Effects of Repeated Practice and Practice Plus Pacing Control on Sound Production Accuracy in Acquired Apraxia of Speech

The majority of treatments for acquired apraxia of speech (AOS) have been developed to improve articulatory skills (Wambaugh, Duffy, McNeil, Robin, & Schmidt, 2006). A variety of techniques have been used facilitate positioning, movement, or coordinated timing of the articulators, and as a whole, have been demonstrated to improve speech sound production in speakers with AOS (Wambaugh et al.). Articulatory accuracy has also been demonstrated to improve without explicit instructions concerning articulation through the use of rate control or pacing therapies (Brendel & Ziegler, 2008; Mauzycki & Wambaugh, 2008; Wambaugh & Martinez, 2000).

AOS pacing therapies entail practicing target productions in time with an externally generated rhythm and typically also utilize hand-tapping. Brendel and Ziegler (2008) recently compared metrical pacing therapy to a control therapy with ten speakers with AOS. The control treatment included use of a variety of articulatory kinematic techniques (e.g., phonetic placement, gestural facilitation, integral stimulation, minimal pair contrast, word derivation), but with no focus on rhythm or metrical features. The investigators found that both treatments were associated with significantly reduced numbers of sound errors. However, only the pacing therapy resulted in reduced proportion of dysfluencies and changes in duration.

The general rationale underlying the use of rate and rhythm treatments is that AOS is characterized by disturbances in the timing of speech production and rhythm is a fundamental component of the speech production process. Many mechanisms have been proposed to account for the effects of for rate and rhythm treatments on articulation (e.g., re establishment of temporal patterning, entrainment of central pattern generators, and additional time for motor planning, etc.). Unfortunately, it has not been established that rate/pacing control is absolutely necessary to effect changes in articulation. Specifically, repeated practice alone may result in similar improvements.

The purpose of this investigation was to examine the effects of repeated practice and repeated practice *plus* rate/pacing control on consonant production accuracy in speakers with AOS.

Method

Participants

Five adults with chronic, moderate AOS and agrammatic aphasia served as participants. All participants demonstrated speech behaviors that were consistent with AOS diagnostic criteria described by McNeil et al. (1997). The participants passed hearing screenings and demonstrated performance within normal limits on a test of nonlinguistic intelligence. All are married and reside at home. They were not compensated for their participation in this investigation (other than reimbursement for travel)

Descriptive and assessment data are shown in Table 1.

Table 1. Participant Information

Participant	Gender	Etiology	Age	MPO	WAB-AQ	PICA - Overall	Aphasia Type-WAB
P1	F	CVA	48	38	43	49	Broca's
P2	M	CVA	49	212	67	65	Broca's
P3	F	CVA	42	27	77	71	Broca's
P4	F	CVA	58	54	78	60	Broca's
P5	M	CVA	37	32	42.4	64	Anomic

Experimental Design

A single-subject, combined multiple baseline and ABCA design was employed with each participant. Additionally, a multiple baseline design across subjects was utilized and entailed extending the number of baseline sessions across participants.

The experimental design was selected to allow examination of the effects of repetition treatment ***alone***, with treatment continuing until maximum gains were achieved. Following a period of five probe sessions with no additional improvements, rate/pacing treatment was ***combined*** with repetition treatment to determine if additional improvements could be obtained.

For each participant, five lists of target items were devised and randomly assigned to the following conditions:

List 1 – repetition treatment, then rate/pacing control ***plus*** repetition treatment
List 2 – repetition treatment only, simultaneously with Set 1
List 3 – repetition treatment, then rate/pacing control ***plus*** repetition treatment; application delayed
List 4 – ***no*** treatment, probed daily
List 5 – no treatment, probed at end of treatment phases

Following a baseline phase (A), repetition treatment (B) was initiated with Sets 1 and 2. Treatment continued until pre-established criteria were met. Rate control ***plus*** repetition treatment (C) was then applied with Set 1 while repetition treatment only continued with Set 2. Then the preceding treatment sequence (B - C) was applied with Set 3, with repetition treatment continuing with Set 2.

