacking empirical or expert support include blowing with items such as balloons, bubbles, feathers; applying pressure or vibration to various body parts such as the diaphragm or ribs; applying ice to the diaphragm; and electrical stimulation.
Postural Adjustments

The nature of the postural adjustments will depend on many factors, including the degree of the patient’s inspiratory versus expiratory difficulty, the level of the patient’s voluntary motor control, and his or her concomitant medical/physical difficulties. At present, the efficacy of using postural adjustments to manage respiratory/phonatory dysfunction is largely unknown. Postural manipulations have been used as a relatively inconsequential part of larger treatment programs with unknown influences on the outcome measures (e.g., Murdoch et al., 1999). Generally, guidance for intervention in this area stems primarily from expert opinion only. In sum, patients with significant inspiratory problems may perform best in the upright position, because gravity can assist in lowering the diaphragm into the abdomen upon inspiration (Duffy, 1995). Conversely, individuals with expiratory difficulties may benefit from the supine position, because gravity and abdominal contents help to push the diaphragm into the thoracic cavity to assist expiration (Netsell & Rosenbek, 1985). Appropriate positioning for adequate physiologic support can be accomplished using adjustable beds and wheelchairs and chairs with adjustable backs (Yorkston et al., 1999). Limitations of this approach are discussed by Hoit (1995) and Yorkston and colleagues (1999). The long history of position modifications has been motivated, in part, by a neurodevelopmental treatment (NDT) framework (Redstone, 1991). However, reviews of the literature (e.g., Solomon & Charron, 1998) suggest that efficacy of NDT for breathing or speech has not been established.

Prosthetic Assistance

In rare cases, prosthetic devices may be necessary to supplement expiratory forces during speech. Abdominal trussing, or the process of fixing the abdomen inward relative to rest position, has garnered some empirical support for patients with severe dysarthria (Simpson, Till, & Goff, 1988) and spinal cord injury (Watson & Hixon, 2001). The use of expiratory boards or paddles, however, is supported by expert opinion only (Rosenbek, 1984) and is not substantiated by dysarthria intervention research.

Speech Tasks

Improvements in respiratory support are ideally targeted during actual speech production.

Numerous research studies have reported improvement of various aspects of respiratory support from biofeedback treatment (McNamara, 1983; Murdoch, Pitt, Theodoros, & Ward, 1999; Ramig & Dromey, 1996; Simpson, Till, & Goff, 1988; Thompson-Ward, Murdoch, & Theodoros, 1997). Various forms of biofeedback can be used to allow patients to gauge both respiratory force and ability to maintain consistent subglottal air pressure while speaking. Speech stimuli can progress from speech-like tasks, such as repetition of syllables, to utterances of increasing length. Manipulations of breathing patterns during speech production also can improve respiratory support, although the suggested methods are supported by expert opinion only. These methods include practice inhaling more deeply or using more force when exhaling during speech (Hammen & Yorkston, 1994; Ramig, 1986; Ramig, Pawlas, et al., 1995), inspiratory checking (Netsell, 1992; Netsell, 1995), and abdominal or diaphragmatic breathing (Thompson-Ward et al., 1997).

Respiratory/Phonatory Coordination/Control

The term decreased coordination and control implies that the individual has adequate respiratory support, but difficulty with the synchronization of breathing and speaking. Speech signs might include excess loudness variations, inappropriate silences, a harsh voice quality, inappropriate breath patterning, transient breathiness, and voice stoppages. Deviant speech signs of this nature most often stem from the abnormal, involuntary movements associated with the hyperkinetic dysarthrias or from the inaccurate timing and range of movement associated with ataxic dysarthria. It is also quite possible for clients with diffuse or multifocal brain injury to evidence both inadequate respiratory support and decreased coordination/control. Techniques in this treatment path are designed to stabilize respiratory/phonatory patterns during speech and can be divided into nonspeech and speech tasks.

Nonspeech Tasks

The caveat regarding non-speech tasks outlined in the previous section applies here as well, that is, nonspeech tasks are often inappropriate for patients who can perform speech exercises. Only one research study exists which supports the use of nonspeech tasks to increase control of respiration: Murdoch and colleagues (1999) implemented nonspeech tasks as part of the respiratory treatment for a child with persistent dysarthria following severe TBI. Support from expert opinion, however, is available for several nonspeech techniques, which mainly derive from the treatment of children with cerebral palsy. These include

1. Practicing an effective breathing pattern (quick inspirations and slow, controlled exhalations),
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2. Using inspiratory checking without speech if it is problematic for the patient to speak on controlled exhalations (Net-sell, 1992),

3. Facilitating inspiratory coordination/speed through sniffing or exhalatory coordination through blowing, and

4. Practice switching between inspiration and expiration.

These techniques are not restricted to patients with dysarthria from cerebral palsy; similar strategies have been suggested for use with other patient populations, such as individuals with spastic dysarthria (Thompson, Murdoch, & Theodoros, 1997) and mixed dysarthria (Murdoch et al., 1999).

Speech Tasks

With the exception of a study by Thompson-Ward and colleagues (1997), the use of speech tasks to improve respiratory/phonatory coordination and control is supported by expert opinion, rather than research evidence. Thompson-Ward and colleagues provided feedback on chest wall movement and phonation to train a speaker with spastic dysarthria to learn to phonate throughout the breath stream.

In general, patients who experience difficulty with respiratory/phonatory coordination or control may benefit from improved awareness of the speech-breathing pattern—that is, quick inspiration followed by prolonged exhalation during speech production. Patients may need to modify how much air is inhaled prior to speaking and may need to learn how to control air use during speaking. Instrumental feedback from Respitrace and magnetometers, for example, can be particularly useful for demonstrating the desired breathing pattern. Speakers also can be instructed to use “optimal breath groups” (Linebaugh, 1983)—that is, the number of syllables that can be produced comfortably on one breath. Once a baseline is established, the targeted length of phrases and sentences uttered in a single breath group can be gradually increased to encourage respiratory control. Additionally, inspiratory checking may prove useful for speakers who release excessive airflow through the larynx when they speak (Net-sell, 1995). Finally, Yorkston and colleagues (1999) provided suggestions regarding the training of respiratory flexibility, which include practice reading cued and uncued conversational scripts with and without a conversational partner.

Reduced Phonatory Function

Reduced phonatory function refers to hypoadduction or hyper-adduction of the vocal folds. Hypoadduction often results in breathiness, hoarseness, and reduced loudness and is most often associated with flaccid and hypokinetic dysarthrias. Hyper-adduction typically manifests as harsh/strained vocal quality, slow rate of speech, and low pitch and is typical of persons with spastic and hyperkinetic dysarthrias. Reduced phonatory function can, and often will, overlap with decreased respiratory support or decreased coordination/control. Hyperadduction also may occur as a compensatory mechanism for managing weakness at the laryngeal or velopharyngeal level. Behavioral techniques to improve hypoadduction generally include (a) physical strategies to enhance adduction or (b) loudness training via the Lee Silverman Voice Treatment.

Enhancing Adduction

Various physical strategies can be implemented to address phonatory impairment from vocal fold hypoadduction. These strategies fall under the broad categories of effort closure techniques, postural adjustments, and physical manipulations. As a whole, these treatment strategies are supported by expert opinion only. Research evidence does exist, however, for intervention using effort closure techniques for respiratory/phonatory dysfunction from dysarthria (DeAngelis, Mourao, Ferraz, Behlau, Pontes, & Andrade, 1997; Workinger & Net-sell, 1992).

Effort closure techniques are exercises that increase the adductory forces of the vocal folds by modifying background of effort. Examples include clasping hands and squeezing palms together as hard as possible (Aronson, 1990; Dworkin & Meleca, 1997; Yamaguchi et al., 1993) or pushing against a lap board on a wheelchair (Rosenbek, 1984). Some limitations associated with these techniques have been discussed by Solomon and Charron (1998) and Yamaguchi and colleagues (1993).

Postural adjustments also have been cited as a behavioral strategy for treating speakers with hypoadduction (Aronson, 1990; Duffy, 1995; Ramig, 1995; Yorkston et al., 1999). The primary strategy suggested for speakers with vocal fold weakness is to turn their head to the left or right during phonation. This postural change may increase the tension of the paretic/paralyzed fold (Ramig, 1995). However, head turning can be considered a pragmatically undesirable solution to the hypoadduction and may not lead to any true improvement in vocal fold adduction (Rosenbek & LaPointe, 1985).

Physical manipulations of the thyroid cartilage occasionally are used to improve vocal quality and loudness in speakers with hypo-adduction. This
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technique requires the speech-language pathologist to gently push on the larynx while the speaker phonates. It has been used to successfully elicit voicing from two speakers with whispered phonation following TBI (Sapir & Aronson, 1985). However, positive results from laryngeal compression in chronic conditions should prompt consideration of surgical treatment options, such as vocal fold repositioning or medialization (Dworkin & Meleca, 1997).

**Loudness Training**

The Lee Silverman Voice Treatment program is an intensive behavioral treatment developed by Ramig, Pawlas, and Countryman (1995) to improve the oral communication of speakers with hypokinetic dysarthria. Ramig and colleagues have conducted a series of studies to demonstrate the efficacy of LSVT, and continue to investigate its use in patients with idiopathic Parkinson’s disease and other neurologic disorders. The effectiveness of LSVT is well-established in speakers with dysarthria from mild to moderate Parkinson’s disease. At present, there is less evidence to support the long-term efficacy of LSVT for speakers with severe Parkinson’s disease or other disorders associated with basal ganglia pathophysiology. Research on the use of LSVT with other neurologic disorders, such as multiple sclerosis, TBI, and stroke is promising, but it is premature to draw conclusions regarding efficacy in these clinical populations.

Behavioral techniques to address hyperadduction of the vocal folds in persons with dysarthria can be grouped as nonspeech techniques and speech tasks. Behavioral treatment of voice quality often is not undertaken for hyperadduction in speakers with dysarthria, because it is quite difficult to modify and may result in a negligible improvement of intelligibility (Duffy, 1995). If the dysphonia is felt to contribute to the speaker’s overall disability, traditional voice techniques designed to reduce laryngeal hyperadduction and increase airflow through the glottis may be appropriate (Pann-backer, 1998).

Nonspeech techniques for improving hyperadduction generally include relaxation strategies and biofeedback. To date, no studies demonstrating the efficacy of muscle relaxation or massage are available. Relaxation strategies, such as the “rag doll” technique (Dworkin & Meleca, 1997) or progressive whole body relaxation (McClosky, 1977), report inconsistent success for improving hyperadduction from dysarthria. Several types of biofeedback on airflow or laryngeal muscles may be used to address dysphonia from hyperadduction. Dworkin and Meleca (1997) suggested using VisiPitch to provide biofeedback of nonvocal airflow control. Ramig (1995) suggested electromyographic and videendoscopic feedback to provide speakers with information on the level of laryngeal muscle tension. There is no research available to support nonspeech biofeedback treatments for hyperadduction due to dysarthria.

