

Treatment for Acquired Apraxia of Speech: A Review of Efficacy Reports

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There have been numerous reports on a wide array of strategies used to treat acquired apraxia of speech (Dabul & Bollier, 1976; Deal & Florance, 1978; Dworkin, Abkarian, & Johns, 1988; Raymer & Thompson, 1991; Rubow, Rosenbek, Collins, & Longstreth, 1982). The purpose of this paper was to review treatment investigations that have been reported over the past twenty years.

The following journals and published proceedings were searched from 1972 (or from the first volume) through 1991: *Archives of Physical Medicine and Rehabilitation*, *Brain and Language*, *Clinical Aphasiology*, *Cortex*, *Journal of Communication Disorders*, *Journal of Speech and Hearing Disorders*, and *Journal of Speech and Hearing Research*. Reports cited in studies from these sources and those included in texts on apraxia of speech, were also considered for potential inclusion in the review.

Following identification of treatment reports, two basic inclusion criteria were employed: (a) the investigators had to specify that the treatment was for acquired apraxia of speech or that the impact of treatment on apraxia of speech was being measured, and (b) data from at least one subject had to be presented.

A total of 28 treatment reports met inclusion requirements for this review and are summarized in Table 1. In two cases, the same treatment investigation had been reported in an earlier publication with only slightly different information (Square-Storer & Hayden, 1989; Stevens, 1989); for the purposes of this review, the overlapping reports were treated as a single report.

All reports were compared on a number of variables related to subject description, methodologic information, and treatment efficacy. Suggestions for procedural changes in future research are provided.

Table 1. Investigations of Treatment of Apraxia of Speech

<i>Author(s)</i>	<i>Number of Subjects</i>	<i>Severity of Apraxia</i>	<i>Type of Aphasia</i>	<i>Months Post Onset</i>	<i>Design</i>	<i>Behaviors Measured</i>
Dabul and Bollier 1976	2	Not described	PICA %: ^a S1:75th S2:70th	S1:192 S2:108	Uncontrolled case studies	Unclear; oral reading or word repetition
Deal and Florance 1978	4	Severe	Unclear	S1:17 S2:14 S3:1 wk. S4:12	Uncontrolled case studies	Production of simple sentences
Dowden, Marshall, and Tompkins 1981	2	Both severe	S1:severe S2:mod.-severe	S1:216 S2:14	Case studies with repeated measures	PICA scores, production of gestures during CADL ^b and in response to pictures
Dworkin, Abkarian, and Johns 1988	1	Moderate	None (some anomia noted)	16	Multiple probe	Nonspeech oromotor movements; articulation; alternate motions; multisyllabic words and sentences
Florance, Rabidoux, and McCauslin 1980	3	S1:unclear S2:severe S3:severe	S1:none S2:nonfluent S3:fluent	5-6	Uncontrolled case studies	MLU ^c in spontaneous utterances; communicative success unclear
Holtzapple and Marshall 1977	1	Unclear	Present, but type unclear	3	Uncontrolled case study	Production of error phonemes
Keith and Aronson 1975	1	Severe	Severe	1	Uncontrolled case study	PICA ^a scores
Lane and Samples 1981	4	All severe	All moderate	S1:42 S2:96 S3:3 S4:48	Uncontrolled case studies	Pointing to symbol and naming symbol