Follow-up probes were completed at 4 and 8 weeks after cessation of all treatment. Please note that P4 is currently completing the final phase of treatment.

Experimental Stimuli

Experimental stimuli were as follows: P1 - mono- and bisyllabic words containing s-clusters, r-clusters, and l-clusters; P2 - trisyllabic words containing a variety of clusters; P3 - bi- and trisyllabic words containing clusters; P4 – sentences with multisyllabic words with different target sounds in each list; and P5- mono and bisyllabic words with different target sounds in each list. All lists were carefully selected and balanced for each participant and will be described in more detail for the presentation. There were 20 items per list for each participant except P4, who had 12 sentences per list (the number of items was reduced because treatment required more time with sentence stimuli than with single word stimuli).

Dependent Measures

Probes of accuracy of production of target items were conducted in baseline and throughout the treatment phases. The items in each set were randomized and the participant was asked to produce the word as accurately as possible following the examiner's model. No feedback or instruction was provided during probes. Productions were scored for accuracy on-line and were audio-recorded for verification purposes. Percentage of accuracy was calculated for each set of items.

Treatment

Repetition treatment consisted of presenting the target item verbally and requesting the participant to produce the item 5 times in succession. Only general feedback about the accuracy of the grouped productions was provided (e.g., "those all sounded perfect", "there were a few sound errors", etc.).

Rate/pacing control treatment entailed provision of a verbal model of the item by the examiner and repeated practice of the item with hand-tapping in time to a metronome. The metronome was set to a rate that approximated a fifty percent reduction in the participant's typical rate of production. Only general feedback was provided as with repetition treatment.

In each treatment session, two sets of stimuli underwent treatment. The order in which the sets were submitted to treatment was counterbalanced. The 20 (or 12) items in the treatment set were presented in random order, with this process completed a total of three times. Then a 10-30 minute break was taken prior to treatment being applied with the remaining set.

Treatment was continued in each phase until 1) 90% accuracy in two consecutive probe sessions was achieved, or 2) no gains were achieved for five probe sessions following the highest level of probe performance (if at least 10 treatment sessions had been completed).

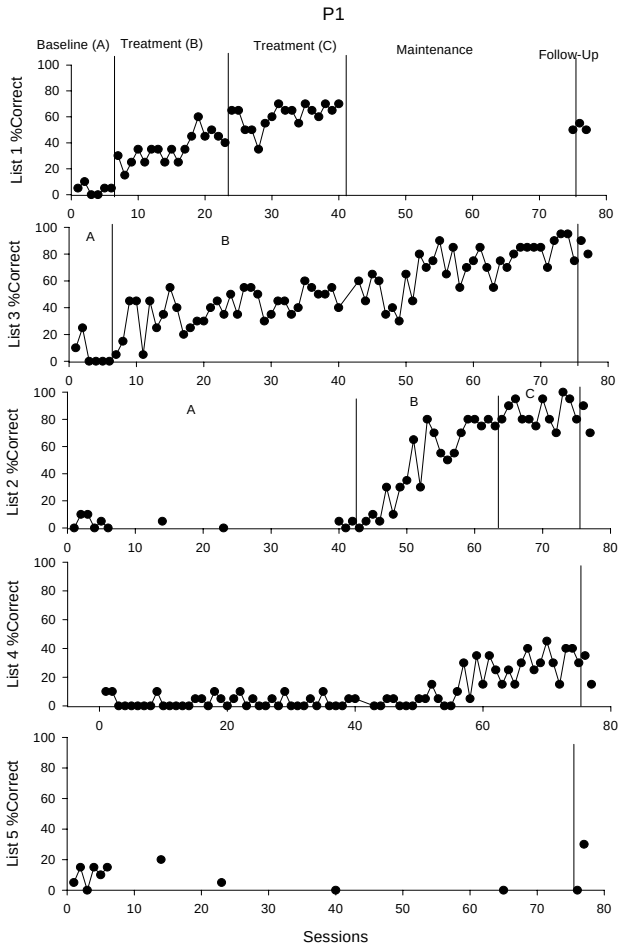
Additionally, if performance reached at least 85% accuracy with repetition treatment ***only***, then rate/pacing treatment was not applied.