Speech tasks for addressing hyperadduction tend to focus on traditional tension-reducing strategies and biofeedback-enhanced relaxation. Traditional approaches to reducing laryngeal tension during speech include strategies for easy onset of phonation, such as the “yawn-sigh” or “chanting” techniques (Darley, Aronson, & Brown, 1975; Dworkin & Meleca, 1997). Murry and Woodson (1995) conducted effort-reducing voice treatment with a group of speakers with extrinsic muscle hyperfunction and airflow abnormalities following Botox injection for spasmodic dysphonia. The investigators found that speakers who received both Botox treatment and behavioral treatment demonstrated improved phonation in terms of increased airflow rate and acoustic measures. Biofeedback during speech may help speakers monitor levels of extrinsic laryngeal muscle tension. This feedback can be electromyographic, videendoscopic, or aerodynamic. Visual biofeedback of vocal fold vibrations would allow the speaker to practice modifying phonatory behaviors during vowel exercises. A progressive hierarchy can be implemented from vowels to syllables, words, and sentences. No studies are available to document the effectiveness of biofeedback in reducing hyperadduction due to dysarthria.

**Conclusions**

Clinical management decisions can be guided by an understanding of the support available for various treatments aimed at respiratory/phonatory dysfunction. Evidence-based support exists for at least two approaches in each of the three main treatment paths: (a) improving respiratory support, (b) increasing respiratory/phonatory coordination and control, and (c) improving phonatory function. The most studied treatment approach is the LSVT, which has demonstrated efficacy for persons with mild-moderate dysarthria associated with idiopathic Parkinson’s disease. If candidacy requirements for a treatment with evidentiary support are met, clinicians may be directed to that particular treatment for an
individual patient. In addition to the evidence, expert opinion is available for many management options. While these techniques do not have the desired support of the research literature, they serve to offer therapeutic guidance to clinicians with the caveat that supportive evidence is lacking. It is hoped that the delineation of management strategies and the corresponding levels of support will prompt treatment efficacy research in the areas that lack strong evidence-based support.

Acknowledgments

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References


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Table 1. Summary of evidence-based studies using biofeedback

<table>
<thead>
<tr>
<th>Reference</th>
<th>Type of Study</th>
<th>Treatment</th>
<th>Number of Subjects</th>
<th>Type of Dysarthria</th>
<th>Medical Diagnosis</th>
<th>Evidence for experimental control</th>
<th>Psychometric Adequacy</th>
<th>Outcome Measures of Impairment</th>
<th>Outcome Measures of Activity or Participation</th>
</tr>
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<tbody>
<tr>
<td>Netsell &amp; Daniel (1979)</td>
<td>case</td>
<td>Pressure biofeedback program</td>
<td>1</td>
<td>flaccid</td>
<td>TBI</td>
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<td>Yes</td>
<td>Yes</td>
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<tr>
<td>McNamara (1983)</td>
<td>case</td>
<td>Hypertonic exercises; biofeedback</td>
<td>1</td>
<td>flaccid</td>
<td>CVA</td>
<td>absent</td>
<td>absent</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Scott and Caird (1983)</td>
<td>group with controls</td>
<td>Prosodic exercises with and without visual feedback</td>
<td>26</td>
<td>not specified</td>
<td>PD</td>
<td>present</td>
<td>present</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Rubow and Swift (1985)</td>
<td>single subject design</td>
<td>Portable biofeedback device</td>
<td>1</td>
<td>not specified</td>
<td>PD</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Simpson, Till, and Goff (1988)</td>
<td>case</td>
<td>Abdominal binder, biofeedback, voice amplifier</td>
<td>1</td>
<td>not specified</td>
<td>Basilar artery stroke</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Daniel-Whitney (1989)</td>
<td>case</td>
<td>Biofeedback of intraoral air pressure</td>
<td>1</td>
<td>spastic-ataxic</td>
<td>TBI</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Johnson and Pring (1990)</td>
<td>group with controls</td>
<td>&quot;Less intensive&quot; treatment targeting pitch and volume with visual feedback</td>
<td>12</td>
<td>not specified</td>
<td>PD</td>
<td>present</td>
<td>absent</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Workinger and Netsell (1992)</td>
<td>case</td>
<td>Respiratory support and coordination exercises</td>
<td>1</td>
<td>not specified</td>
<td>TBI</td>
<td>limited</td>
<td>absent</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Thompson-Ward, Murdoch, and Stokes (1997)</td>
<td>single case design</td>
<td>Two types of biofeedback of respiratory kinematics</td>
<td>1</td>
<td>spastic</td>
<td>CVA</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Murdoch, Pitt, Theodoros, and Ward (1999)</td>
<td>single case design</td>
<td>Traditional therapy versus physiological biofeedback</td>
<td>1</td>
<td>spastic-ataxic-flaccid</td>
<td>TBI</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
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### Table 2. Summary of evidence-based studies using devices

<table>
<thead>
<tr>
<th>Reference</th>
<th>Type of Study</th>
<th>Treatment</th>
<th>Number of Subjects</th>
<th>Type of Dysarthria</th>
<th>Medical Diagnosis</th>
<th>Evidence for Experimental Control</th>
<th>Psychometric Adequacy</th>
<th>Outcome Measures of Impairment</th>
<th>Outcome Measures of Activity or Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hanson and Metter (1980)</td>
<td>case</td>
<td>Delayed auditory feedback</td>
<td>1</td>
<td>hypokinetic</td>
<td>PSP</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Hanson and Metter (1983)</td>
<td>case series</td>
<td>Delayed auditory feedback</td>
<td>2</td>
<td>hypokinetic</td>
<td>PD</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Rubow and Swift (1985)*</td>
<td>single subject</td>
<td>Portable biofeedback device</td>
<td>1</td>
<td>not specified</td>
<td>PD</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Simpson, Till, and Goff (1988)*</td>
<td>case</td>
<td>Voice amplifier</td>
<td>1</td>
<td>not specified</td>
<td>Basilar artery stroke</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Adams and Lang (1992)</td>
<td>case series</td>
<td>Masking noise to increase voice intensity</td>
<td>10</td>
<td>not specified</td>
<td>PD</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Cariski and Rosenbek (1999)</td>
<td>case series</td>
<td>Speech Enhancer with and without behavioral treatment</td>
<td>2</td>
<td>hypokinetic</td>
<td>PD; multiple strokes</td>
<td>present</td>
<td>absent</td>
<td>No</td>
<td>Yes</td>
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</table>

*Also included in summary of biofeedback studies; overall treatment included both approaches.*
### Table 3. Summary of evidence-based studies using the Lee Silverman Voice Treatment Program

<table>
<thead>
<tr>
<th>Reference</th>
<th>Type of Study</th>
<th>Treatment</th>
<th>Number of Subjects</th>
<th>Type of Dysarthria</th>
<th>Medical Diagnosis</th>
<th>Evidence for Experimental Control</th>
<th>Psychometric Adequacy</th>
<th>Outcome Measures of Improvement</th>
<th>Outcome Measures of Activity or Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Countryman and Ramig (1993)</td>
<td>case</td>
<td>LSVT</td>
<td>1</td>
<td>mixed hypokinetic-spastic</td>
<td>PD (with bilateral thalamotomy)</td>
<td>limited</td>
<td>present</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Countryman, Ramig, and Pawlas (1994)</td>
<td>case series</td>
<td>LSVT</td>
<td>3</td>
<td>not specified</td>
<td>Parkinsonian Plus Syndrome</td>
<td>limited</td>
<td>present</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Ramig, Bonitat, Lemke, and Hori (1994)</td>
<td>group</td>
<td>LSVT</td>
<td>40</td>
<td>not specified</td>
<td>PD</td>
<td>limited</td>
<td>present</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Dromey, Ramig, and Johnson (1995)</td>
<td>case</td>
<td>LSVT</td>
<td>1</td>
<td>not specified</td>
<td>PD</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Ramig, Countryman, Thompson, and Hori (1995)</td>
<td>group with control</td>
<td>LSVT versus respiratory-only therapy</td>
<td>45</td>
<td>not specified</td>
<td>PD</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Smith, Ramig, Dromey, Patz, and Samandari (1995)</td>
<td>group with control</td>
<td>LSVT versus respiratory-only therapy</td>
<td>22</td>
<td>not specified</td>
<td>PD</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Ramig and Dromey (1996)</td>
<td>group with control</td>
<td>LSVT versus respiratory-only therapy</td>
<td>17</td>
<td>not specified</td>
<td>PD</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Ramig, Countryman, O'Brien, Hoehn and Thompson (1996)</td>
<td>group with control</td>
<td>LSVT versus respiratory-only therapy: long-term treatment effect</td>
<td>35</td>
<td>not specified</td>
<td>PD</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Countryman, Hicks, Ramig, and Smith (1997)</td>
<td>case</td>
<td>LSVT</td>
<td>1</td>
<td>not specified</td>
<td>PD with supraglottic hyper-adduction</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Theodoros, Thompson-Ward, Murdoch, Leblen, and Silburn (1999)</td>
<td>case</td>
<td>LSVT</td>
<td>1</td>
<td>hypokinetic</td>
<td>PD with thalamotomy and pallidotomy</td>
<td>present</td>
<td>absent</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Ward, Theodoros, Murdoch, and Silburn (2000)</td>
<td>group with control</td>
<td>LSVT</td>
<td>30</td>
<td>not specified</td>
<td>PD with or without pallidotomy and/or thalamotomy</td>
<td>present</td>
<td>absent</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Ramig, Sapir, Fox, and Countryman (2001)</td>
<td>group with control</td>
<td>LSVT</td>
<td>14</td>
<td>not specified</td>
<td>PD</td>
<td>present</td>
<td>absent</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Sapir, Pawlas, Ramig, Seely, Fox, and Corboy (2001)</td>
<td>case series</td>
<td>LSVT</td>
<td>2</td>
<td>not specified</td>
<td>MS</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Solomon, Mckee, and Garcia-Barr (2001)</td>
<td>case</td>
<td>LSVT alone versus LSVT combined with respiratory treatment and physical therapy</td>
<td>1</td>
<td>mixed hypokinetic-spastic</td>
<td>TBI</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Ramig, Sapir, Countryman, Pawlas, O'Brien, Hoehn, and Thompson (2001)</td>
<td>group with control</td>
<td>LSVT versus respiratory-only therapy</td>
<td>33</td>
<td>not specified</td>
<td>PD</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Baumgartner, Sapir, and Ramig (2001)</td>
<td>group with control</td>
<td>LSVT versus respiratory-only therapy</td>
<td>20</td>
<td>not specified</td>
<td>PD</td>
<td>present</td>
<td>present</td>
<td>Yes</td>
<td>No</td>
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Table 4. Summary of evidence-based studies using group therapy

<table>
<thead>
<tr>
<th>Reference</th>
<th>Type of Study</th>
<th>Treatment</th>
<th>Number of Subjects</th>
<th>Type of Dysarthria</th>
<th>Medical Diagnosis</th>
<th>Evidence for Experimental Control</th>
<th>Psychometric Adequacy</th>
<th>Outcome Measures of Impairment</th>
<th>Outcome Measures of Activity or Participation</th>
</tr>
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<tbody>
<tr>
<td>Robertson and Thomson (1984)</td>
<td>group with controls</td>
<td>Group therapy to improve capacity/control of respiration, and coordination/control of voice production</td>
<td>12</td>
<td>not specified</td>
<td>PD</td>
<td>present</td>
<td>absent</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Sullivan, Bruner, and Beukelman (1996)</td>
<td>case series</td>
<td>Group therapy to increase breath support and voice projection</td>
<td>6</td>
<td>hypokinetic</td>
<td>PD</td>
<td>limited</td>
<td>present</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>DeAngelis, Mourao, Ferraz, Behlau, Pontes, and Andrade (1997)</td>
<td>group</td>
<td>Group therapy to increase vocal intensity</td>
<td>20</td>
<td>not specified</td>
<td>PD</td>
<td>limited</td>
<td>absent</td>
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Table 5. Miscellaneous evidence-based studies

