

## **Impairment-based therapy for apraxia of speech: a single case study**

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Apraxia of speech (AOS) has been described as a disorder of articulatory planning resulting from impaired translation of phonological representations into specifications for articulation (McNeil, Robin, & Schmidt, 1997). In practice, however, descriptions of the symptoms associated with AOS may differ somewhat from one setting to another or from one speech pathologist or researcher to another (Croot, 2002). Few controlled treatment studies of AOS have been reported, and there is limited replication of therapies that have been shown to be effective (Wambaugh, 2002). This paper describes an impairment-based therapy trialed with a 55 year-old man (FB) whose speech difficulties subsequent to cardiovascular accident (stroke) broadly fit many of the descriptors associated with AOS.

FB was 54 years of age when he was admitted to hospital following a stroke in the left basal ganglia. Although initially anommic and making some errors in the production of speech sounds, FB's speech returned to normal within a few months. A year later he was again admitted to hospital and showed a new left parietal infarct on imaging. Initial right limb weakness and mild speech difficulties again resolved rapidly. FB received speech pathology intervention on both occasions. Two months later FB was readmitted following two days of deteriorating expressive speech. On admission he had difficulties initiating sounds, was groping for articulatory positions for word- and syllable-initial sounds, prolonged both vowels and consonants, and repeated speech sounds and words. He was able to achieve some functional verbal communication despite these difficulties, but very slowly and with major effort that left him exhausted. FB also showed right upper limb difficulties such that he could barely write his name: attempts at writing were extremely laborious and could not be used for communication. MRI imaging showed no further infarct but widespread small vessel disease in the white matter.

A month after this admission FB attended two months of outpatient speech pathology before the commencement of the treatment study reported here. At initial assessment, FB showed no evidence of receptive aphasia (scoring within normal limits on the Comprehension scale of the Western Aphasia Battery) and he was able to carry out 15 nonspeech orofacial praxis tasks to verbal command. All assessments of speech production confirmed FB's difficulties in the area of initiating sound and word production. Word production was no easier in singing, counting or saying the days of the week.

Initial speech pathology goals included achieving relaxation and adequate respiratory support during speech. Alternative and augmentative communication strategies including Lightwriter and computer-based communication tools were offered but not accepted because FB was keen to rely solely on spoken communication, albeit with great effort. Methods trialed in the first two months to improve speech initiation included teaching soft contacts, integral stimulation and unison reading, and rate control, none of which appeared to give him any ease in initiating speech or increase his fluency. FB also attempted positioning of the articulators for vowels, /h/ and nasal consonants.

FB attended half-hour speech therapy sessions twice a week. The controlled intervention commenced three months after FB's third hospital admission and had an ABA design consisting of 3 baseline sessions, 7 treatment sessions, and 3 post-test sessions. Materials were 45 CVC (consonant-vowel-consonant) pictureable nouns (e.g. cup, fish, bus), of which 21 were high-frequency (HF) and 24 were low-frequency (LF), with mean frequencies of 55.1 per million and 4.65 per million respectively using the CELEX spoken word frequencies (Baayen, Piepenbrock, & van Rijn, 1993). One third of the words were elicited in Picture Naming, one third in Reading Aloud and one third in Repetition tasks on each Baseline session, and all words were elicited in each task on each Post-test session with counterbalancing for task order across sessions. Two thirds of the HF and two thirds of the LF words were targeted during the Treatment sessions using articulatory-kinematic techniques (soft contacts, articulatory placement instruction, integral stimulation and unison reading, and production of CV words with same-phoneme onset as target words) and techniques intended to facilitate lexical retrieval (reading aloud, orthographic visualisation, completion of semantically-rich sentences). The trained and untrained sets were matched on frequency and approximately matched on order of acquisition of initial phonemes (as an index of articulatory difficulty). FB also carried out the therapy activities at home with assistance of his wife for approximately 10 minutes after most meals (three times per day). Both the speech pathologist and FB's wife applied motor learning principles (McNeil et al., 1997) of random rather than blocked practice and praising FB at irregular intervals.

Over a one-month period, FB improved more on the treated HF words than on matched untreated HF words ( $\chi^2 = 6.81$ , d.f. = 1,  $p = .009$ ) or LF words (treated and untreated), but the therapy programme was cut short when he experienced a subsequent CVA. This improvement on treated HF words was small, however, compared with the striking reduction in the number of multiple attempts seen at Post-test compared with Baseline. FB's multiple attempts almost disappeared on both treated and untreated CVC words. Analysis of multiple attempts, repeated words and phrasal repairs in FB's conversational speech suggest there was a modest improvement (around 10-15% reduction in these features) in his conversation with the speech pathologist in the clinic. There was also a trend for FB's word production to improve more in Repetition than Picture Naming or Reading Aloud.

Despite the unanticipated foreshortening of therapy due to FB's subsequent stroke, the study demonstrates that interventions involving articulatory-kinematic approaches can improve single word production for people with symptoms associated with AOS, consistent with recently-completed treatment guidelines for AOS (Wambaugh, Duffy, McNeil, Robin, & Rogers, in press). It also suggests that in some cases a modest improvement may generalise to conversational speech in the clinical setting. Given that FB's primary improvement occurred in the reduction of multiple attempts in single word production, we will discuss the potential dissociability of symptoms associated with AOS, as well as the effect of frequency and elicitation task on FB's speech production.

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