<i>Treatment Methods</i>	<i>Response Generalization</i>	<i>Stimulus Generalization</i>	<i>Results</i>	<i>Reliability Data</i>	<i>Speech Analysis Procedures</i>	<i>Maintenance</i>
Combination of sound placement, sound drill, and graphic stimulation	Not reported	Not reported	Positive results reported	No	Not described	Unclear if measured
Flexible treatment hierarchy combined with home programs	Not reported	Not reported	Positive results reported	No	Clinician judgement of overall utterance intelligibility	Not reported
Hierarchy: Object manipulation, imitation, graphic and auditory stimulation	To untrained gestures	Not reported	No significant increase in PICA ^a scores	No	N/A	Received additional treatment during "maintenance" phase—positive results
Metronome pacing accompanying drill of all behaviors	Measured, but unclear	To contextual speech	Positive	Yes	Acceptable/unacceptable ratings	Yes; of previously trained behaviors during subsequent training
Significant others trained in interviewing techniques; training in self-regulation	Not reported	Anecdotal	Dramatic increases in MLU ^c	No	Unclear	Not reported
Multiphonemic artic. therapy: visual, auditory; Phonetic placement (+undefined "other" treatment)	Not reported	Not reported	Positive	No	Unclear	Not reported
Singing	Not reported	Not reported	Positive	No	N/A	Not reported
Blissymbol training	Not reported	Not reported	Positive for 3 of 4	No	Unclear	No

(Continued)

Table 1. (continued)

<i>Author(s)</i>	<i>Number of Subjects</i>	<i>Severity of Apraxia</i>	<i>Type of Aphasia</i>	<i>Months Post Onset</i>	<i>Design</i>	<i>Behaviors Measured</i>
LaPointe 1984	1	Initially severe	Nonfluent	3	Multiple baseline across behaviors	Single word naming
McNeil, Prescott, and Lemme 1976	4 1 not apraxic	2 moderate 1 mild	Unclear; PICA %: ^a 58-98th	10-71	Small group	PICA ^a scores RTT ^d scores Standard speech sample
Rabidoux, Florance, and McCauslin 1980	3	Severe	Minimal to severe	4+	Uncontrolled case studies	MLU; ^c communicative success (unclear)
Raymer and Thompson 1991	1	Severe	Severe Broca's	10	Multiple baseline across behaviors	/s,f,t,l/ in words
Rosenbek et al. 1973	3	Moderate	Present (type unclear)	12+	Uncontrolled case studies	5 utterances (1-7 words)
Rubow, Rosenbek, Collins, and Longstreth 1982	1	Moderate	Mild-Moderate (not agrammatic)	14	Modified ATD ^e	A = plosive words B = fricative words
Simmons 1978	1	Marked	PICA %: ^a 37th (at 3mpo.)	14	Uncontrolled case study	Performance on PICA ^a
Simmons 1980	1	Moderate	Nonfluent with agrammatism; PICA %: ^a 51st	8+	ABCBCA ^g	Sentence formulation
Skelly et al. 1974	6	All severe	2 with 4 without	S1:24 S2, S3:36, S4 S6:36, S5:1	Uncontrolled case study	PICA ^a scores
Southwood 1987	2	S1-mild S2-moderate	Some residual not agrammatic	Both 6	Withdrawal, changing criterion	Articulation in oral reading; rate in oral reading

<i>Treatment Methods</i>	<i>Response Generalization</i>	<i>Stimulus Generalization</i>	<i>Results</i>	<i>Reliability Data</i>	<i>Speech Analysis Procedures</i>	<i>Maintenance</i>
Package: modeling, integral stim., phonetic placement, multiple repetitions	Limited	Not reported	Positive	Yes	Plus/minus based on all phonemes	Positive for previously trained set 1; during training of set 2
Electromyographic biofeedback (re: tension)	N/A	N/A	Significant increases in PICA ^a gestural and verbal and RTT ^d	Yes	Qualitative	Not reported
Use of Handi Voice	Not reported	Anecdotal	Positive results for all subjects	No	N/A	Not reported
Verbal plus gestural	Limited to repetition	To oral-reading, naming, and repetition	Improvement limited to repetition	Yes	10-point scale	Measured during treatment of subsequent sounds
8-step continuum modeling, integral stim., graphic stim.	Not reported	Not reported	Positive	No	Modified PICA ^a	Not reported
A = imitation b = imitation + vibrotactile stress/rhythm	Not reported	Not reported	Pre-, posttreatment scores only positive results	Yes	16 point rating of entire word	Not reported
Finger counting combined with graphic cues in sentence production	Not reported	Not reported	Increased PICA ^a scores and positive anecdotal reports	No	N/A	Not reported
Heirarchy: unison production, repetition, responding to questions, use of braille	Not reported	Not reported	Positive acquisition results stronger when braille included in treatment	No	PICA 15 point scoring system	Positive in final A phase
AMERIND paired with speech	Not reported	Not reported	Positive for verbalizations and sign use	No	N/A	Not reported
Prolonging rate and reducing rate during reading	Not reported	To one-minute monologues, minimal	Decreased rate and articulation errors; no generalization	Yes	On-line error frequency counts	Not reported