<table>
<thead>
<tr>
<th>Reference</th>
<th>Type of Study</th>
<th>Treatment</th>
<th>Number of Subjects</th>
<th>Type of Dysarthria</th>
<th>Medical Diagnosis</th>
<th>Evidence for Experimental Control</th>
<th>Psychometric Adequacy</th>
<th>Outcome Measures of Impairment</th>
<th>Outcome Measures of Activity or Participation</th>
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<tr>
<td>Murry and Woodson (1995)</td>
<td>group with controls</td>
<td>Voice therapy after Botox treatment (compared to Botox only)</td>
<td>17</td>
<td>hyperkinetic</td>
<td>Adductor spasmodic dysphonia</td>
<td>present</td>
<td>absent</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Cerny, Panzarella, and Stathopoulos (1997)</td>
<td>group</td>
<td>Expiratory resistive breathing</td>
<td>10</td>
<td>not specified</td>
<td>hypotonia</td>
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</table>
Treatment of Dysarthria: Evidence-Based Practice
Managing Speaking Rate in Dysarthria

Vicki L. Hammen
Arnett Clinic
Lafayette, IN

The manipulation of speaking rate is often used as a strategy to improve speech intelligibility in persons with dysarthria. This is likely because it is the approach used by neurologically intact persons when we experience a breakdown in intelligibility or when we want our message to be understood clearly. Persons without dysarthria will tend to self-regulate speaking rate, depending on the situation. In dysarthria, however, this self-regulation is often impaired. Thus, the clinician must provide the person with dysarthria with a systematic approach to reducing his or her speaking rate. This article will address the factors used in the selection of a rate control method, the types of rate control approaches available, and the impact of rate control on speech production. The article includes both evidence from the research literature and the opinions of experts in the field.

Rationale

For many persons with dysarthria, reducing speaking rate results in a substantial improvement in speech intelligibility. Yorkston, Hammen, Beukelman, and Traynor (1990) showed an average improvement in intelligibility of 26% for 4 persons with ataxic and 4 persons with hypokinetic dysarthria. Other researchers, however, have found a less clear-cut relationship between rate and intelligibility. Turner, Tjaden, and Weismer (1995) found that only about half of the persons with Amyotrophic Lateral Sclerosis in their study showed an increase in speech intelligibility with a reduction in speaking rate. While there is compelling evidence that rate control is an effective approach to improving intelligibility in some patients, each clinician must determine if it is an appropriate intervention strategy for his or her particular client.

Speaking Rate Characteristics

Overall speaking rate is comprised of two factors, speech (or articulation) time and pause time. Pauses can be intra-utterance (such as a pauses around a clause) or inter-utterance (such as those that occur between sentences). Typical speaking rates for neurologically normal speakers during paragraph reading tasks are approximately 160-170 words per minute (wpm; Fairbanks, 1960). Yorkston and Beukelman (1981) reported rates of around 190 wpm for speakers completing a sentence reading task. Conversational speaking rates ranged from 150 wpm to 250 wpm for a set of speakers studied by Goldman-Eisler (1968). Of the two components related to overall speaking time, pause time is the most changeable when rate control methods are employed.

Speaking rate differs as a function of the speaking task. Reading tasks have natural boundary markers, such as commas and periods that cue a speaker to pause. In conversational speech it is the cognitive flow of the individual and conversational turn taking that most often determine the location and duration of pauses.

Common Approaches

Clinicians may divide the types of rate control into two categories: rigid and rhythmic approaches. Rigid approaches, such as pacing boards and alphabet supplementation (discussed below), are designed to have maximum control over the speaker’s rate. However, they also have a negative impact on prosody and, in turn, naturalness. Most rigid approaches to rate control affect the number and duration of pauses. This can serve to better mark word and syntactic boundaries as well as allow for additional listener processing time. The prosodic cues that provide important information regarding sentence structure and meaning may be lost, however, due to the word-by-word production style these approaches induce.

Yorkston, Beukelman, Strand, and Bell (1999) used the concept of “preserving prosody” to describe the rhythmic approaches (discussed below). These approaches, such as rhythmic cueing, typically have a lesser impact on prosody, and therefore, naturalness, but are not as effective at controlling speaking rate to a specified target. Creating a balance between the control of speaking rate and naturalness is the challenge of rate manipulation intervention.

Rigid Techniques

One of the earliest reports on the use of rate control in dysarthria was Helm’s (1979) description of the use of a pacing board to reduce palilalia in a person with Parkin-son’s disease. This individual would rapidly repeat phrases multiple times. The pacing board devised by Helm was a narrow,
rectangular board with a set of colored squares separated by a ridge or divider. The person tapped his or her finger on a square for each word. Alternatively, the person could slide his or her hand along the board, then lift it over the ridge to the next square in order to say the next word. This movement provided an external method of pacing speech and yielded a word-by-word production style.

Another rigid method of rate control is finger tapping. In this approach the person taps his finger while saying a word. He or she may tap his finger on the table, or tap his thumb to each finger in succession in a metered fashion. The key element is that the patient taps his finger as he begins to produce each individual word in an utterance. The advantage of this technique over the pacing board is that no external device is needed. This approach is more unobtrusive than the pacing board, but requires more diligence on the part of the speaker. It is incumbent upon the individual to tap for each word. For some patients, finger tapping becomes easier and more automatic, causing them to either tap independently of their speech production, or speed up the finger tapping to match the rapid rate of speech. Should this occur, it may be necessary to choose a different strategy.

A third rigid method of controlling speaking rate is alphabet board supplementation (Beukelman & Yorkston, 1977; Crow & Enderby, 1989). The board contains the letters of the alphabet arranged in rows. Boards can be arranged to suit the patient; for example, the letters may be arranged with the vowels at the start of each row. Control phrases, such as “Start again” or “End of sentence” can be included to provide the speaker with additional cues to give his or her communication partner. The individual with dysarthria is instructed to point to the first letter of the word she is saying, as they begin to say it. This provides a rigid method of controlling speaking rate because the motor act of pointing to the letter prior to producing the word automatically reduces rate. A benefit of this method is that the communication partner is provided with a phonemic cue for the word being produced. Finally, should the communication partner be unable to decode the intended word, the board can be used by the speaker to spell out the word. When using this technique with persons with severe dysarthria, it may be helpful to have the communication partner repeat each word after the speaker says it. This allows the speaker to know when communication breakdown has occurred and make a repair before the message is lost.

Pilon, McIntosh, and Thaut (1998) employed a metronome to control speaking rate. Three individuals with dysarthria following a traumatic brain injury were participants in this study, which used a single-case design with baseline reversal, in which treatment was followed by a no-treatment period of baseline data collection. Consistent with what has been documented for other forms of rigid rate control, these authors found that metronome pacing resulted in the greatest synchrony between the metronome rate and actual speech rate as compared to singing and board pacing. That is, it was the most effective in controlling speaking rate. In addition, this technique was associated with the greatest change in speech intelligibility for the two out of three persons who showed a change in intelligibility with rate reduction.

Rhythmic Techniques

In contrast to the rigid rate control techniques, the rhythmic techniques attempt to preserve naturalness, while providing some control over the person’s speaking rate. Computerized, rhythmic pacing can be accomplished by the use of the Pacer/Tally program (Beukelman, Yorkston, & Tice, 1997). With this program, user-created text is analyzed for the number of syllables per word and presence of punctuation (for pausing). The clinician can add additional pause markers at specific locations. A duration is assigned to each syllable and pause marker. The target syllable per minute rate is specified by the clinician, and multisyllabic words are allocated more time than single-syllable words. The passage appears on the computer screen and is paced by the use of underlining, bolding, or highlighting. The speaker is directed to follow the pacing signal through the passage by saying the word when it is marked. He or she is encouraged not to get ahead or to lag behind and to slow down articulation for the longer words. While it may require many practice sessions to train the speaker to produce a slower rate, many persons with dysarthria readily internalize this rate and no longer require the computerized pacing system to maintain their new speaking rate.

Berry and Goshorn (1983) described a method of rhythmic pacing that uses an oscilloscope. They presented a case study in which an individual with severe atactic dysarthria was given a time-by-intensity display on the oscilloscope as feedback for rate and intensity. The researchers determined a set length of speech time for the oscillographic display, and the client was instructed to “fill up the screen.” Using this form of feedback, the client was successful in reducing his speaking rate and improving his intelligibility. Clinicians with access to a Visi-pitch (Kay Elemetrics) can use this strategy for reducing speaking rate. The intensity trace in the stationary mode is used, and the clinician can set the time
Delayed auditory feedback (DAF) is another rhythmic rate control method that is primarily used in the treatment of stuttering but may have a positive impact on dysarthric speech as well. In the early 1980s, Hanson and Metter (1980, 1983) reported the use of DAF with two persons with hypokinetic dysarthria. These speakers slowed their speaking rates by 62-116 wpm and improved their intelligibility by up to three scale points on a 7-point, equal-appearing interval scale. Adams (1994) used DAF to slow the speaking rate of a person with suspected supranuclear palsy who presented with hypokinetic dysarthria and rapid, accelerating speech. Through the use of DAF this individual was able to slow his speaking rate from 350-400 wpm to 150-200 wpm. His speech intelligibility increased from 55% pre-DAF to 95% post-DAF. It is important to note, however, that DAF has not been found to be effective with all persons with hypokinetic dysarthria (Yorkston et al., 1999), nor has it been employed with other types of dysarthria.

The final method that is considered a rhythmic approach to rate control is direct magnitude production (DMP; Castor, 1995). In this paradigm, the individual speaks at her comfortable or habitual rate. She may then be asked to speak at “twice that rate” or “half that rate.” Habitual rate is often given a number (e.g., 10) with multiples of that number being given for the “twice habitual rate” and “half habitual rate.” This strategy differs from the others discussed thus far in that there is no external device needed for implementation.

Various types of instructions are used to elicit a change in speaking rate during a DMP task. For example, Castor (1995) used both Pacer and DMP to control speaking rate, while examining whether speakers with and without Parkinson’s disease could generalize reduced speaking rates to novel material. For the DMP task the author assigned the number 10 to each speaker’s habitual rate. Speakers were subsequently asked to reduce their rate to a 5 and a 2.5. No further instructions were provided. Castor found that when asked to reduce rate to a 5, speakers actually reduced their rate to about 75% of their habitual rate. This provided evidence that direct magnitude production was effective in reducing speech rate in persons with and without neurologic disease, though not with the same degree of accuracy as found in other methods, such as Pacer.

