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Evidence-Based Intervention for Individuals With Acquired Apraxia of Speech

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Structured Abstract

Clinical Question: Would individuals with acquired apraxia of speech (AOS) demonstrate greater improvements for speech production with an articulatory kinematic approach or a rate/rhythm approach?

Method: EBP Intervention Comparison Review

Study Sources: ASHA journal, Google Scholar, PubMed, CINAHL Plus with Full Text, Web of Science, Ovid, and Scopus

Search Terms: apraxia AND adult OR acquired, and intervention OR therapy

Number of Included Studies: 18

Primary Results:

Articulatory kinematic and rate/rhythm approaches are beneficial to individuals with AOS.

Sound Production Therapy (SPT) is one articulatory kinematic approach with data from a meta-analysis that demonstrates large and positive results for individuals with AOS. This approach incorporates a majority of the strategies included in most of the articulatory kinematic approaches.

Rate/rhythm approaches have produced positive results for some individuals with AOS. There are fewer studies examining rate/rhythm approaches. One study by Brendel & Ziegler (2008) demonstrates support for the use of one rate/rhythm approach.

Conclusions: Research supports the use of articulatory kinematic and rate/rhythm approaches for AOS. Choose the best intervention based on the patient's level of functioning and goals. For example, current rate/rhythm approaches include the production of phrases with a metronome, hand tapping, or a sequence of tones. If the patient demonstrates severe AOS and only produces utterances at the single-syllable word level, then a rate/rhythm approach may not be the best first choice.

Evidence-Based Intervention for Individuals With Acquired Apraxia of Speech

Angela Van Sickle

Clinical Scenario

Carole is a speech-language pathologist (SLP) working in the outpatient department of a stroke rehabilitation center. She recently evaluated Joyce, a 70-year-old female patient, who demonstrated severe expressive speech deficits. Her spontaneous speech consisted of a few words and automatic phrases.

At the time of her evaluation, Joyce was eight months post onset of a left hemisphere stroke. She demonstrated severe acquired apraxia of speech (AOS) as measured by the Apraxia Battery for Adults–Second Edition (ABA-2; Dabul, 2000) and criteria for AOS diagnosis outlined by McNeil, Robin, and Schmidt (1997): disturbed prosody, prolonged segment durations, prolonged intersegment durations, and sound distortions. On the Western Aphasia Battery–Revised (WAB–R; Kertesz, 2006), Joyce demonstrated moderate Broca's aphasia as measured by her Aphasia Quotient (AQ) of 53.8 and other subtest scores (Kertesz, 2006).

Scores on the following subtests determined the AQ of 53.8: Spontaneous Speech, Auditory Verbal Comprehension, Repetition, and Naming/Word Finding. Her AQ was low due to the reduced scores on the expressive language subtests. Her ability to write several words suggested that her difficulty was not with the retrieval of the word, but with the production of the word.

It is possible that her moderate aphasia severity rating was due to her AOS. When factoring in written words to the scores on the WAB–R (Kertesz, 2006), her AQ was 61.4. Even with this, her low score on the repetition task was still the main reason for her lower AQ and seemingly higher aphasia severity rating. Dabul (2000) suggested that a person with aphasia without AOS is usually able to repeat words following a model, but an individual with AOS and aphasia will continue to demonstrate difficulty with production. Overall, Joyce demonstrated limited abilities to verbally answer questions or make requests, and her repetition skills were inconsistent. Through yes/no questioning and written information, she was able to communicate that she knew, but could not say words. Auditory comprehension subtests were within normal limits as measured by subtests of the WAB–R (Kertesz, 2006). Collectively, results from Joyce's evaluation suggested that her main communication deficit was related to AOS.

Joyce was highly motivated to participate in skilled speech therapy and indicated that her main goal was to verbally communicate. Joyce was active in many social groups and played bridge at least twice a week, but the quality of her interactions was diminished by her reduced ability to participate in conversations.

