

## Critical Review:

### Does treatment using meaningful gestures improve functional, expressive communication skills in adults with acquired apraxia of speech?

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This critical review examines evidence related to treatments for severe, acquired apraxia of speech, which incorporate the use of meaningful gestures. Study designs include: ABABA (1); multiple-baseline, across behaviours (1); and case studies (3). The findings of this review suggest mixed results regarding the role of gestures in the facilitation of speech, but indicate that gestures may be used as an augmentative or alternative communication method.

#### *Introduction*

Acquired apraxia of speech (AOS) is an adult neurogenic speech disorder that occurs as a result of brain damage (Knollman-Porter, 2008). According to Wambaugh and colleagues (2006a) from the Academy of Neurologic Communication Disorders and Sciences (ANCDS), AOS is characterized primarily by the following: slow rate of speech due to lengthened segments and/or intersegment durations, inaccurate speech sound production, distorted, perceived sound substitutions, errors that are usually consistent in type and location, and abnormal prosody. Wambaugh et al. (2006a) also list the following non-discriminative characteristics: articulatory groping, difficulties in speech initiation, motoric perseverations, awareness of errors, increasing number of errors with increasing word length, automatic speech that is superior to propositional, and islands of error-free speech. Though healthcare professionals have not yet universally agreed upon primary and non-discriminative characteristics, those aforementioned are part of the most comprehensive inclusion and exclusion criteria and definition of AOS to date (Knollman-Porter, 2008).

Wambaugh et al. (2006b) analyzed over 50 AOS treatment research articles and concluded that individuals with AOS may make improvements in speech production as a result of treatment, even if the AOS is chronic. A variety of treatment techniques for AOS that have been investigated over a span of 37 years, typically focusing directly on improving articulatory-kinematic aspects of speech production (Wambaugh, 2002). In other words, treatment approaches are most often direct and impairment-based. Contrastively, the concept of *intersystemic reorganization* (IR) – using a relatively intact system or modality, to facilitate the functioning of an impaired system or modality – has also been applied to the treatment of AOS (Wambaugh, 2002). One hypothesis is that the use of limb gestures in reorganization may provide the necessary organizational framework to

improve speech production (Wambaugh et al., 2006b). “Iconic” or meaningful gestures have been used most frequently in this approach (Wambaugh, 2002).

Because it is the most natural form of expressive communication, whenever speech is possible, it should be attempted (Knollman-Porter, 2008). Unfortunately for some individuals with severe AOS, speech may not be a realistic goal. In these cases, clinicians may adopt an *augmentative/alternative communication* (AAC) approach (Knollman, 2008; Wambaugh, 2006b). Meaningful gestures may be utilized as an AAC approach, as part of a generally more functional system (Dowden et al., 1986).

#### *Objective*

The primary objective of this review is to critically evaluate the existing literature on treatments for severe, acquired AOS that report the use of meaningful gestures to improve functional, expressive communication, based on two different approaches, or a combination of the two: IR and AAC.

#### *Methods*

##### Search Strategy

Electronic databases (Proquest Education, Medline, Scopus, and PubMed) were searched using the terms ((apraxia of speech) OR (apraxic) OR (apractic) OR (dyspraxic)) AND ((treatment) or (therapy)) AND ((gesture)). References from relevant articles found were also examined for possible inclusion. The search was limited to articles published in English and not limited by year of publication.

##### Selection Criteria

Papers were only selected for review if they examined the expressive communication outcome for at least one adult participant, diagnosed with AOS (or an equivalent diagnosis since the label has changed over time) and treated using an approach that incorporated gestures.

Additionally, the gestures used must have been iconic or meaningful in nature.

#### Data Collection

Results of the literature search yielded five studies based on two different theoretical approaches to AOS intervention. The theoretical bases included: IR (2), AAC (1), or a combination of the two approaches (2). Year of publication ranged from 1974 to 2006. The experimental designs included: ABABA (1); multiple-baseline, across behaviours (1); and case studies (3). All participants in were identified as having “severe” AOS.