Recently, Logan, Roberts, Pretto, and Morey (2002) investigated the effects of several self-guided approaches to rate reduction neurologically normal speakers. One of the approaches, termed the self-devised method, instructed participants to reduce their speaking rates by about 25%. They were further instructed to reduce their rate any way they preferred (e.g., pausing more often or stretching out words). The syllable per second rate dropped from an average of 4.35 sec during the control phase to 4.29 sec using the DMP approach, a statistically significant decrease.

A number of researchers have used the DMP method to control speaking rate while examining a variety of physiologic and acoustic variables (Adams, Weismer, & Kent, 1993; Kleinow, Smith, & Ramig, 2001; Shaiman, Adams, & Kimelman, 1997; Tjaden, 2000). Tjaden (2000) found that when speaking rate was reduced in persons with and without Parkinson’s disease, coarticulation (as measured by the ratio of F2 onset frequency/target frequency) decreased. Velocity profiles for lip and tongue movements were investigated by Adams and colleagues (1993) and Shaiman and colleagues (1997). Adams and colleagues interpreted their finding of changes in the topology of velocity profiles as suggesting that changes in speaking rate affect motor control strategies. In support of this impression, Shaiman and colleagues (1997) found greater asymmetry, irregularity, and changes in the shape of lip velocity profiles when speaking rates were reduced from the speaker’s habitual rate.

Recently, some interesting questions have been raised from the work of Kleinow and colleagues (2001). In their work with individuals with Parkinson’s disease, Kleinow and colleagues reported that the index of spatial and temporal stability in the orofacial system showed that slower speech rates resulted in the greatest amount of motor variability. One would have predicted that if rate control improves speech intelligibility then motor variability would be reduced, not increased. The relationship between the effects of rate control, variability in the motor system, and speech intelligibility needs to be examined.

**Indirect Effects**

Finally, there are a number of treatment approaches that have an indirect effect of rate reduction. Yorkston and colleagues (1999) refer to these as “backdoor approaches to rate control” (p. 426). These approaches do not specifically focus on rate manipulations, but usually rate reduction is a by product of successful implementation of the treatment paradigm. One backdoor approach to rate reduction is improving prosodic characteristics of speech. An early example of this phenomenon was described by
Simmons (1983), who found that by focusing treatment for an individual with severe ataxic dysarthria on improving pitch and loudness characteristics, changes occurred in the rate of speech. The client lengthened syllables and inserted additional pauses. It was hypothesized that the client needed additional time to produce the intended pitch and loudness variations. The author concluded that target behaviors in the treatment of dysarthria are not independent; that is, working on one aspect, such as loudness or pitch variation, can cause alterations in other aspects of speech, such as rate.

The concept of improving rate by improving loudness has support from Ramig, Pawlas, and Countryman (1995), who suggested that instructing an individual with Parkinson’s disease to “Think Loud” as part of the Lee Silverman Voice Treatment (LSVT) program results in a reduction of speaking rate. Since it has been shown that increased drive to the orofacial muscles occurs with increased loudness (Wohlet & Hammen, 2000), it is reasonable to hypothesize that this may result in increased articulatory excursions. When the distance an articulatory structure travels is increased, there will likely be a concomitant increase in articulation or speech time.

**Selecting Strategies**

Yorkston and colleagues (1999) identified three criteria for selecting a rate control approach for an individual client: effectiveness, training requirements, and consequences. Effectiveness refers to whether the strategy used actually reduces speaking rate in an individual and whether maintenance of the reduced rate over time is possible. An additional component of effectiveness is how the rate reduction is accomplished. As discussed previously, some strategies have a greater impact on pausing and pause structure, while others can affect speech time. It is necessary for the clinician to determine whether alteration of speech time or the duration and distribution of pauses will have the most beneficial effect on speech intelligibility. The amount of training required for implementation of a rate control strategy is an important factor to consider in today’s challenging health care environment. The rigid methods of rate control, such as alphabet board supplementation or a pacing board, require minimal training and can be effective almost immediately. As they have the most negative impact on naturalness, however, they may not be the preferred method in the long-term. Backdoor approaches such as LSVT require several weeks of intensive therapy to achieve the desired outcome, but may be associated with a more desirable outcome than rigid control techniques.

While on the surface, self-determined approaches such as DMP may seem like they would require minimal training. This may not be the case, as they have less control over the actual rate produced, and extensive training may be necessary to effectively decrease speaking rate.

It may be possible to use both rigid and rhythmic approaches when working on improving speech intelligibility through rate reduction. Use of an alphabet board or finger tapping can substantially improve intelligibility and the ability of the person with dysarthria to communicate effectively within one or two therapy sessions. This can be motivating to the individual and demonstrate the benefits of rate reduction. Simultaneously, training with a rhythmic method, such as DMP, can be initiated. Once the individuals can reliably produce an effective rate change with a self-regulated method, the rigid method is phased out.

The last selection criterion for a rate control strategy discussed by Yorkston and colleagues (1999) is consequences. The main consequence for the use of rate control strategies is the reduction in speech naturalness. Yorkston and colleagues (1990) found that rigid rate control methods had a more negative impact on naturalness than did rhythmic methods. Logan and colleagues (2002) investigated the effect of rate reduction on naturalness in a group of female college students without speech impairments. They used four different, self-devised rate control methods. In three of the four conditions, the participants were asked to alter speech time, turn-taking pauses, or the number and duration of intra- and inter-sentence pauses. The fourth condition was the self-devised method, in which speakers were instructed to reduce their speaking rates by 25% using any strategy they chose. The results showed that, with the exception of altering turn-taking pauses, there was a significant, negative impact on naturalness when rate reduction strategies were employed. On a positive note, they found that the self-determined or DMP-type method had the least negative effect on naturalness.

**Conclusions**

Rate control is an effective strategy to improve the speech intelligibility of persons with dysarthria. While it would seem that selection and use of a rate control strategy is a simple endeavor, in fact, the decision-making process must take into account a number of factors. There are no specific guidelines to indicate which method is most effective for an individual with dysarthria. Selection of the target rate will vary from person to person. The clinician must consider not only improvement in intelligibility, but
also maintenance of speech naturalness. The available knowledge of the impact of certain types of rate control on speech characteristics can be helpful to the clinician in providing effective treatment. We know from the available research that rate control often improves the speech intelligibility of persons with dysarthria. We have just begun to understand why that improvement occurs. It is important that clinical researchers continue to provide research evidence to guide our clinical decisions regarding rate control strategies.

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References


Treatment of Dysarthria: Evidence-Based Practice
Nonspeech Oral Motor Treatment Approaches for Dysarthria: Perspectives on a Controversial Clinical Practice

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This article addresses non-speech oral motor treatments and reports the results of a search for evidence of their effectiveness in improving the speech of persons with dysarthria. The term oral motor treatment refers to a range of nonspeech and speech-like activities used to achieve a variety of goals that involve actions of the lips, jaw, and tongue. Interested readers should refer to the comprehensive review by Chapman Bahr (2001) for further information on this topic. Typically, these treatments are limited to behavioral techniques applied by professionals (e.g., oromyo-functional therapists, occupational therapists, speech-language pathologists) who are members of health service delivery teams, but they may be conducted in conjunction with surgical, orthodontic or pharmacological treatments in an attempt to maximize the functional benefits of these medical procedures (ASHA, 1993; Dworkin, 1991).

Nonspeech oral motor treatment activities described in the literature fall under three broad categories. These include: (a) isotonic and isometric strengthening exercises, (b) relaxation exercises, and (c) neurophysiological or neuro-therapeutic approaches (Gordon, 1987). The goal of strengthening exercises is to promote appropriate lip, jaw, and tongue postures at rest and to increase the stability, strength, range, speed, and control of lip, jaw, and tongue movements (Duffy, 1995; Hanson & Barrett, 1988). In strengthening exercises, a person voluntarily activates target muscle groups to perform isometric or isotonic exercises, with or without resistance. These exercises are based on general principles of muscle conditioning. Increases in strength occur when muscle mass (number and/or size of muscle fibers) or recruitment and rate of firing of motor units increases (Duffy, 1995). If available, instrumentation can be used with these exercises to provide feedback to the person about strength or forces achieved.

The goal of relaxation exercises is to reduce abnormally high muscle tone in the lip, jaw, and tongue muscles. The goals of neurophysiological or neurotherapeutic approaches are to reduce muscle tone, inhibit abnormal oral reflexes and postures at rest and during functional tasks like talking and eating, and promote sensorimotor integration for learning skilled actions of the lips, tongue, and jaw for speech and the oral phase of eating (Chapman Bahr, 2001; Dworkin, 1991; Mysak, 1983; Robertson & Thompson, 1986). These approaches, which include the application of sensory stimuli to facilitate muscle activity, are based on techniques of Rood (1956) and proprioceptive neuromuscular facilitation (Knott & Voss, 1968), as well as techniques that focus on normalizing abnormal muscle tone and postural control and inhibiting reflexes and abnormal movement patterns. The latter techniques are based, in turn, on neurodevelopmental treatment (NDT; e.g., Bobath & Bobath, 1984).

Neurotherapeutic approaches are based on reflex or hierarchical models of motor control and traditional motor developmental and learning theories. They use a neurophysiological rationale to explain normal motor behavior and share the same assumptions about how the central nervous system (CNS) is organized and what happens when CNS damage occurs (Gordon, 1987; Mathiowetz & Haugen, 1994).

Some authors (e.g., Boshart, 1998; Chapman Bahr, 2001) include techniques that are components of traditional articulation therapy in “oral motor” treatment. These techniques use sensory stimulation in the form of physical prompts, spoken instructions, and visual, auditory, and tactile cues to help children and adults learn or relearn how to position and move the lips, jaw, and tongue to produce target consonant and vowel sounds. They resemble Duffy’s (1995) description of traditional methods of articulation therapy for dysarthric speakers, which include integral stimulation (watch and listen imitation tasks); phonetic placement (hands-on assistance in attaining targets and movements, with picture or other cues for articulatory place and manner); and phonetic derivation (using an intact nonspeech gesture to establish a sound target such as blowing to facilitate production of /u/). The use of traditional articulation therapy placement techniques will not be reviewed here. Instead, the paper focuses on nonspeech oral motor treatment techniques.

Perspectives on Nonspeech Oral Motor Treatment

Nonspeech oral motor techniques are mentioned under behavioral treatments for the articulatory subsystem in many publications on intervention for
persons with congenital and acquired dysarthria (e.g., Chapman Bahr, 2001; Duffy, 1995; Dworkin, 1991; Hodge & Wellman, 1999; Love, 2000; Theodoros & Thompson-Ward, 1998; Mysak, 1983; Solomon & Stierwalt, 1995; Ton-kovich, Boettcher, & Rambow, 2001; Yorkston, Beukelman, Strand & Bell, 1999). The authors vary, however, in their views on the appropriateness and effectiveness of these techniques.

Advocates state that nonspeech techniques reduce neuromuscular impairments such as weakness, muscle tone abnormalities (abnormally increased or reduced), and reduced control in the lips, jaw, and tongue. The underlying hypothesis is that if the neuromuscular impairment in these muscle groups is reduced, the articulatory movements of the person with dysarthria will “normalize,” resulting in improved speech function such as increased articulatory accuracy and speech intelligibility. Proponents claim that these techniques improve muscle function and motor control for speech by one or more of the following:

1. Increasing muscle strength and endurance,
2. Normalizing abnormal muscle tone,
3. Increasing sensory awareness and sensorimotor integration, and
4. Eliminating abnormal reflex behaviors that interfere with voluntary speech movements.