Background Information

AOS and aphasia are two distinct communication disorders: AOS affects the planning and programming of speech (McNeil, Pratt, & Fossett, 2004), whereas aphasia affects the processing of language (National Aphasia Association, 2016). McNeil, Pratt, and Fossett (2004) defined AOS as a disorder of speech production, characterized by sound distortions; increased durations within and between sounds, syllables, and words; and disturbed prosody. Their definition also states that AOS is not related to language processing, as with aphasia. Although it is common for an individual with AOS to have some degree of aphasia, a person with aphasia may not necessarily exhibit AOS. AOS may range from mild (with few instances of disturbed speech) to severe (which may limit spontaneous speech to a few words or automatic phrases). Some individuals with AOS are able to write words or parts of words to facilitate communication and demonstrate that language is relatively intact, but the planning and programming of the utterance is impaired.

Two intervention protocols with support in the literature are articulatory kinematic and rate and/or rhythm approaches (Wambaugh, Duffy, McNeil, Robin, & Rogers, 2006a). Articulatory kinematic approaches focus on improving speech through improving the movements required for production. Rate and/or rhythm approaches match speech to hand tapping, a metronome, or tone sequences to facilitate control of the rate or rhythm of speech (Wambaugh et al., 2006a).

Clinical Question

Carole's goal was to determine the most effective therapy strategies for Joyce and develop an evidence-based intervention plan. Since the main communication deficit was related to AOS, intervention protocols to improve production of speech were investigated. Using the PICO framework (OCEBM Levels of Evidence Working Group, 2011; Sackett, Straus, Richardson, Rosenberg, & Haynes, 2000), she identified the patient group or problem (P), an intervention approach (I), a comparison approach (C), and the possible outcomes of using an approach (O):

P – individuals with acquired apraxia of speech (AOS)
I – articulatory kinematic approach
C – rate/rhythm approach
O – improvement in the production of words and/or phrases

The specific question for this case was: Would individuals with AOS demonstrate improvements for speech production with an articulatory kinematic approach or a rate/rhythm approach?

Search for the Evidence

In beginning a search for evidence-based intervention, an ASHA journal and Google Scholar search were completed first. Since Carole had access to a university library, the following databases were also used in the search: PubMed, CINAHL Plus with Full Text, Web of Science, Ovid, and Scopus. All searches included the following keywords in various combinations: apraxia, adult, acquired, intervention, AND therapy. Thirty articles were identified from 2004 to 2015.

In 2006, Wambaugh and colleagues compiled, categorized, analyzed, and rated all intervention studies conducted from 1970 to 2003. After detailed examination and ratings of the studies, these authors concluded that interventions for AOS were beneficial, but up to that point "the evidence base for AOS treatments was relatively meager in terms of both quantity and quality" (Wambaugh et al., 2006a, p. xxviii). In a companion article, Wambaugh, Duffy, McNeil, Robin, and Rogers (2006b) concluded that articulatory kinematic approaches and rate/rhythm approaches were two intervention categories showing promise for evidence. Due to issues with research design, reliability of an AOS diagnosis, and internal and external validity of studies from 1970 to 2003 (Wambaugh et al., 2006a), articles from 2004 to 2015 were reviewed for Joyce. Many of these current studies considered the recommendations from Wambaugh et al. (2006a) and produced higher quality research.

Next, inclusion and exclusion criteria were determined. Carole was interested in therapy that would facilitate the goals for Joyce, including the production of words and phrases. Articles considered for review included participants with AOS, an intervention protocol that could be replicated, and one or more clear dependent variables with words as targets. Carole also decided to review the studies that included phrases as targets for future references for Joyce, even though she would start therapy using a protocol focusing on words. Studies were excluded if the intervention required equipment that was not readily available to most SLPs, if the dependent variables were related to the production of specific sounds only or nonwords, and if the diagnosis of AOS was questionable as rated by Ballard et al. (2015). Using these inclusion and exclusion criteria, 18 studies were reviewed.

The majority of studies were articulatory kinematic approaches (i.e., 13 of 18). Three studies included rate/rhythm approaches, one of which also fell under the articulatory kinematic category. Two of the articles were systematic reviews of the literature related to AOS intervention (Ballard et al., 2015; Wambaugh et al., 2006a), and one article was a meta-analysis of treatment data for one approach (Bailey, Eatchel, & Wambaugh, 2015).