(Continued)

Table 1. (continued)

<i>Author(s)</i>	<i>Number of Subjects</i>	<i>Severity of Apraxia</i>	<i>Type of Aphasia</i>	<i>Months Post Onset</i>	<i>Design</i>	<i>Behaviors Measured</i>
Square, Chumpelik, and Adams 1985 (abstract)	1	Severe	Moderate Broca's aphasia	Probably "chronic"	Uncontrolled case study	Phrases and minimal pairs of words
Square, Chumpelik, Morningstar, and Adams 1986 and Square-Storer and Hayden 1989	3	All severe	All Broca's WAB ^f AQ: 23.2-52.8	All at least 12	Uncontrolled case studies	Minimally contrastive phonemes: polysyllabic words; functional phrases
Stevens, E. R. 1989 and Stevens, E. 1986	10	Severe	Unclear	At least 6	2 group comparison and case studies	Verbal production during a variety of activities one total score
Stevens and Glaser 1983	5	All severe	Severe to mild-moderate	2-36	Uncontrolled case studies	Verbal expression (unclear)
Thompson and Young 1983	1	Moderate	Mild Broca's	4	Multiple baseline across behaviors	/s,r,l/-clusters and /o/ in words
Warren 1977	5	Unclear	All moderate Broca's	S1:16, S2:65, S3:10, S4:67, S5:26	Modified ATD ^e	Production of bisyllabic nouns
Wertz 1984	19:Apraxia of speech 10:possible AOS	Varied	Varied	1	Retrospective 2 groups 2 treatments	Ratings of severity of apraxia
Wertz et al. 1984	Report several single-case experiments illustrating various approaches to treatments; reports are somewhat brief, but appear to be experimentally sound; replications lacking.					

Note: PICA = *Porch Index of Communicative Ability*
 CADL = *Communicative Abilities of Daily Living*
 RTT = *Revised Token Test*

ATD = *Alternate Treatment Design*
 WAB = *Western Aphasia Battery*
 AOS = *Apraxia of Speech*

<i>Treatment Methods</i>	<i>Response Generalization</i>	<i>Stimulus Generalization</i>	<i>Results</i>	<i>Reliability Data</i>	<i>Speech Analysis Procedures</i>	<i>Maintenance</i>
PROMPT system and integral stimulation	Not reported	Not reported	Positive results reported	No	Not described	Measured over 5 mo. period declining performance noted
PROMPT motokinesthetic stimulation with some rate control	To untrained exemplars	Not reported	Positive acquisition results; minimal generalization results	Yes	Correct/incorrect for entire word or sound pair and 3-pt. scoring (1989 report)	Not reported
Group 1: multiple input phon. therapy (derivation of new words from stereotypes); Group 2: undefined traditional therapy	Not reported	Not reported	Positive increases reported for multiple input phon. therapy but not traditional; results unclear	No	Not reported	Not reported
Derivation of new words from stereotyped utterances; unclear	Not reported	Not reported	Anecdotal positive results reported	No	Not reported	Not reported
Modeling, imitation, use of intrusive schwa	Limited within class; negligible across class	Not reported	Positive acquisition; limited generalization	Yes	Plus/minus based on target phoneme	Measured during treatment of subsequent sounds
A = imitation B = rehearsal	Not reported	Not reported	Positive; no real difference between conditions	Yes	Phonetic transcription	Yes
A = undefined traditional B = general language stimulation	Not reported	Not reported	Positive for group A subjects only	Yes	Rating on 7 point scale based on 3-5 minute conversation	Not reported

SUMMARY OF REPORTS

Subject Description

The number of subjects studied in each investigation ranged from 1 to 19, with the modal number being 1 (40% of the reports). The number of apraxic subjects studied across all reports was 84.