The predicted results are increased stability, speed, range, strength, and accuracy of movement of oral muscle groups (lips, jaw, tongue) in speech articulation.

Several authors who promote the inclusion of nonspeech oral motor techniques in treatment of dysarthria (e.g., Chapman Bahr, 2001; Dworkin, 1991; Mysak, 1983) provide step-by-step, sequentially ordered behavioral exercises for treating various speech subsystem disturbances, including deficits in articulation. These include exercises to treat lip, tongue, and jaw weakness or hypertonia and typically precede activities that involve phonetic stimulation of speech sounds. For example, Chapman Bahr (2001) described a typical 45-minute oral motor treatment session as having four segments, in the following order:

1. Gross motor activity to improve postural tone and stability necessary for improved eating, drinking, and speaking;
2. Oral massage that may improve precision of oral movements needed to improve drinking and eating skills as well as speech production;
3. Specific nonspeech oral motor activities and exercises to improve oral strength, mobility, and coordination for eating, drinking or speaking; and
4. Specific speech and language activities.

The gross motor, oral massage, and oral exercises occur in the first 15 to 20 minutes, leaving 20 to 25 minutes for more traditional speech and language treatment.

In contrast, several authors who are considered experts in the assessment and management of dysarthria (Duffy, 1995; Love, 2000; Theodoros & Thompson-Ward, 1998; Yorkston, Beukelman, Strand & Bell, 1999) expressed guarded opinions about the effectiveness of nonspeech oral motor techniques in improving speech performance and noted that the use of these techniques is controversial. For example, Duffy stated that patients who require a focus on articulation typically receive traditional articulation treatments, while other techniques like strength training, relaxation, stretching, and biofeedback are less universally appropriate. He advised that, in general, strengthening exercises should be used only after establishing that weakness of the oral articulators is clearly related to the dysarthria. He commented that patients whose physiologic support for speech is severely compromised might benefit from efforts to increase strength. Duffy also observed that if increasing the strength of a muscle group (in this case the lips, jaw, or tongue) is a treatment goal, then procedures need to adhere rigorously to principles for standard muscle strengthening exercises. For example, one would have to do five sets of 10 repetitions each, three to five times per session, with 5 to 10 exercise periods per day. The exercises should overload the muscle in some way, such as with high repetition-low resistance exercises or low repetition-high resistance exercises.

Theodoros and Thompson-Ward (1998) observed that the effectiveness of nonspeech techniques to alter muscle tone and strengthen oral muscles is difficult to quantify and has yet to be determined for the population of persons with dysarthria. Yorkston and colleagues (1999) stated that there is little evidence to support any generalization of nonspeech oral motor interventions to improved speech function in persons with spastic, hyperkinetic, hypokinetic, or ataxic dysarthria and advocated that intervention focus on speech or speech-like movements. Specific to children, Yorkston and colleagues were of the opinion that some nonspeech activities may be useful on occasion for children with dysarthria, who may benefit from improving strength or range of motion. They also stated that oral motor techniques they have found helpful are those that lead directly to phonetic placement and derivation. They concluded by stating
that, “although nonspeech activities may be used during the first few minutes of a session to increase attention to the face, increase awareness of movement and so on, spending much of the session on nonspeech movement is probably not the best use of treatment time” (Yorkston et al., 1999, p. 563).

Love (2000) noted that there are conflicting research findings concerning the effects of muscle weakness and other types of oral motor impairment on speech performance. He suggested that careful analysis of muscle strength and movement rates in a given child with dysarthria is probably the only reliable guide for recommending oral exercises to increase strength or movement. He observed that current management programs for childhood dysarthria are likely to use a broad spectrum of techniques and that oral exercises are generally given limited prominence in current intervention approaches. Tonkovich and colleagues (2001) stated that while many clinicians advocate the use of nonspeech repetitive exercises in the clinical management of dysarthric speech, there is little if any evidence to support the efficacy of such exercises. These authors stated that they did not include repetitive nonspeech movement exercises in their clinical program manual, Dysarthria Rehabilitation, because they believe that repetitive nonspeech movements do not generalize to speech intelligibility. They stated that clients might be misled by implicit or explicit claims that the practice of nonspeech movements will result in restored speech performance.

There appear to be many reasons for opposing views about the effectiveness of nonspeech oral treatment techniques for dysarthria. As descriptions of the specifics of these treatments vary from source to source, they are not delivered in a standardized manner. Also, dysarthria is a low incidence disorder and persons with dysarthria are a heterogeneous population. Children with dysarthria are undergoing growth and maturation, and are changing over time. They also differ in how they respond to the constraints imposed by their nervous system impairment as they attempt to function in their environments. It would appear, however, that the major reason for continued controversy is that there is not sufficient or compelling information available to resolve it. The arguments put forward by those who advocate nonspeech oral treatment techniques are not convincing those who oppose these techniques to change their views. Arguments put forward by those who oppose these techniques are not convincing those who do support their use to change their practice.

**Data-Based Studies of the Effectiveness**

Electronic health databases, books, and newsletters addressing treatment for dysarthria written by authorities in the field and two recent therapy manuals that include nonspeech oral motor techniques were reviewed. The purpose was to obtain data-based information addressing the effectiveness of non-speech oral motor treatment techniques for adults and children with dysarthria.

**Literature searches of health research databases.** Medline, Psychinfo, and CINHAL were searched for citations from January 1960 to July 2002 that included the combined terms “oral motor” or “oromotor” and “dysarthria.” Only one article was identified that reported the results of behavioral oral motor intervention. Harris and Murry (1984) reported the case of a 44-year-old man with flaccid dysarthria and aphagia resulting from a gunshot wound. Seven years after his injury, he received speech therapy. Initially, therapy focused on glottic closure, velopharyngeal closure, and tongue strength and mobility. After 9 weeks of intensive practice, gains were noted in strength and movement of the tongue, velum, and larynx, and in speech and swallowing function. The literature search did not identify any published, controlled, experimental studies (either group or single subject design) of the application of nonspeech oral motor behavioral techniques to children or adults with dysarthria.

Together, Duffy (1995) and Theodoros and Thompson-Ward (1998) identified 12 published studies of cases with dysarthria that reported results of the application of EMG biofeedback therapy to alter muscle tone and strength by decreasing and increasing muscle activity in the lips and jaw. In a few of these (e.g., Nemec & Cohen, 1984; Netsell & Daniel, 1979), improvements noted in jaw closure and/or lip strength were reported to result in an increase in speech intelligibility, which was maintained following discontinuation of the biofeedback.

**Published anecdotal reports.** Chapman Bahr (2001) and Dworin (1991) were judged to be most comprehensive in their descriptions of the specific application of non-speech oral motor techniques. Dworin described the case of a 52-year-old woman with flaccid dysarthria resulting from a unilateral left acoustic neuroma. Strengthening exercises for the tongue, then lips, and then jaw were followed by training to improve the fine force control of each of these muscle groups. This was followed in turn by phonetic stimulation for consonants. Performance on these exercises was reported for each session. Ratings
of the woman’s speech improved from a pre-treatment articulation subsystem baseline rating of 3.5 on a 7-point scale, indicating mild to moderate articulatory imprecision, to a post-treatment score of 2.0. The effect of this change in rating on speech intelligibility was not reported. Chapman Bahr presented case descriptions to consider for practice in treatment planning, but did not report any data from individuals with dysarthria.

In a previous ASHA Division 2 newsletter, Solomon and Stierwalt (1995) described two patients with dysarthria who underwent tongue-strengthening training. The first was a 17-year-old woman who had sustained a traumatic brain injury as a result of a motor vehicle accident 30 months prior to the authors’ evaluation. A program to increase tongue strength was implemented. After 18 months, tongue strength increased from 9 kPa to high 40s to low 50s kPa and the woman was able to produce 10 to 15 functional phrases. Speech progress was confounded by velopharyngeal incompetence. The progress with speech indicated that a palatal lift was an option to further enhance speech intelligibility.

The second case involved a 72-year-old man with Parkinson’s disease who demonstrated reduced and variable measures of tongue strength following a unilateral pallidotomy. Use of tongue strengthening exercises was one of several approaches used to increase his speech intelligibility. While his overall tongue strength improved, his performance remained variable and conversational speech remained largely unintelligible. Tongue strength training was terminated and treatment approaches with more promise were identified. Solomon and Stierwalt commented that strengthening exercises might not have been the best approach to remediating this patient’s speech, even though he had reduced tongue strength. These authors suggested that tasks addressing the underlying motor problems of control and consistency of productions probably would have greater impact on speech.

In summary, the use of strengthening exercises for treatment of acquired dysarthria in adults was described in a few case studies. No studies of children were located. Reports of improvement in speech were limited to individuals with flaccid dysarthria and/or severely compromised function of the lips, jaw, and tongue for speech. There also are a few single case studies in which adults with dysarthria were reported to successfully alter muscle tone using biofeedback, with positive effects observed on speech. It would appear that there is insufficient empirical evidence to evaluate the effectiveness of these approaches for persons with dysarthria.

Occupational and Physical Therapy

In the occupational and physical therapy literature, several authors (e.g., Gordon, 1987; Mathiowetz & Haugen, 1994) have contrasted traditional neurophysiological approaches with more contemporary task-based approaches. As noted earlier, the former approaches are based on older reflex and hierarchical theories of motor development and motor responses to CNS damage. The latter approaches are based on systems models of motor development and control and are influenced by contemporary developmental and motor learning theories. Treatment approaches based on a task-oriented model of therapy focus on accomplishing functional goals rather than normalizing movement patterns. They involve more problem-solving by the client and less “hands-on” facilitating by the clinician. The emphasis is on specific skill acquisition versus enhancing quality of movement. Task-based approaches have emerged because of the limitations of neurophysiological approaches. As Gordon (1987) stated, “essentially the facilitating [neurophysiological] approaches promised more than they could deliver. The hope was that we could reinstate normal movement patterns. The reality was that even when we succeed in accomplishing this, we find that patients use movements different from the ones we teach them when confronted with functional tasks in meaningful environments” (p. 11). Gordon’s chapter is relevant across the rehabilitation disciplines. It is recommended for clinicians looking for a very interesting, thoughtful, and reader-friendly discussion of the relationship between changes in scientific attitudes and new scientific knowledge and the development of new therapeutic models.

Another relevant contribution from the physical therapy literature is the American Academy for Cerebral Palsy and Developmental Medicine (AACPDM) evidence report on the effects of NDT (Butler & Darrah, 2000). In the report summary, the authors stated that the preponderance of results presented in the evidence table did not confer any advantage to NDT over the alternatives to which it was compared, other than immediate improvement in dynamic range of motion. There was no consistent evidence that NDT changed abnormal motor responses or facilitated more normal motor development or more functional motor activities. Based on the evidence reported, the authors noted the need for concerted efforts to investigate other therapy approaches that may prove more clearly beneficial. They suggested that these new approaches might grow out of more contemporary theories of motor development and motor learning and skill acquisition.
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and may include task-oriented approaches based on dynamic systems concepts.