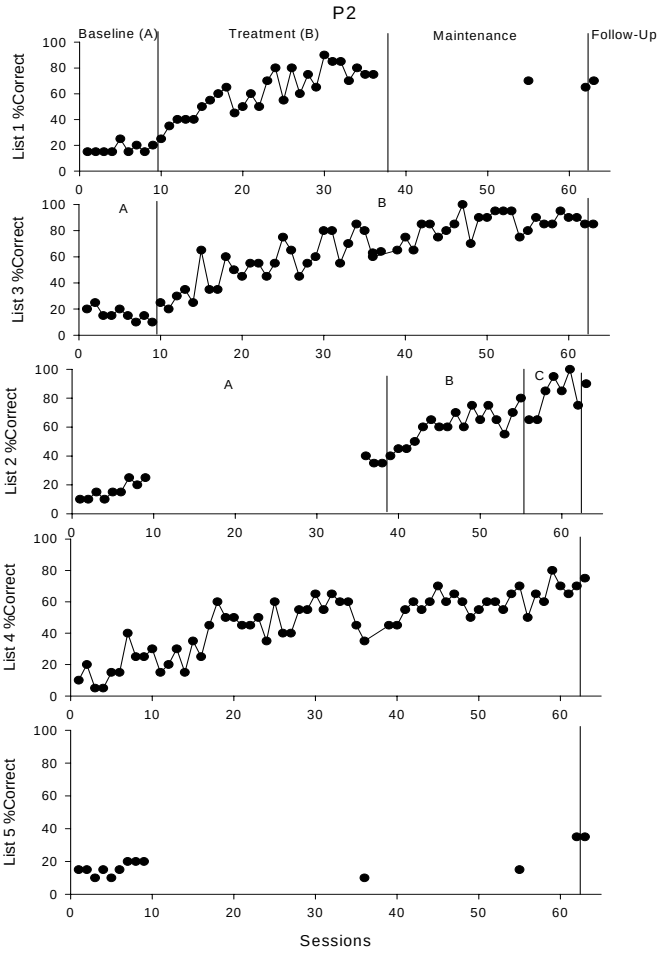
Results

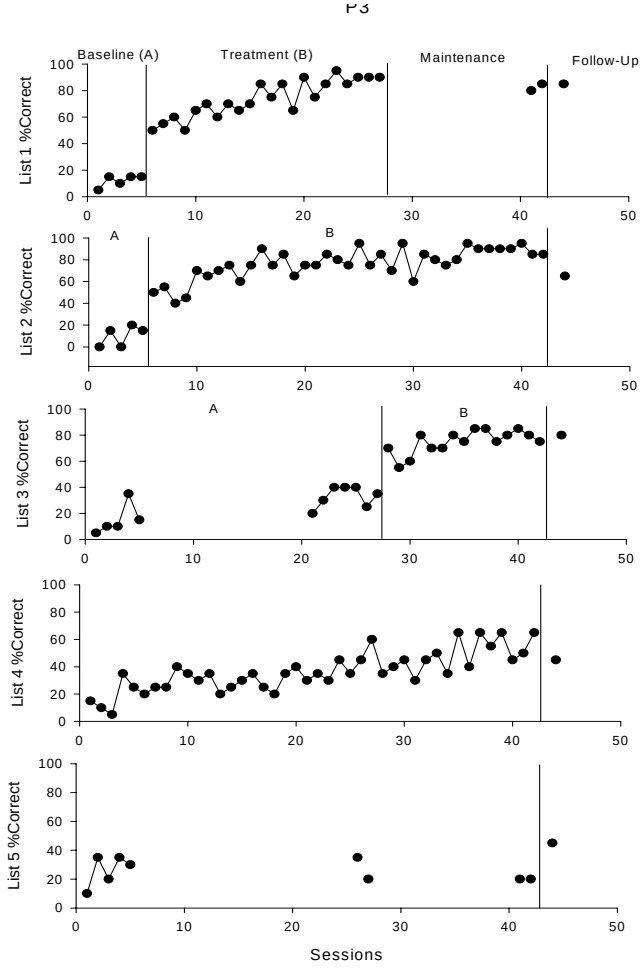
Probe data are shown in the following figures. Results varied across speakers, although all displayed substantial improvements in accuracy with repeated practice alone. Rate control treatment was not necessary in some cases because high levels of performance (i.e., 85% or >) were achieved with repeated practice alone. When applied, rate control treatment resulted in additional gains.