Although 13 studies were categorized as articulatory kinematic, a variety of intervention protocols were administered. The articulatory kinematic category included seven different approaches: the 8-step task continuum (Aitken Dunham, 2010); the Motor Learning Guided (MLG) approach (Friedman, Hancock, Schulz, & Bamdad, 2010; Lasker, Stierwalt, Hageman, & LaPointe, 2008; Lasker, Stierwalt, Spence, & Cavin-Root, 2010); phonologic placement treatment (Savage, Stead, & Hoffman, 2012); script training with clinician models, unison production, and orthographic cues (Youmans, Youmans, & Hancock, 2011a, 2011b); repeated practice (Wambaugh, Nessler, Cameron, & Mauszycki, 2012); the Speech Motor Learning (SML) Program (van der Merwe, 2007, 2011); and Sound Production Treatment (SPT) (Wambaugh, 2004; Wambaugh & Nessler, 2004; Wambaugh & Mauszycki, 2010). Investigations on rate and/or rhythm approaches included metrical pacing treatment to improve words

and phrases (Brendel & Ziegler, 2008), the production of syllables with hand tapping (Mauszycki & Wambaugh, 2008), and hand tapping with a digital metronome (Wambaugh et al., 2012).

With 18 articles and 10 different protocols to consider (i.e., seven articulatory kinematic and three rate/rhythm), Carole began to review the research. She quickly realized that many of the articulatory kinematic approaches included similar strategies, such as repetition and visual cues or models. She grouped all approaches based on their similarities and began to evaluate their efficacy as they related to Joyce.

Evaluating the Evidence

Eighteen articles were identified that matched Carole's criteria. Carole used the *Oxford Centre for Evidence-Based Medicine 2011 Levels of Evidence* (OCEBM Levels of Evidence Working Group, 2011) as a guide to rate the quality of the research for her intervention. The ratings start at Level 1 as the highest level and include systematic reviews of randomized trials, and move toward Level 5, utilizing mechanism-based reasoning. All 13 of the articulatory kinematic studies were Level 4 studies (i.e., several cases in which the same treatment was provided). Of the three rate/rhythm control approaches, two were Level 4 studies; one study included 10 participants in a single-subject design and the other included one participant. The remaining rate/rhythm approach study was rated Level 2 and included the random assignment of individuals to experimental and control groups. Finally, the remaining three studies were rated at Level 1; two of these studies were systematic reviews of the literature related to AOS intervention and one included a meta-analysis of the literature related specifically to SPT.

Although there were seven articulatory kinematic approaches, the strategies were similar. Many protocols included a hierarchy of strategies that may or may not be used by every participant. Table 1 lists the common strategies and the intervention protocols that employed each strategy. For some intervention protocols, participants did not always need the full hierarchy of strategies or did not need the full hierarchy for each trial/production. For example, a participant may have repeated a word on the first attempt for some trials, but may have needed phonetic placement cues, models, or unison production for other trials. Different components of the protocol may have been helpful for different trials or participants. Because of this, it is difficult to determine which strategies were consistently helpful.

All articulatory kinematic approaches included immediate repetition, imitation/modeling, or integral stimulation (i.e., "listen to me, watch me, and do what I do"). Some included other techniques along with imitation or repetition, such as phonetic/articulatory placement cues or unison production. The main difference between the seven intervention protocols was the slight differences in the strategies and the order of the hierarchy of cues/strategies. The focus of this type of intervention was to improve the production of sounds in words, words, or phrases (i.e., to improve the planning and programming of sounds in words, words, or phrases). Twenty-five individuals participated in these 13 articulatory kinematic studies and 23 of the 25 participants demonstrated positive results and improved the production of words with this type of approach. A meta-analysis of treatment data for the SPT approach was completed for 24 participants (Bailey et al., 2015). The authors reported large and positive effects for this intervention strategy for individuals with AOS.

The three rate/rhythm approaches utilized a metronome, a tone sequence, and/or hand tapping with the focus on the timing or pacing of speech production. Overall, 9 of 21 participants demonstrated improvements with rate/rhythm approaches. Brendel and Ziegler (2008) used a metrical pacing therapy (MPT) technique in which 10 participants synchronized speech to a computer-controlled metrical template; eight demonstrated positive results. Mauszycki and Wambaugh (2008) employed a treatment technique in which one participant produced four-syllable and four- to five-syllable words/phrases in rhythm with a metronome and hand tapping. This participant showed an increase in the percentage of words produced correctly for four-syllable treated words. Wambaugh et al. (2012) examined the effects of adding a rate/rhythm approach (i.e., hand tapping with a metronome) to a repeated practice intervention protocol. Eight of the 10 participants improved production with the repeated practice component, but demonstrated limited additional improvements with the addition of the rate/rhythm component.