Treatment principles that are derived from contemporary motor learning theories have also been proposed to guide speech therapy practice. Sample principles based on Schmidt and Bjork (1996) and Strand (1995) include the following:

1. Training tasks are goal-directed and build on previously learned behaviors;

2. Learning is context-specific, and training activities should simulate real-world tasks (in this case, speech); and

3. The learner has the necessary prerequisite behaviors (motivation, attention, effort/focus, trust), is actively involved as a problem solver, has multiple opportunities to practice attaining the goal, and has knowledge of the results.

Conclusions

The use of nonspeech oral motor treatment approaches for persons with dysarthria is controversial. Acknowledged experts in assessment and treatment of dysarthria are guarded in their opinions about the use of these techniques to improve function. There is very little published data on the use of nonspeech oral motor treatments for treating speech function in persons with dysarthria. The information that does exist is limited to adults and primarily addresses the use of strengthening exercises. A few case studies reported beneficial effects of strengthening exercises for adults with acquired flaccid dysarthria and/or severely compromised physiologic support for speech. Similarly, a small number of adult case studies reported positive changes in speech when biofeedback was used to decrease or increase abnormal muscle tone. In regard to children with dysarthria, no empirical studies were located in any of three major health databases for either oral motor strengthening exercises or neurotherapeutic approaches. Although several current therapy manuals advocate such techniques for children, none include efficacy data or even anecdotal descriptions of treatment results. The search yielded no evidence to support the use of passive facilitative techniques (like brushing, icing, application of stretching or massage to inhibit reflexes, normalize increased muscle tone, or promote sensorimotor integration) to improve speech function in children or adults with dysarthria.

Contemporary reviews of the use of traditional neurophysiological treatment approaches by physical and occupational therapists suggest that these approaches are not effective in improving functional motor behaviors. A recent AACPDM evidence report on the effects of NDT, which has strongly influenced the development of nonspeech oral motor neurotherapeutic techniques, did not find consistent evidence that NDT changed abnormal motor responses or facilitated more normal motor development or functional motor activities in children with cerebral palsy. There is a shift in the occupational and physical therapy literature away from these more traditional neurophysiological therapy approaches to ones based on more task-oriented models.

The AACPDM reports list levels of evidence based on whether evidence is empirical or not and, if so, the rigor of the experimental design. The highest level of evidence is Level I, which is group or single subject randomized controlled trials. The lowest is Level V, which ranges from descriptive case studies, anecdotes, expert opinion, and theories based on physiology, to “common sense/first principles.” The little “evidence” that was identified for the effects of nonspeech oral motor treatment for persons with dysarthria falls at this lowest level. Clearly, if these treatments are used with the expectation that they will improve speech function, their effects need to be documented and reported. Studies of the relative effects of these treatments compared to other approaches, such as those based on more recent theoretical models of motor development and control, are also required. There are alternative treatment approaches for dysarthria that have evidence to support their effectiveness, while evidence to support the effectiveness of nonspeech oral-motor treatment approaches for dysarthria is lacking. Until this information is available, the clinician may want to consider a set of guiding questions to assist in clinical decision-making. These are based on the literature and the author’s “common sense” and may be helpful when considering the use of nonspeech treatment approaches for persons with dysarthria.

- What is the overarching goal of treatment?
  - Is speech the highest priority for the individual’s communication needs and goals?
  - If speech is a priority, remember that in dysarthria, the impairment may extend to structures beyond the oral articulators. The articulatory disorder needs to be considered in relation to function of the respiratory, laryngeal, and velo-pharyngeal systems. Will effective treatment of articulatory disturbances need a broader treatment approach rather than a focus on just articulatory training?
- Will the selected exercises result in improved performance on the target behaviors?
- Is there a better technique available to accomplish the goal? As an ethical practitioner, one must always consider the principles of beneficence (do good) and non-maleficence (do no harm). Use of an
ineffective or unnecessary technique has the potential to do harm because it is wasting client time and resources that could be spent on more efficient (better outcome in less time) treatment approaches to achieve functional speech goals.

- Are there contraindications to using therapeutic non-speech oral motor exercises?
- Are there structural constraints (e.g., trismus, large tonsils, complete lip paralysis) on oral function?
- Is there a potential for harm (e.g., temporomandibular joint vulnerability)?
- Is the client motivated to participate in a therapeutic exercise program? Attention, motivation, and effort are needed for learning.
- If strengthening exercises are used, can the client, family, and clinician invest the time needed for the oral motor exercises to make a difference? The client must “overload" muscle to change its strength so multiple repetitions and sets are needed several times a day over several weeks.
- How will the individual know that he or she has accomplished the task successfully (i.e., achieved the goal)?
- How will you know when the goal of the exercises has been met?
- What will the individual have learned when the goal of the exercises has been met?
- How will you tell if treatment is working?
- How will you document and report the results of the treatment?

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References


Treatment of Dysarthria: Evidence-Based Practice


A diverse group of individuals with acquired neurogenic disorders and severe dysarthria may benefit from augmentative and alternative communication (AAC). These include persons with traumatic brain injury (TBI), stroke, and those with degenerative neurological diseases such as amyotrophic lateral sclerosis (ALS), Parkinson’s disease (PD), Huntington’s disease (HD) and multiple sclerosis (MS; Doyle, Kennedy, Jausalties, & Phillips, 2000; Klasner & Yorkston, 2000; Mathy, Yorkston, & Gutmann, 2000; Yorkston, 1996). The etiology, incidence, and characteristics of these disorders are described elsewhere (e.g., Doyle et al., 2000; Klasner & Yorkston, 2000; Mathy, Yorkston, & Gutmann, 2000; Yorkston, Miller, & Strand, 1995).

January 1, 2001, the United States’ national public health care system, Medicare, responded to the growing body of evidence documenting the efficacy of AAC interventions for individuals with dysarthria and other severe expressive communication disorders (aphasia, apraxia, aphony) by reversing the longstanding policy of non-reimbursement of AAC devices (AAC/RERC Web site). This policy change was a major step in the journey to bring AAC intervention into standard speech/language pathology practice for persons whose speech functioning is so impaired that they are unable to meet their communicative needs in activities of daily living. For the first time, AAC intervention, including assessment, treatment and prescription of high tech AAC devices (referred to as Speech Generating Devices, SGD, by Medicare) has national Health Care Financing Administration Common Procedure Coding System (HCPCS) billing codes. Moreover, since the Medicare policy took effect, private insurance carriers have begun to modify their coverage policies for AAC devices and services (L. Golinker, 2002, personal communication). Therefore, the goal of this article is to provide an update on AAC intervention focusing on individuals with severe acquired dysarthria. The article includes a multi-dimensional clinical decision-making model for AAC intervention in dysarthria, an overview of the components of AAC intervention, and a summary of recent research in evidence-based practice in AAC with individuals who have dysarthria.

**Clinical Decision-Making Model**

The process of clinical decision-making involves determining the stage of functioning or progression of a disorder and providing evidence-based treatments at each level. This practice is well established in the medical profession and is becoming more common in speech language pathology. For example, Yorkston and Beukelman (1999, 2000) described a treatment staging strategy for individuals with progressive dysarthria. They described five stages, beginning with Stage 1—“no detectible speech disorders” and culminating with Stage 5—“no functional speech.” Proposed treatments ranged from providing information for planning for the future loss of speech in Stage 1, to the use of low technology and high technology AAC strategies in Stage 5. An example of this model was provided by Mathy, Yorkston, and Gutman (2000) who presented an overview of AAC intervention in ALS. They included a detailed description of the staging of AAC intervention, based on stages of speech and physical functioning typically observed during the progression of the disease.

An AAC treatment staging strategy that encompasses the range of disorders associated with acquired dysarthria requires a multidimensional perspective. This approach addresses speech, language, cognitive, physical, and visual functioning as well as progression (static or progressive), and prognosis for regaining functional speech with treatment. At the end of this paper is a list of the stages of functioning in speech, language (literacy), cognitive, visual, and physical domains relevant for AAC intervention planning, in disorders associated with acquired dysarthria (“Functional Staging for AAC Intervention”).

**Speech Staging**

The planning and implementation of AAC intervention differs based on the etiology of the dysarthria. In degenerative diseases, for example, speech decline into stage 2 and beyond may be a presenting or early symptom, such as with bulbar onset ALS and HD (Klasner & Yorkston, 2000; Mathy et al., 2000; Yorkston, Miller, & Strand, 1995). In contrast, dysarthria may not appear until late in the course of the disease in PD and MS (Armstrong, Jans,
& MacDonald, 2000; Klasner & Yorkston, 2000; Porter, 1989; Yorkston et al., 1995). As well as evidencing persistent changes over time, speech performance in people with degenerative dysarthria may show fluctuation during the course of a day due to the effects of fatigue or medication. In some cases (e.g., MS), speech also may oscillate between functional stages due to exacerbations and remissions of the disease. These factors may influence AAC use and must be taken into consideration in intervention planning.

In all of the studies reviewed for this paper, the authors stressed that an essential component of successful intervention was the provision of regular follow up to assess speech functioning and assist individuals with degenerative diseases and their families to plan for the future. (Armstrong et al., 2000; Ball, Willis, Beukelman, & Pattee, 2001; Doyle & Phillips, 2001; Klasner & Yorkston, 2000, 2001; Porter, 1989). For example, Ball and colleagues (2001) stressed the importance of monitoring speech functioning over time, using objective measures of speech intelligibility, speaking rate, voice, and resonance. Their longitudinal monitoring of speech in persons with ALS showed that rapid (within 2 to 4 months) decline in speech functioning into Stage 3 and below consistently followed a reduction in speaking rate to half of that predicted for non-impaired speakers. The implications of these results are that once speaking rate has declined to this point, the decision to begin the assessment for a high technology AAC device should occur immediately, to allow time for the funding process and for the individual to learn to use the AAC device before needing to rely on it.

In contrast to degenerative dysarthria, people with TBI may show a recovering pattern of speech functioning. Based on their review of speech recovery in TBI, Doyle, Kennedy, Jasualaitis, and Phillips (2000) concluded that the majority of persons with TBI recover speech functioning to the point where they do not need to rely on AAC or require it only in challenging speaking situations (e.g., noise, unfamiliar communication partners). Doyle and colleagues also found a relationship between speech and cognitive recovery in adults with TBI. When speech recovered, it typically occurred by the middle stage of cognitive recovery. This corresponds to Stages V and VI in the Levels of Cognitive Functioning (LOCF; Hagen, 1984). Those who did not recover speech by this stage were likely to have permanent speech impairment. The rate of recovery of speech in the studies reviewed by Doyle and colleagues (2000) ranged from 3 to 48 months post-injury. An example of a protracted period of recovery was given by Light, Beesley, and Collier (1988), who documented improvement of speech in an adolescent girl across a 44-month period. During that time, she began augmenting her communication using low technology AAC strategies and then moved to microcomputer-based devices. Finally, she regained the ability to rely primarily on natural speech to meet her communication needs.

Cognitive Staging

Concurrent cognitive processing deficits are seen in both degenerative and acquired motor speech disorders (Armstrong et al., 2000; Doyle et al., 2000; Klasner & Yorkston, 2000, 2001; Mathy et al., 2000; Yorkston et al., 1995). Therefore, the intervention team should be prepared to examine functional cognitive skills as part of AAC intervention. This includes use of information from formal cognitive assessments and scales (e.g., LOCF; Hagen, 1984) and observation of the person’s ability to learn to communicate with targeted AAC strategies and devices. In addition, AAC interventions for persons with both degenerative and acquired disorders must accommodate changing (i.e., declining or improving) cognitive status over time.