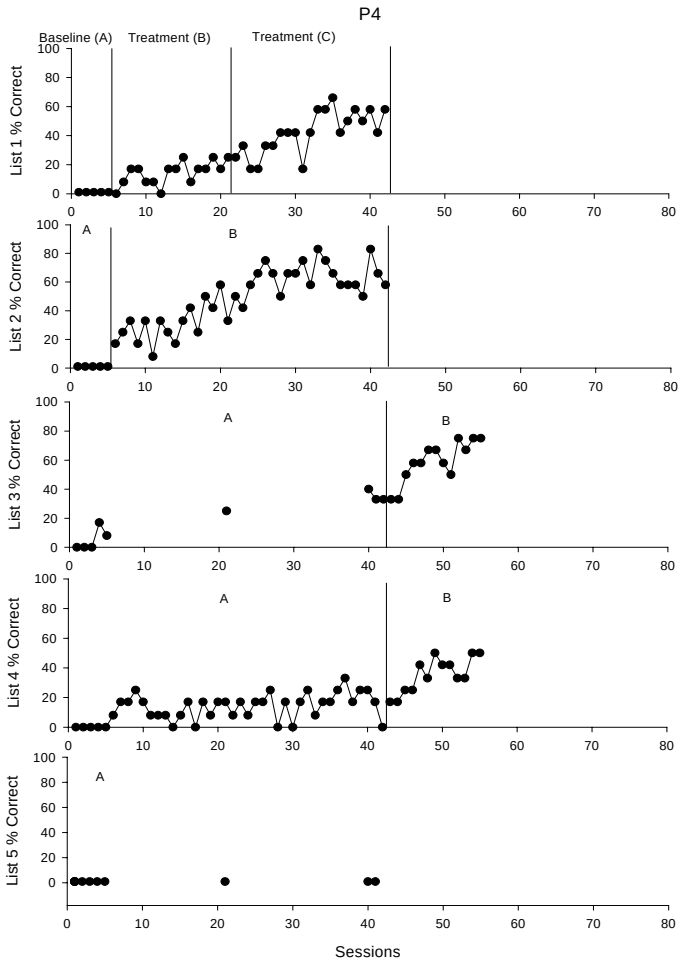
Discussion

Findings will be discussed relative to the DIVA model (Guenther, 2006) and the AOS treatment guidelines (Wambaugh et al., 2006).