The two remaining articles were systematic reviews of the existing literature related to AOS intervention. Wambaugh et al. (2006a) and Ballard et al. (2015) did not conduct a meta-analysis on collective data for each intervention protocol, but provided important information

related to each investigation: the number of participants, a rating for the confidence that participants exhibited acquired AOS, severity, a brief description of the treatment, a research category rating, and treatment effects. Ballard et al. (2015) stated that it would be beneficial to conduct a meta-analysis on those interventions with repeated investigations to demonstrate efficacy.

The Evidence-Based Decision

In choosing an evidence-based intervention, Carole considered Joyce's strengths, weaknesses, and goals. Since Joyce was only able to produce a few single words and some automatic phrases, she decided that the rate/rhythm approaches would not be her first choice; each of those studies examined the production of words in phrases and Joyce was not yet able to produce phrases. Also, for the three studies reviewed, this approach was helpful for only 9 of 21 participants depending on the strategy used. Brendel and Ziegler (2008) demonstrated positive results for 8 of 10 participants using a sequence of tones. This may be a strategy to examine further once Joyce is to that level of functioning.

This left the articulatory kinematic approaches, which were also helpful to many individuals with AOS. Many of the articulatory kinematic approaches included a hierarchy of strategies that may facilitate improved speech. There were only 2 of 25 participants across the 13 studies reviewed that did not show positive results with these approaches. Table 2 summarizes the 13 studies on articulatory kinematic approaches. Again, there were a few protocols that focused on the production of phrases; these were eliminated as first-choice therapy approaches until Joyce was at that level of functioning, leaving five intervention protocols.

The remaining intervention protocols included the 8-step task continuum (Aitken Dunham, 2010), the Speech Motor Learning (SML) approach (van der Merwe, 2007, 2011), Sound Production Treatment (SPT) (Wambaugh, 2004; Wambaugh & Nessler, 2004; Wambaugh & Mauszycki, 2010), phonologic placement treatment (Savage et al., 2012), and repeated practice (Wambaugh et al., 2012). The 8-step task continuum, SML, and phonologic placement interventions were eliminated since there were only one to two articles including only one to two participants for each approach. The study on repeated practice included 10 participants in one study, but repeated practice is a component of other approaches. SPT includes most of the strategies included in these other four intervention approaches.

SPT includes many of the strategies that are components of several articulatory kinematic intervention protocols. A meta-analysis of the data on this treatment protocol demonstrated large and positive results for 24 individuals with AOS (Bailey et al., 2015). To date, this approach has the most robust support. Since this approach fit well with Joyce's strengths, weaknesses, and goals, Carole decided to start with Sound Production Treatment. Through analysis of Joyce's speech, Carole chose six sounds that were difficult for Joyce to produce. She chose 25 functional CV and/or CVC words for each sound that would serve as targets. During therapy, Joyce will work to improve production of difficult sounds using functional words that she will be able to use in real-life situations.

Author Note

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Table 1. Articulatory Kinematic Approaches to AOS Intervention and Specific Strategies

Author(s) & year	Immediate repetition	Delayed repetition	Phonetic/ Articulatory placement	Phonetic/ Articulatory placement diagrams	Graphemic/ Orthographic cues	Models/ Imitation/ Integral stimulation	Unison production	Reading aloud	Answering questions	Additional self-practice/ Auditory models from AAC device	Verbal feedback
8-step task continuum											
Aitken Dunham (2010)	X	X				X					
Motor Learning Guided (MLG) approach											
Friedman et al. (2010)	X					X	X	X	X	X	
Lasker et al. (2008)	X	X						X		X	X
Lasker et al. (2010)	X	X						X		X	X
Phonologic placement treatment											
Savage et al. (2012)			X	X						X	
Speech Motor Learning (SML) Program											
van der Merwe (2007)					X	X					X
van der Merwe (2011)					X	X					X
Sound Production Treatment (SPT)											
Wambaugh (2004)	X		X			X					X
Wambaugh & Nessler (2004)	X		X		X	X	X				X
Wambaugh & Mauszycki (2010)	X		X		X	X	X				X
Repeated practice											
Wambaugh et al. (2012)	X					X					X
Script training											
Youmans et al. (2011a)					X	X	X	X			
Youmans et al. (2011b)					X	X	X	X			