The five stages of cognitive functioning described in “Functional Staging for AAC Intervention” highlight important skills related to the selection and use of AAC strategies and devices. For example, with individuals who have cognitive impairments affecting attention, memory and learning (Stage 3 or below), published reports have documented greater success with AAC devices and strategies that capitalize on well-learned skills (Armstrong et al., 2000; Doyle et al., 2000; Klasner & Yorkston, 2000, 2001; Mathy et al., 2000). For example, Doyle and colleagues (2000) found that persons unfamiliar with the QWERTY layout did better with an alphabetic letter arrangement on a low technology or high technology AAC device.

Language (Literacy) Staging

As part of the AAC assessment process, it is important to determine the person’s ability to construct messages using spelling. Most adults with the neurogenic disorders discussed in this paper retain the ability to spell, but cognitive processing deficits may impede their ability to use spelling independently to communicate (Doyle et al., 2000). To construct messages through spelling, the communicator must formulate the message and keep it in mind long enough to deliver it through a process of searching for and selecting each letter to spell the message. Motor impairments and language impairments, such as word retrieval deficits, also may
increase the cognitive load of message construction (Doyle et al., 2000).

**Visual Staging**

Many individuals with acquired dysarthria have concomitant visual processing deficits that affect their ability to use and benefit from features available on AAC devices. Although formal assessment of visual processing may be helpful, as was suggested in relation to cognitive functioning, determination of the effects of visual functioning may best be determined by observing performance with target AAC technologies during the assessment process. For example, word prediction, a common feature on high technology devices, requires the user to look away from the keyboard to the screen to determine if the program has predicted the target word. Individuals with visual tracking deficits (functioning in Stage 2 or below) may have difficulty using word prediction or other features that require rapid shifts of gaze.

**Upper and Lower Extremity Staging**

The staging of upper and lower extremity physical functioning also influences the selection of high technology and low technology AAC aids. For example, an individual who is at Stage 1 in upper extremity physical functioning, but at Stage 5 in speech functioning, may benefit from a high tech device with a full-sized keyboard to allow for a typing rate (communication rate) that is as rapid as possible. Before an individual enters the final phase of AAC device selection, however, he and his caregivers and service providers should consider the stage of lower extremity physical functioning. Individuals functioning at Stage 3 or above in ambulation usually want a device that is small enough to be carried by hand or in a purse or “fanny pack,” whereas those using a wheelchair may require a wheelchair mounting system to transport the device. A team evaluation that includes an occupational and physical therapist is recommended for the assessment of upper and lower extremity functioning and to determine the best options for the person to access and transport AAC devices.

**Intervention Strategies**

The next section is a review of AAC intervention strategies ranging from those designed to supplement natural speech to interventions for individuals whose speech is no longer functional. In each section, results from published studies of the use of AAC interventions by people with acquired dysarthria will be presented when available.

**Speech Supplementation**

Even when their speech is moderately to severely unintelligible, most individuals with dysarthria continue to rely on it as their primary mode of communication. In such instances, speech supplementation strategies, also referred to as signal-independent strategies (Yorkston, Beukelmen, Strand, & Bell, 1999), should be evaluated. These strategies are designed to provide listeners with contextual information external to the speech signal, to increase the comprehensibility of the message. Such strategies include gestures, alphabet supplementation, topic supplementation, and managing the environment (e.g., reducing background noise).

When using alphabet supplementation, the speaker points to the first letter of each word on an alphabet display as the word is spoken, thereby providing the listener with the orthographic-phonetic context to support speech production and increasing the listener’s ability to understand the message (Yorkston et al., 1999). For topic supplementation, the user indicates the topic of the message prior to speaking it, to provide the listener with a frame of reference in hopes of increasing the accuracy of understanding (Yorkston et al., 1999). Each of these methods can be used alone or in combination with low technology or high technology communication displays. The user can point manually, if possible, or use a head stick or head-mounted optical pointer.

Hustad and Beukelman (2000) reviewed the results of published experimental studies examining the effects of speech supplementation strategies, including alphabetic cues and topic cues, on sentence and discourse intelligibility. They found that listeners’ ability to transcribe sentences and discourse produced by dysarthric speakers was better with alphabetic and topic cues when compared to no cues. Results varied based on the type of cue. Alphabetic cues were more beneficial than topic cues, and combined cues (alphabetic and topic) had the greatest effect on improving intelligibility. In addition, the severity of dysarthric speech also affected results. In general, speech supplementation produced the greatest improvement in intelligibility for individuals with moderate and severe dysarthria compared to those with profound dysarthria.

Although a number of studies have examined the potential of speech supplementation to improve speech intelligibility of dysarthric speakers, Hustad and Beukelman (2000) found few studies that examined its use in daily communication. Other areas for future research include examination of patterns of use of speech supplementation strategies by individuals who have access to them, partner
attitudes and acceptance of speech supplementation, and cognitive/linguistic skills required to use speech supplementation strategies successfully. Research on listener attitudes toward speech supplementation is a current focus of the Research Engineering Research Center (RERC) on AAC (http://www.aac-rerc.com). As part of this project, Hustad (2001) examined listener attitudes toward three speech supplementation strategies: topic cues, alphabet cues, and combined cues. Listeners indicated a higher degree of communicative effectiveness and willingness to interact with the dysarthric speaker when combined cues (topic and alphabet) were used.

When Speech Is Not Functional

When speech is no longer functional, intervention becomes focused on AAC methods that will maintain the person’s communicative functioning in activities of daily living. Research examining the outcomes of AAC intervention for people with ALS (Doyle & Phillips, 2001; Mathy et al., 2000) indicates that these individuals use different AAC methods, depending on factors such as their communication goal and their communication partner. For example, Mathy and colleagues (2000) found low technology methods were preferred to communicate a simple request such as for something to drink, whereas high technology methods were used to communicate detailed directives, talk on the phone, and tell stories. These results emphasize the importance of providing a continuum of AAC methods that can be employed, depending on the user needs and communicative circumstances.

Unaided AAC Methods

Unaided AAC methods are those that do not require any external device or chart, such as facial expressions, responses to yes-or-no questions, gestures, and partner-assisted auditory scanning. With partner-assisted auditory scanning, the communication partner verbally lists the alphabet or a predetermined list of options until the user indicates that the desired element has been reached, and then the process is repeated until the message is complete. When this method is used to spell messages, the alphabet may be segmented in half or into quarters to speed up the message construction process (e.g., A-M, M-Z). The user can indicate a letter through any means established by the user and the listener (e.g., gesture, vocalization, buzzer switch). For example, the author worked with a patient with ALS who used a buzzer switch (e.g., one buzz for “yes,” two buzzes for “no”) with partner-assisted auditory scanning. At a clinic visit, he and his wife clipped his buzzer switch to his pillow. When he needed something, he moved his head to access the buzzer to wake his wife. Once awake, his wife began the process of assisting him to construct his message using partner-dependent auditory scanning.

As unaided AAC methods require minimal physical movement, they are appropriate for individuals functioning across the range of physical stages described in “Functional Staging for AAC Intervention.” They can also be used in situations where the partner cannot look at or see the listener (e.g., in the dark, riding in a car) or when the AAC user has reduced visual acuity and/or visual processing deficits. In addition, partner-assisted auditory scanning can be adjusted to accommodate for a range of cognitive and language (literacy) functioning. For example, individuals who have a good attention span and unimpaired spelling ability can use partner-dependent auditory scanning to spell messages. Those with reduced attention span and spelling skills may benefit from a hierarchy of yes and no questions, asked in a consistent order to narrow down the message as illustrated in “Example of a Yes/No Question Heirarchy” at the end of this article.

Research on the use of unaided AAC methods is lacking. There are, however, a few published reports on their use by individuals with acquired neurogenic communication disorders. Mathy and colleagues (2000) reported on AAC use patterns by people with ALS. A total of 24 subjects were included, 12 with spinal onset and 12 with bulbar onset of the disease. At the time of the study, all subjects functioned at Stage 5 on the speech scale. All subjects reported using facial expression and responses to yes-or-no questions. Five of the 12 patients with spinal onset ALS reported using partner-dependent auditory scanning, but none of the patients with bulbar onset ALS used this method. The latter group functioned at Stage 1 or 2 in upper extremity functioning and at Stage 3 or above in lower extremity functioning and, therefore, had less need to rely on partner-dependent communication methods than did the patients with spinal presentation, who all functioned at Stage 5 in both upper and lower extremity staging at the time of the study.

In their long-term case studies of AAC intervention for four people with ALS, Doyle and Phillips (2001) found that although the participants had access to high technology AAC devices, they primarily relied on unaided approaches during the late stage of the disease. This stage corresponded with reduced motor abilities and a narrowing of communication partners and topics. During the final stage of the disease, subjects spent most of their time in bed cared for by family members and
communicated primarily to indicate basic needs. In a similar vein, Porter (1989) presented a case study of AAC intervention for a man during late stage MS. Due to motor and visual deficits, he relied primarily on auditory scanning (both partner-assisted and automatic scanning). Finally, Soderholm, Meinander, and Alaranta (2001) reported on the use of AAC by 17 patients with locked-in syndrome. The initial communication methods used by all of these individuals included eye movements to indicate responses to yes-or-no questions and respond when the alphabet was “read-out” by the communication partner.

Teaching unaided AAC strategies, particularly establishing a means to answer yes-or-no questions, is often the first step in the AAC intervention process. Moreover, research examining the use of these strategies with individuals with acquired dysarthria indicates that the strategies continue to be used as part of the individual’s communication repertoire, even when the user has access to high technology AAC devices. This is particularly true for individuals with reduced upper extremity functioning.

**Low Technology AAC**

Low technology AAC methods include alphabet boards or picture symbol communication displays, accessed using either manual direct selection, optical direct selection, or partner-assisted manual scanning. Partner-assisted manual scanning requires the communication partner to point sequentially to letters on the alphabet board, written message lists, or picture symbol displays until the user indicates that the desired element has been reached. The process is repeated until the message is completed. It is useful for the partner to write down the elements of a message during the message construction process so that both partners can keep track of the message as it is created.

As with unaided AAC methods, an advantage of low technology AAC methods is their cost and the flexibility to be adjusted by the communication partner to meet the physical, cognitive, and linguistic abilities of the AAC user. Low technology AAC strategies also allow for immediate improvement of communicative functioning and provide a means to practice skills necessary to be successful with high technology AAC methods. For example, individuals in Stage 5 in upper extremity functioning may need practice to become proficient in accessing a switch for a high technology AAC device that uses row-column scanning. Practice can be accomplished with partner-assisted manual scanning by having the user access a bell or buzzer placed in the most physically accessible location to indicate when the partner has reached the desired message element on the manual scanning display. Partner demands for timing and accuracy can gradually be increased to simulate the demands of scanning on a high technology AAC device.