#### **Results**

Early case studies demonstrated encouraging results for six non-verbal participants with severe AOS. Skelly and colleagues (1974) were the first to report on the use of iconic gestures as a form of IR and AAC in the treatment of clients with AOS. American Indian Sign (Amer-Ind) was the gestural code of choice because previous research showed that motivated and interested viewers were able to understand it with 88% accuracy, without previous training (Skelly et al., 1974). Amer-Ind is not viewed as a language. It has no specified grammar and there is no one correct Amer-Ind sign for an idea. In fact, any sign or combination of signs that adequately and reliably convey an idea is considered acceptable. Following six months of Amer-Ind training and pairing signs with verbal output, all six participants mastered 120 to 150 signs and made progress augmenting speech with signs. Two participants were also attempting three-word sentences of propositional speech without signs. Another two were using approximately 200 single, spoke words and began placing some in phrases. Yet another participant could speak about fifty words. Improved *Porch Index Communicative Abilities* (PICA) verbal scores confirmed these positive results. They also reportedly resorted back to using Amer-Ind when communication breakdowns occurred. The remaining participant made limited speech gains, being only able to approximate ten spoken words. However, he reportedly profited from the use of Amer-Ind by improving his overall communicative abilities and reducing his frustration level. The group’s verbal PICA scores increased by a range of 1.60 to 7.07. Despite the weak level of evidence this study provides, being uncontrolled case studies, five of the six participants having documented success should justify further investigation regarding the use of Amer-Ind as a treatment for AOS (Wambaugh et al., 2006b). Hospital personnel, family and friends also noted comparable improvements in everyday communication, thus supporting the findings with social validity.

Only one study found that gestures did not facilitate speech, and suggested instead that gestures be used as an AAC system. Oddly enough it was also the only study in which gestures alone were trained; yet verbal production was still measured. Dowden et al. (1981) presented two case studies with repeated measures. Amer-Ind training was conducted in three steps: pre-training, training and maintenance. Pre-training consisted of an introduction to Amer-Ind by way of viewing videotape, created by Skelly et al. (1974). Within each training session, the participants moved through a hierarchy of tasks. The participants had to reach a criterion level to complete each step in the hierarchy. The maintenance stage stressed the use of Amer-Ind in everyday conversation through individual sessions. A fifty-item gestural test was administered at each of the three stages. 25 trained and 25 untrained gestures were cued by drawings of an object or action. The tests were videotaped and played to small groups of untrained viewers. Average percents of gestures comprehended were calculated and plotted for each participant. Both had improved scores of intelligibility of their Amer-Ind, especially following the maintenance period. It was reported that one of the two patients improved as much on untrained as trained gestures. This claim is difficult to judge because no raw data was published, and looking at the graph for that one patient, it appears that the slope of the plotted mean percentage of correctly identified trained gestures is significantly steeper than that of the untrained gestures. Therefore, this study has failed to produce established generalization effects. To determine if Amer-Ind facilitates speech, a baseline was established during the pre-training phase when PICA scores varied less than 5% over two consecutive tests. The PICA was re-administered following the training and maintenance periods. No changes in PICA verbal scores were observed. The authors assert that they have failed to replicate findings from Skelly et al. (1974). This assertion should not have been made considering there was little to no attempt made to replicate the Skelly et al. (1974) procedure. Finally, the *Communicative Abilities in Daily Living Measure* (CADL) was administered at pre-training, training and maintenance to determine if these individuals would change, over the course of treatment, in proportions of successful verbal, nonverbal and combined responses during a communicative interaction. The participants’ answers were videotaped and judged by the author based on success of responses and mode of communication used. According to Dowden et al. (1981), one participant demonstrated a sharp decrease in the proportion of verbal responses and a marked increase in non-verbal and combined following maintenance. The other reportedly exhibited almost the same distribution of responses for each of the three tests. Though the

methods described in this study are approaching validity (e.g. partial blinding of raters, and repeating measures), without controls, it is still difficult to judge whether improvements are attributable to the treatment.

Treatment via the total communication approach – encouraging the use of multiple modes of communication – has been reported to result in improved expressive communication skills for adults with AOS (Fawcus & Fawcus, 1990). An increasing emphasis on functional communication led Fawcus & Fawcus (1990) to investigate, through case studies, the use of AAC within a total communication approach. Modes of communication included: gestures/miming, drawing and writing. Four participants with “severe dyspraxia” were trained in group therapy to increase their awareness of AAC strategies. Each subject was then presented with a message to convey to their caregivers at home, despite some doubts regarding the participants’ ability to retain the message long enough. The extent to which the message was correctly conveyed, which nonverbal strategies were employed, and the time it took to convey each message were all dependent factors recorded by the caregiver. Gestures were used to communicate 39% of the elements with 24% errors, suggesting that gestures may be a viable mode of communication but that they require more work to improve their accuracy (Fawcus & Fawcus, 1990). Unfortunately, results from this study are questionable, partially because only post-treatment data were presented. Fawcus & Fawcus (1990) made no claim that this should be regarded as an efficacy study. Instead, they conclude that their results are promising. It was stated that the participants were able to express communicative competence and show their resourcefulness. With such positive outcomes, the use of iconic gestures within a total communication approach warrants further research. Additionally, despite the obvious reasons why limb apraxia should impede gestural use, two of three participants in this study with limb apraxia overcame it to acquire functional gestural communication abilities.