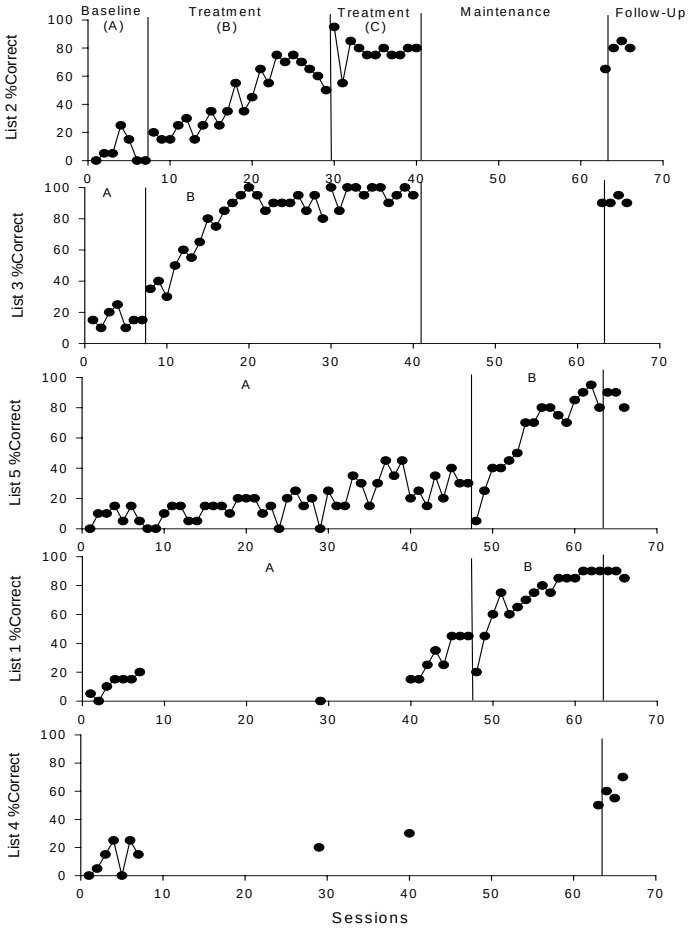

P1
Baseline (A)
Treatment (B)
Treatment (C)
Maintenance
Follow-Up
List 1 %Correct
List 3 %Correct
List 2 %Correct
List 4 %Correct
List 5 %Correct
A
B
C
Sessions


P2
Baseline (A)
Treatment (B)
Maintenance
Follow-Up
List 1 %Correct
List 3 %Correct
List 2 %Correct
List 4 %Correct
List 5 %Correct
A
B
C
Sessions


P3
Baseline (A)
Treatment (B)
Maintenance
Follow-Up
List 1 %Correct
List 2 %Correct
List 3 %Correct
List 4 %Correct
List 5 %Correct
A
B
Sessions


P4
Baseline (A)
Treatment (B)
Treatment (C)
List 1 % Correct
List 2 % Correct
List 3 % Correct
List 4 % Correct
List 5 % Correct
A
B
Sessions

P5


Baseline
(A)
Treatment
(B)
Treatment
(C)
Maintenance
Follow-Up
List 2 %Correct
List 3 %Correct
List 5 %Correct
List 1 %Correct
List 4 %Correct
A
B
Sessions

REFERENCES

Brendel, B., & Ziegler, W. (2008). Effectiveness of metrical pacing in the treatment of apraxia of speech. *Aphasiology*, 22 (1), 77-102.

Guenther, F.H. (2006). Cortical interactions underlying the production of speech sounds. *Journal of Communication Disorders*, 39, 350-365.

Mauszycki, S.C., & Wambaugh, J.L. (2008). The effects of rate control treatment on consonant production accuracy in mild apraxia of speech. *Aphasiology*, 22(7/8), 906-920.

McNeil, M.R., Robin, D.A., & Schmidt, R.A. (1997). Apraxia of speech: Definition, differentiation, and treatment. In. M.R. McNeil (Ed.), *Clinical management of sensorimotor speech disorders* (pp. 311-344). New York: Thieme.

Wambaugh, J.L., Duffy, J.R., McNeil, M.R., Robin, D.A., & Rogers, M.(2006). Treatment guidelines for acquired apraxia of speech: Treatment descriptions and recommendations. *Journal of Medical Speech Language Pathology, 14(2),* xxxv-ixvii.

Wambaugh, J.L., & Martinez, A.L. (2000). Effects of rate and rhythm control treatment on consonant production accuracy in apraxia of speech. *Aphasiology, 14(8),* 851-871.