A few recent studies have examined low technology AAC use by individuals with acquired dysarthria, including those with ALS (Doyle & Phillips 2001; Mathy et al., 2000), HD (Klasner & Yorkston 2001), and PD (Armstrong et al., 2000). In their report of AAC usage patterns in ALS, Mathy and colleagues (2000) found that the majority of the subjects with spinal onset (9/12) and all of the subjects with bulbar onset (12/12) used low technology AAC techniques; however, the techniques differed based on physical abilities. All of the bulbar onset subjects had adequate upper extremity functioning at the time of the study and therefore used handwriting as their primary low technology method. The spinal onset group relied on alphabet boards accessed with partner-dependent visual scanning or optical pointing. The four subjects with ALS studied by Doyle & Phillips (2001) included two with bulbar onset and two with spinal onset ALS. Both of the subjects with bulbar onset used handwriting in the early and middle stages of the disease when it was still physically possible. One of the subjects with spinal onset used an Eye-Gaze board, and no low technology strategies were described for the other subject with spinal onset ALS.

Klasner and Yorkston (2001) described the use of low technology AAC strategies termed “cognitive and linguistic supplementation” for WD, a 44-year-old man diagnosed with HD in 1993. They used an in-depth, guided interview process with WD and his wife to identify the communicative activities that were most important to him and that he wished to have assistance to maintain. These included involvement in running the household and family decision-making and talking to his wife and friends about his daily life. Intervention for conversation with his wife involved the use of linguistic-cognitive supplementation with scripts. For example, WD wanted to be able to talk to his wife about what he did at home during the day while she was at work. To support this activity, a notebook with short descriptions of the activities in which WD typically engaged during the day was developed. During therapy, WD learned to trigger his scripts of various activities using key words and his wife learned strategies to facilitate effective conversation with WD, such as beginning with similar questions each day.

Armstrong and colleagues (2000) surveyed speech language pathologists in Scotland regarding their experiences implementing AAC with
individuals diagnosed with PD. Of the 32 therapists initially contacted, 23 responded. When queried about their application of low technology AAC devices, respondents indicated most frequent use of amplifiers, alphabet boards, picture charts, and pacing boards. Nearly half of those surveyed indicated a low rating of success with low technology with PD clients. Among the primary reasons given for this rating included cognitive/memory problems, preference for speech, and lack of motivation.

As is the case with unaided strategies, low technology AAC strategies are inexpensive and highly adaptable to needs of the user. Continued research on low technology AAC strategies is needed to support evidence-based AAC practice with individuals who have acquired dysarthria.

High Technology AAC

Traditionally, high technology AAC devices are placed in two categories: dedicated devices and integrated/multipurpose devices. Dedicated devices are designed and manufactured specifically for the purpose of augmentative communication. They provide a means to select message elements on the device (e.g., a keyboard, switch scanning, or combinations of input methods), a means to formulate messages (e.g., iconic codes, orthography, or combinations of message construction elements), and a mode of output (e.g., synthesized speech or digitized speech). Multipurpose/integrated AAC devices consist of standard microcomputer platforms and special software and hardware. The special software instructs the operating system (e.g., Windows, Windows CE, Macintosh OS) to work with a speech synthesizer, and provides access to the computer through a variety of methods including a modified keyboard, joystick, or mouse, and optical or switch scanning.

As indicated above, the means to access the AAC device is an essential component. Access technologies are designed to accommodate the user’s physical abilities to make selections. These technologies range from simple micro-switches to brain-computer interface technologies in which the user moves the cursor on the computer screen by learning to control the amplitude of mu and beta rhythms in electroencephalographic recordings from the sensorimotor cortex (Wolpaw, Bir-baumer, Heetderks, McFarland, Peckham, Schalk, Donchin, Qua-trano, Robinson, & Vaughan 2000).

In their studies of AAC technology usage patterns with people with ALS, Doyle and Phillips (2001) and Mathy and colleagues (2000) reported that all subjects used high technology devices. People with bulbar onset were more likely to use small, keyboard-based devices such as the Link™ and the LightWRITER™. These devices were accessed using manual direct selection in the early to middle stages of the disease process (Doyle & Phillips, 2001), and adapted to be used with a keyguard (Link™) and scanning (LightWRITER™) as upper extremity functioning declined in the late stage of the disease process. These results underscore the need to plan for upper and lower extremity functioning decline, when selecting high technology devices for people with degenerative diseases.

All of the individuals with spinal-onset ALS studied by Doyle and Phillips (2001) and Mathy and colleagues (2000) used multipurpose devices, such as EZ Keys™, accessed using single-switch scanning or two-switch Morse Code. This multipurpose AAC device includes the EZ Keys™ software implemented on a notebook computer (the package is sold as the Freedom 2000™). In addition to providing a means for speech communication, this program also allows the user to apply his or her physical access method (e.g., single switch scanning, Morse Code, Joystick) for full computer access. Mathy and colleagues found that subjects with spinal onset ALS used their high technology AAC devices extensively for computer activities, such as written communication and email, as well as for speech augmentation.

In their survey of AAC use by individuals with PD, Armstrong and colleagues (2000) found that the LightWRITER™ was the most frequently used device with this group. The respondents in the study reported a generally higher level of success with high technology AAC than with low technology strategies. In their conclusions from this preliminary study, the authors stressed the need to provide early and regular speech/language intervention for people with PD to enable timely introduction of AAC intervention as needed. They also stressed the need for controlled research examining the efficacy of AAC intervention in PD.

Medicare groups all dedicated AAC devices under four codes based on the following characteristics: type of speech output (synthesized or digitized), message type (pre-recorded messages or formulated “spelled” messages), recording time (for digitized devices only—shorter than 8 minutes or longer than 8 minutes), and access method options available (direct physical contact only or multiple access methods). AAC software programs for integrated devices have a separate Medicare code. There are additional codes for device accessories and wheelchair mounting systems. Further information regarding Medicare guidelines for AAC assessment
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and funding can be found on the Medicare information Web site (AAC/RERC Web site).

**Future Research Needs**

As indicated in the beginning of this article, the documentation of positive outcomes of AAC intervention for individuals with severe expressive communication disorders was essential to bring about the change in Medicare reimbursement policy for AAC intervention. For continued optimal intervention for individuals with AAC needs, the field must continue to provide evidence. As illustrated by the publications reviewed in this paper, most of the information currently available to support evidence-based practice in AAC for people with acquired dysarthria comes from clinical experience and case studies. Although this information is useful to illustrate the effects of AAC intervention with individuals with various disorders, there is also a need for controlled studies examining the efficacy of AAC interventions for individuals with acquired dysarthria across the etiological groups. A suggested list of questions for future research includes the following:

- What are the most effective service delivery models for assuring the timely provision of AAC intervention across the etiological groups?
- What features of AAC devices and accessories do individuals prefer across the etiological groups?
- Which AAC devices are the most effective for individuals from different etiological groups with differences in cognitive, literacy, visual, and physical functioning?
- Which cognitive skills and deficits have the greatest impact on the success of AAC intervention?
- Which features of AAC devices and accessories do family members and friends of AAC users prefer?

The field of AAC is diverse and challenging, but there are numerous resources (e.g., books, workshops, World Wide Web sites) available for speech language pathologists and other professionals to assist them in assessment, funding, and treatment planning in AAC intervention. In addition to the AAC-RERC Web site, which contains information on Medicare and descriptions of research in AAC currently in process, the site hosted by The Hattie B. Munroe and the Barkely Memorial Augmentative Communication Centers is another valuable resource (http://aac.unl.edu/). The materials provided on this site include links to all of the vendors and manufacturers of AAC devices, AAC device tutorials, treatment resources, and more. Moreover, with the lifting of barriers to funding AAC devices and services by Medicare and private insurance carriers, there has never been a more rewarding time to provide AAC intervention for individuals with acquired neurogenic disorders.

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**References**


Speech Staging
1. No reduction in speech functioning.
2. Detectable speech disorder but speech remains intelligible.
3. Speech intelligibility reduced especially in challenging speaking situations (e.g., noise-groups).
4. Natural speech requires supplementation by augmentative communication aids and strategies in most situations.
5. No functional speech. Augmentative communication aids or strategies needed to maintain functional communication.

Cognitive Staging
1. Cognitive functioning not affected.
2. Cognitive functioning mildly affected in the areas of attention, memory and new learning but aware of deficits and able to compensate independently.
3. Cognitive functioning moderately affected in the area of attention, memory, new learning, self monitoring. Performs best with previously learned tools.
4. Cognitive functioning severely affected in all areas. Needs context (e.g., scripts) and partner support to engage in communication.
5. Cognitive functioning profoundly affected may not be aware of communication partner.

Literacy Skills Staging
1. Spelling communicator. Has functional literacy skills for written communication and has no difficulty using spelling to communicate on an AAC device.
2. Supported spelling communicator. Reading is functional for reading the newspaper but relies on spelling supports such as word prediction to maintain independent communication.
3. Graphic symbol/sight word communicator. Recognizes basic sight word vocabulary, is not able to use spelling to maintain independent communication even with support, however, may be able to identify first letters of words.
4. Graphic symbol communicator. Not able to read or spell. Relies on graphic symbols to construct/represent messages.
5. Non-symbolic communicator.

Visual staging:
1. Visual processing not affected.
2. Visual processing mildly affected. May have ocular motor deficits that affect tracking, and/or field cuts that cause visual neglect, but is aware of deficits and able to use compensatory strategies effectively.
3. Visual processing moderately affected. Unable to independently compensate for deficits in tracking, neglect, etc. Performs best when materials are placed in optimal areas for viewing.
4. Visual processing severely affected. Requires auditory and/or tactile information to augment visual input for optimal performance.

**Upper Extremity Staging**

1. Accelerated rate AAC communicator. Has full use of both upper extremities, may already have developed good keyboarding skills or is capable of learning keyboarding. Handwriting not affected.

2. Moderate rate AAC communicator. Has adequate use of one or both upper extremities, but demonstrates some fine motor impairment that affects message construction rate. Able to handwrite but legibility may be affected.

3. Supported manual use communicator. Has sufficient use of one or both upper extremities for accessing AAC device but requires supports (e.g., key guard) to maintain accuracy. Unable to handwrite.

4. Alternate access direct selection communicator. Upper extremities not functional for access but has sufficient control head or other body part to use optical pointer (e.g., head mouse).

5. Alternate access switch user. Must use micro switch with scanning, etc. to access an AAC device.

**Lower Extremity Staging**

1. Ambulation not affected.

2. Gait affected but independent ambulation.

3. Supported ambulation (must use crutches, cane or walker to prevent falling, may use wheelchair for long distance mobility).

4. Independent supported mobility (uses manual or power wheelchair to maintain independent mobility).

5. Dependent supported mobility (requires assistant to move wheelchair).

**Example of a Yes/No Question Hierarchy**

**Directions**

1. Determine the method that the individual uses to indicate “yes” and “no.”

2. Ask the questions in the same order each time.

3. Continue through the series of questions until the message has been determined.

**Questions to Narrow Down the Message Category**

- Do you need to tell me something? [If “yes,” ask the next question]
- Is it an emergency? [If “yes,” go to Emergency Questions sub list]
- Are you in pain? [If “yes,” go to the Pain Questions sub list]
- Do you want to do something? [If “yes” go to the Things to do Questions sub list]
- Do you want to ask about someone in your family? [If “yes,” go to the Family Questions sub list]