The severity of the apraxia of speech was indicated for 56 of the 84 subjects (67%). Of those 56 subjects, 84% had marked/severe apraxia, 12.5% had moderate apraxia, and 3.5% had mild apraxia.

The majority of the subjects were chronic apraxic speakers, with 52 of the 84 subjects (62%) being 6 months postonset (MPO) or greater. Of those 52 subjects, 32 were at least 12 MPO. Of the remaining 32 subjects who were less than 6 MPO, 23 were less than 3 MPO.

All but 6 of the subjects were reported to have some degree of aphasia. The amount of information provided regarding co-occurring aphasia varied across studies, but in general it was quite limited.

Suggestions for describing subjects with adult neurogenic disorders have been offered by Brookshire (1983) and Tompkins, Jackson, and Schulz (1990). In reviewing this group of apraxia treatment studies, it was found that the majority of investigators had reported information on subjects' age, gender, MPO, and etiology, as suggested by Brookshire. However, other characteristics that Brookshire suggested be reported, such as education, handedness, and source of referral, were most often not included in these investigations.

Tompkins et al.'s (1990) more recent suggestions of including measures of subjects' nonchronological age, estimated premorbid intelligence, auditory processing, personality or additudinal factors, and social support have not been included in apraxia treatment reports. Clearly, these subject characteristics may influence response to treatment and should be considered in future research.

Additionally, in light of the evolving picture we have of apraxia of speech (AOS) (Odell, McNeil, Rosenbek, & Hunter, 1990; Square-Storer & Apeldoorn, 1991), it is important to provide more information specific to apraxic subjects' diagnoses, overall severity, speech output, and aphasic impairments. Specifically, the criteria used in making the diagnosis of AOS should be reported, as should the background and experience of the diagnosticians. Because some cases of AOS may be particularly difficult to diagnose, consensus diagnosis should be employed when possible.

The procedures used to determine AOS severity ratings should be described in sufficient detail to allow for replication and comparisons across studies. Because speech production skills vary considerably across

apraxic speakers, investigators should provide a summary sound error analysis based on narrow phonetic transcription, along with basic temporal measures of speech production (e.g., speaking rate, sound/word durations).

Finally, because AOS is frequently accompanied by aphasia, a thorough description of apraxic subjects' language skills should be provided. This should include standardized aphasia subtest scores, measures of auditory processing, and data regarding mean length and complexity of subjects' spoken utterances.

Methodologic Information

In terms of methodologic issues, we examined (a) type of experimental design, (b) description of dependent measures, (c) method of speech/communication analysis, (d) description of treatment, and (e) reports of reliability measures.

Fifty-six percent of the treatment reports were uncontrolled case studies. However, several single-subject experimental designs were employed, including a multiple probe design, three multiple baseline designs, two modified alternating treatments designs, and two reversal designs. In addition, three group designs were used.

Dependent measures varied across investigations and often were not operationally defined. They included measures of mean length of utterance, communicative success, production of error sounds, production of word/phrases/sentences, rate of nonspeech movements, gestures, and standard test scores. The most frequently measured behaviors were productions of whole words and utterances (40% of all measured behaviors).

The manner in which speech production was analyzed was difficult to determine in most cases and could not be determined for 36% of the reports. Twenty percent of the investigations employed correct/incorrect scoring of sounds or entire utterances, 12% used scaled scoring, another 12% employed nonspecific subjective ratings of the *adequacy* of productions, and 4% used error frequency counts. The remaining 16% of the reports measured behaviors inappropriate for speech analysis (e.g., gesturing).