Table 2. Summary of Articulatory Kinematic Studies

Author(s) (year)	Number of participants	AOS severity & aphasia	Targets/Dependent variables	Treatment description	Outcomes
Aitken Dunham (2010)	2	Both mild–moderate AOS With aphasia	Words	8-step task continuum—integral stimulation; delayed production; successive productions	2/2 participants demonstrated improvement for producing words
Friedman et al. (2010)	1	Moderate–severe AOS No mention of aphasia	Functional phrases	Motor Learning Guided (modified)—unison production with clinician, repetition, delayed repetition, clinician models, orthographic cues, fading cues	Accuracy increased for trained targets. Scores decreased after 1 to 2 weeks, but remained higher than baseline.
Lasker et al. (2008)	1	Severe–profound AOS With aphasia	CV words Two-syllable words/phrases	Motor Learning Guided—clinician model, immediate repetition, imposed delay between each attempt, independent production	Acquired and used treatment targets
Lasker et al. (2010)	1	Severe AOS With aphasia	4 to 11 syllable phrases	Motor Learning Guided—clinician model, immediate repetition, imposed delay between each attempt, independent production	Improvements for trained stimulus items
Savage et al. (2012)	1	Severe AOS No reported aphasia	Sounds in words	Phonologic placement treatment—drawings or photographs for phonological support, tactile cues, auditory input	Improved production of sounds in words
van der Merwe (2007)	1	AOS severity not reported Without aphasia	Words	Speech Motor Learning Program—see van der Merwe (2011)	Decrease in incorrect productions and increase in self-corrections for words
van der Merwe (2011)	1	Moderate AOS—spoke in 4- to 5-word phrases/sentences With aphasia	Words	Speech Motor Learning Program—hierarchy of steps and stimuli from simple to complex—imitation, orthographic cues, integral stimulation	Improvements for the production of words, but loss of experimental control. Unknown if improvements were due to treatment.
Wambaugh (2004)	2	Moderate–severe AOS With aphasia Mild–moderate AOS With aphasia	Phrases of 2 words One participant: /r/ blends in monosyllabic words	Sound Production Treatment—minimal pair contrasting, repetition, modeling, articulatory placement cues, verbal feedback	Increased accuracy for sounds treated

Table 2. Summary of Articulatory Kinematic Studies (continued)

Author(s) (year)	Number of participants	AOS severity & aphasia	Targets/Dependent variables	Treatment description	Outcomes
Wambaugh & Nessler (2004)	1	Moderate–severe AOS With aphasia	Specific sounds in monosyllabic words	Sound Production Treatment—minimal pair contrasting, repetition, modeling, articulatory placement cues, verbal feedback, integral stimulation, visual cues, graphemic cues	Improved production of sounds in words. Improved production maintained for some sounds.
Wambaugh & Mauszycki (2010)	1	Severe AOS With aphasia	Sounds in CV or CVC words	Sound Production Treatment—minimal pair contrasting, repetition, modeling, articulatory placement cues, verbal feedback, integral stimulation, visual cues, graphemic cues	Improved production of trained words; generalization to untrained examples of trained sounds; maintenance at 10 weeks
Wambaugh et al. (2012)	10	AOS, but no reported severity With aphasia	Sounds in words	Repeated practice after a model. Repeated practice with rate rhythm control.	Improvements with repeated practice. Limited affects with the addition of rate/rhythm approach.
Youmans et al. (2011a; 2011b)	3	(1) Mild–moderate AOS (2, 3) Moderate–severe AOS With aphasia	Scripts personalized to the specific participant	Script training—clinician models, unison productions of phrases, fading cues during unison productions, orthographic cues, and independent productions	Increased the number of correct words produced in each of three scripts. Participants reported using the scripts and demonstrated maintenance.