Previous evidence has also demonstrated some success despite the presence of limb apraxia, with gestural reorganization treatment techniques. Code and Gaunt (1986) devised an ABABA single-subject design therapy program to teach specific hand signs to a participant with severe AOS, limb apraxia and “global aphasia.” The participant was in desperate need of some fundamental communicative ability, though he was almost two years post stroke. So, the authors aimed to establish some gestural skills; along the way, examining how combining gestures and speech in various ways would affect speech production. Clinical tests of aphasia and limb apraxia revealed little to no changes. However,

objective repeated measured showed the man was successful at learning a range of meaningful gestures and had somewhat improved his verbal single-word and gestural responses. In this study, training gestural use involved: the simultaneous production of words and gestures; the modeling and/or repetition of words and gestures; and, practice pairing verbalization with gesture. The experiment control task chosen was the *Letter Recognition* subtest from Schuell’s 1973 *Minnesota Test for the Differential Diagnosis of Aphasia* to be maximally different from the treatment task. According to Code & Gaunt (1986), this letter discrimination task is an “auditory-visual linguistic comprehension task”, whereas the assessment and treatment tasks are considered “articulo-praxic linguistic expression tasks.” Baseline assessments probed the participant’s performance for responding to commands and imitations under three conditions: (1) a word representing a gesture was cued by the therapist and the gesture was the required response; (2) a word was cued by the therapist and the corresponding gesture with repetition of the word was required; and (3) a gesture was given by the therapist and only a corresponding word was the required response. The tasks were ordered within steps of a hierarchy and a criterion of at 90% correct or more had to be achieved at least twice before progressing. Following once-weekly, 45-minute sessions over 8 months, Code and Gaunt (1986) found the participant improved on repeated measures by 30-40%. His performance on the control task was preserved. Therefore, improvements are likely the effect of treatment and not attributable to natural recovery or a placebo effect. Also, an increase of 5.5 in his overall percentage on the *Functional Communication Profile* was observed. A 22.5% increase of the participant’s *Scale of Psychosocial Adjustment* score supported the clinical impression of an improved mood during the course of treatment. Another clinical impression, without empirical support, was that the participant was using the signs he knew during group therapy and in everyday conversations. Although it appears as though the participant was using his gestures as part of an AAC system, this purpose is not directly mentioned by Code & Gaunt (1986). Because this ABABA design was realistic for clinical settings, it may be more easily applied to a speech-language pathologist’s everyday practice. Like Dowden et al. (1981), there was little indication of generalized improvement. Unlike Dowden et al. (1981), gestures appeared to facilitate speech production and hearing spoken words appeared to facilitate gestural production. Despite having limb apraxia, among other impairments, this individual was able to learn gesture-to-word and word-to-gesture cues in therapy, improving both forms of facilitation. A limitation described by Code & Gaunt (1981) is in regards to the reported improvements being

predominately within drilled tasks. Despite limited effects, their investigation is one of few in the area of AOS treatment with a relatively strong level of evidence for positive treatment effects.

Internal validity was evident in only study that paired the intact gestural modality with impaired verbal production to treat severe AOS. Raymer and Thompson (1991) used a single-subject, multiple-baseline experimental design to investigate the effectiveness of verbal plus gestural treatment for improving the verbal production of trained single words with specific initial phonemes. Additionally, the generalization effect was assessed across phonological contexts in a variety of single-word tasks. To achieve a baseline measure, showing stable performance levels pre-treatment, three probe tasks across four interactive sessions were scored online, out of ten, by an observer behind a one-way mirror. A score of 6/10 or more is considered a correct response. During the treatment phase: first, probe tasks that were randomized and counterbalanced across sessions were administered for all trained and some untrained stimuli; then one target phoneme was treated, using a prescribed sequence, across time, with 80% accuracy being the criterion. Probe sessions were videotaped. An independent assessor also scored and  $\pm 1$  point was considered to be in agreement. Agreement on every third probe session was on average 88% with a range of 77-97%. Verbally, the participant showed speech improvements for 3/4 trained phonemes in repetition tasks, demonstrating that improvements in articulatory accuracy might be sound dependent (Raymer & Thompson, 1991). A variable generalization effect was noted for untrained phonemes of a similar manner or place. Little change in oral-naming performance was observed. The importance of using gesture to facilitate the production of accurate oral naming responses was established by identifying the percentage of correct responses that were accompanied by a gesture, across baseline and treatment conditions. Following treatment, the number of attempts at gesturing to augment oral naming increased by 40% and the accuracy of oral naming responses that utilized gestures increased 61%. Thus, there was an increase in the frequency of gestural use during oral naming, and these gestures seemed to facilitate the verbalizations they accompanied. Overall, gestural reorganization appeared to have facilitated verbal production, though the subject improved in only some aspects of verbal production. Even more discouraging was the report that most speech improvements were restricted to repetition tasks (vs. oral naming) and that performance decreased during the withdrawal phase. Raymer and Thompson (1991) discussed that the participants concomitant aphasia and deep subcortical injury may explain the limited improvements.