Intervention programs also varied across studies. Most investigators used some type of treatment package or hierarchy. One of three basic approaches appeared to underlie most techniques: (a) improving speech production itself through direct means (e.g., imitation, integral stimulation, or multiple repetitions); (b) reorganizing speech indirectly through relatively intact nonspeech systems (e.g., singing, vibrotactile stimulation, or gesturing); or (c) training an alternate/augmentative system of communication. Treatments often appeared to be specifically tailored to

meet an individual subject's needs, which accords with the large number of single-subject reports.

Reliability data of any kind were reported for only 60% of the investigations.

The methodologic issues that should be addressed in future AOS treatment research center on the concerns of internal and external validity, procedural replicability, and reliability.

In examining the types of experimental designs employed, it was apparent that a lack of design was the most common. However, because this review covered 20 years of research, this predominance of case studies was not surprising. The more recent reports of AOS treatment have used some type of controlled experimental design, so that internal validity concerns pertain primarily to the older reports.

However, even with the more recent studies, direct and systematic replications have been lacking; such replications are necessary to "establish the reliability of previous findings" and to "determine the generality of findings" (Barlow & Hersen, 1984, p. 325). As indicated previously, many AOS treatments appeared to be designed specifically for an individual subject. This may be why many investigators have not attempted to replicate their findings. However, although direct replications may not always be possible with AOS subjects, systematic replications should be attempted.

An important consideration in this regard has to do with the description of treatment techniques. Most of the reviewed reports did not provide enough detail about their treatment procedures for other researchers to attempt replications. Dworkin, Abkarian, and Johns (1988) suggested that treatment descriptions specify (a) the nature of the task, (b) the type and sequences of the steps in treatment, (c) the criterion for progression in treatment, and (d) the number of trials and the time required to complete intermediate goals.

Similarly, detailed descriptions of dependent measures were frequently lacking in the reports we reviewed and are equally important for purposes of replication. Operational definitions should specify (a) the behaviors being measured, (b) the specific conditions under which measurements were obtained, and (c) any instrumentation employed.

With respect to reliability, reports should include descriptions of who performed the measures, how reliability was calculated, and any reliability training that was involved. It is suggested that at least three basic types of reliability data be reported in future AOS treatment research: (a) reliability of scoring of the dependent measures, (b) reliability of administration of the treatment (particularly when treatment hierarchies are employed), and (c) reliability of phonetic or orthographic transcription.

Treatment Efficacy

Almost all the reviewed studies reported positive results. However, claims that treatment resulted in improved performance were often unsubstantiated because of lack of experimental control, as evidenced by the large percentage of uncontrolled case studies.

Measures of generalization and maintenance of treatment effects were usually not reported. Response generalization (to untrained exemplars of trained behaviors) was reported in only 24% of the studies and was limited in most cases. Stimulus generalization (to other measurement conditions) was reported in only 12% of the investigations and was also limited.

Maintenance measures were reported in 32% of the studies. In six reports, maintenance of a previously trained behavior was measured during subsequent training of another behavior. In only two reports was maintenance measured at time intervals following cessation of all treatment. Findings of maintenance effects were varied.

Social validation findings were not included in any of the reports.

Future AOS treatment research should include measures of generalization, maintenance, and social validity to further our understanding of the full impact of treatment on subjects' communication skills.

SUMMARY

A wide variety of interesting and apparently promising treatments have been reported for AOS. Unfortunately, basic methodologic problems were frequently encountered in this review of the literature, thus limiting our confidence in reported findings. Inroads have been made in more recent years with regard to design and generalization issues (LaPointe, 1984; Raymer & Thompson, 1991; Wertz, LaPointe, & Rosenbek, 1984). Future AOS treatment research should include more comprehensive descriptions of subjects and treatment procedures, and promising findings should be replicated across subjects and research sites.

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