## *Discussion*

Limitations exist when summarizing these results, which are from vastly divergent studies. One limitation is in the loose subject inclusion criteria, secondary to debatable definitions and diagnoses of AOS. Over the years in which AOS treatments have been developed, the definition and characteristics of AOS have been refined and are still questioned (Knollman-Porter, 2008). Until a universally agreed upon definition with classification criteria is accomplished, investigators must provide detailed descriptions of their study's participants. Two of the studies (Dowden et al., 1981; Raymer & Thompson, 1991) merely indicate a diagnosis of AOS, without any description of characteristics associated with the diagnosis. The other three studies (Code & Gaunt, 1986; Fawcus & Fawcus, 1990; Skelly et al., 1974) provide an incomplete or inadequate description of the discriminative characteristics of AOS each participant displays. Without detailed descriptions of the participants' speech characteristics, one must question whether the subjects being reviewed truly demonstrated AOS. Furthermore, without this information, it is difficult to decide whether clinicians should expect similar outcomes if they choose to apply the same treatment option. Recently, it has been demonstrated that speech-language pathologists who specialize in adult neurogenic communication disorders have exhibited a high degree of clinical interreliability when diagnosing and giving a severity rating of AOS based on their clinical subjective judgment alone (Knollman-Porter, 2008). However, this may not have been the case during the time of some of these early investigations (e.g., Skelly et al., 1974). All five studies in this review reported their participants as having "severe" AOS. Of course, these severity judgments are subjective and may therefore vary. Compounding the issue of subject heterogeneity, pure AOS is rarely seen and more often co-occurs with aphasia and/or dysarthria (Knollman-Porter, 2008). Of the 14 participants across the five studies, only 3 demonstrated a pure AOS (Skelly et al., 1974). All other subjects were battling their own variety of co-morbid disorders (i.e. oral, verbal and limb apraxia, aphasia, dysarthria, and visual-spatial difficulties). Most of the co-morbid disorders have the potential to affect the use of gestures. For example, a link between severity of aphasia and the capacity to use and comprehend symbolic gesture has been demonstrated (Code & Gaunt, 1986). The enormous range in time post onset (1 to 216 months) and the different methods and outcomes reported also pose a problem for summarizing the results of these studies.

### Level of Evidence

Study design and methodology should be considered when deciding how compelling the results are. The level of evidence that each of these studies yield varies this way also. These early investigations of AOS treatments were predominately poorly controlled case studies (Skelly et al., 1974; Dowden et al., 1981; Fawcus & Fawcus, 1990) in which treatments do not convincingly demonstrate to be responsible for improved patient performance. A couple of the studies (Code & Gaunt, 1986; Raymer & Thompson, 1991) used controlled experimental designs, which increased the level of confidence that AOS treatments may affect positive behavioural changes. Sample sizes ranged from 1 to 6 participants per study. The level of evidence could be improved if sample size increased. Overall, the evidence base for this treatment of AOS is limited in quantity and quality.

### Future Research

This review does suggest that further research is warranted in this area of AOS treatment. Despite the promising initial findings reviewed, these investigations of treatment approaches have not been followed by investigations to replicate their findings. However, this is understandable considering how difficult they would be to replicate without detailed procedures or participant descriptions. There have not been follow-up studies to expand on findings either. Would the results be different if gestures were introduced earlier on in treatment? Is it necessary to train verbal and gestural production simultaneously for the use of gestures to facilitate speech? Is the PICA an adequate measure of verbal facilitation? These questions, and more, have arisen from the reviewed literature.

### ***Clinical Implications***

There is no clearly defined treatment protocol for AOS (Knollman-Porter, 2008). There is also no strong empirical support for AOS treatments that include the use of meaningful gestures. Knowing that predicted effects are not well established, clinicians must use their own clinical judgment to decide if incorporating the use of gestures into therapy will meet the unique needs of an individual client with AOS. Speech-language pathologists may choose, as a treatment option, to train clients to use meaningful gestures, after or during a course of traditional speech therapy. These gestures may serve as a mode of communication in an AAC approach to improve a client's overall communicative ability. Though research results are inconclusive, it is interesting to imagine that the use of iconic gestures might also facilitate speech gains.

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