Improving auditory access to low imageabilty words by embedding them in imageable semantic-syntactic contexts in a case of deep phonological dysphasia

Part 1- A Single Case Treatment Study

Introduction

Deep dysphasia is a relatively rare subcategory of aphasia, characterized by word repetition impairment and profound auditory-verbal short-term memory (AVSTM) limitation. Accuracy of word repetition is better for words than nonwords (lexicality effect) and better for high-image than low-image words (imageability effect). The cardinal feature of deep dysphasia is the occurrence of semantic errors in single word repetition (Howard & Franklin, 1988). Phonological dysphasia shares all of these features except that semantic errors in repetition appear in repetition of multiple words and sentences. Thus, it has been proposed that these two 'syndromes' are not distinct, but actually are based on an impairment of auditory-verbal STM that can vary by severity, leading to deep dysphasia when severe and phonological dysphasia when mild (Martin, Saffran & Dell, 1996; Ablinger, Abel & Huber, 2008).

First, we report a single case treatment study of a person whose pattern of word repetition performance was consistent with the continuum of phonological-deep dysphasia: poor repetition of nonwords, imageability effects in repetition of single and multiple words and semantic errors in repetition of multiple word utterances. Differences in processing abstract (i.e., low imageability) versus concrete (i.e., high image) have been considered recently in aphasic treatment protocols (Kiran, Sandberg & Abbott, 2009). Here we test the effects of a theoretically motivated treatment that manipulates the semantic cohesiveness of low imageability (i.e., abstract)-low frequency (LI-LF)

words to improve access to and short-term retention of LI words in deep-phonological dysphasia.

Following presentation of the treatment case study, we describe an experimental protocol to determine if this approach of increasing imageability of abstract words through syntactic and semantic contexts can be extended to other individuals who present along the deep--phonological dysphasia continuum.

Aims of the Study

Our aim is to evaluate an approach to improving the ability to access and maintain activation of LI words in the lexicon sufficiently to support repetition of those words. Specifically, we investigate whether increasing semantic cohesiveness of LI-LF words through phraseological collocation improves the ability to accurately repeat LI-LF word pairs. This manipulation is founded in the notion that the meaning of an abstract (LI) word becomes more evident when embedded in a semantically coherent sentence context.

Methods

Participant and Design: A single subject multiple baseline, multiple probe design was used. Our participant was LT; a thirty-four year old female who was thirty-six months post left middle cerebral artery infarct.

Treatment Program: *Baseline Phase:* Repetition of LI-LF pairs were probed until a stable baseline was achieved.

Treatment Condition 1(TX 1): Each noun in an LF-LI noun pair was combined with a LI-LF adjective to form semantically cohesive adjective-noun phrases (e.g., long *distance*; social *exclusion*). These were used as primes for the LI-LF pairs (*distance-exclusion*)

Treatment Condition 2(TX 2): In this condition, adjective-noun prime phrases formed from LI-LF pairs were not semantically cohesive (e.g., purple *agility)*.

Hypotheses:

(I) Training repetition of LI-LF nouns in semantically cohesive LI-LF adjective-noun phrases (e.g., long *distance*; social *exclusion*) will improve performance in repetition of these same nouns when they are presented as word pairs (e.g., *distance exclusion*).

(II) Treatment effects will be present, but will be less robust when training repetition of LI-LF adjective-noun phrases that are not semantically cohesive.

Results

Baseline testing revealed that LT's mean repetition performance across 10 baseline probes for TX1 words was .22. During the Treatment 1 condition, which utilized the semantically cohesive adjective-noun phrases, LT demonstrated steady improvement of .70 in repetition of LI-LF pairs in treatment probes and met behavioral criterion of .80 over 2 consecutive sessions by Probe 10 [see Figure 1]. In Treatment 2, which used adjective-noun phrases that were not semantically coherent, mean repetition performance across 10 baseline probes for TX2 words was .26 and accuracy levels remained variable, behavioral criterion was not met [see Figure 2]. Notably, in all-probes administered to assess maintenance, at 3, 6 and 8-week markers following the end of TX2 condition, LT maintained behavioral criterion for TX1 words to approximately 15 weeks post treatment [see Figure 3]. TX2 words continued to demonstrate variability and were not maintained. Post-test data revealed substantial improvement in digit span (2.8 to 4.2) and word span (2.4 to 3.2). Also, following the treatment, results of the Western Aphasia Battery-Revised (WAB-R; Kertesz, 2006) revealed that LT's aphasia quotient improved from 88.6 (pre-treatment) to 94.5 and her aphasia classification changed from conduction aphasia to normal or non-aphasic.

Discussion

Results indicate that increasing semantic cohesiveness of LI-LF nouns in the context of adjective-noun phrases improved LT's ability to repeat those nouns within noun pairs. We suggest that this manipulation

improved her ability to access the semantics of these words, which in turn made them easier to retrieve.

Part 2- Expanding this Treatment Beyond Single Words

Although there is a fair amount of research on the deep--phonological dysphasia continuum, there is a paucity of evidence available on the treatment of this disorder; the literature base is comprised of less than thirty studies, all directed at understanding its nature.   The results of this treatment study suggest that the strategy of increasing imageability of abstract words by embedding them in a semantically cohesive context may be extended to other individuals whose word processing disorder falls somewhere along the deep-phonological dysphasia severity continuum. Thus, we present a plan to expand the study beyond single words to determine if enhancing the semantic cohesiveness of LI-LF words will benefit more individuals on the deep-phonological dysphasia continuum. This investigation will add four experimental conditions to the current protocol that will accommodate individuals with milder verbal STM impairments and phonological dysphasia. Conditions 1 and 2 will feature sentence level combinations of LI-LF words for repetition; Condition 1 will feature easier and shorter sentences (*"The positive energy from the cancer support group was contagious")* and Condition 2 will present more difficult, lengthier sentence combinations *("The senator lifted the spirits of the voters as he introduced new legislation with cautious optimism.")*. Condition 3 will present sentences of a moderate complexity level which are syntactically, but not semantically cohesive (*The geometric permission was considered a contagious spirit.*). The final Condition 4 will be a span task of LI-LF words (spirit-agility-license-cycle-humor). A normative study will be conducted with a group of individuals without aphasia or brain damage to confirm a training item's status on a gradient scale of difficulty level of LI-LF. Results of this experiment will be applied to a facilitation study in which this priming

protocol will be administered to 20 participants with word repetition impairments that fall along the deep-phonological dysphasia severity continuum.

This approach that uses manipulation of semantic and syntactic context to improve access to and short-term retention of LI-LF words is based on a theoretical model that postulates interaction across levels of word representation.

Another approach that is consistent with this model and which we are investigating is the use of intact visual processing of words to facilitate access to retention of LI-LF words (McCarthy, Martin, Berkowitz, Kohen & Kalinyak-Fliszar, in preparation). We expect results of these facilitation and treatment studies to show that manipulation of stimuli characteristics and modality of presentation are useful strategies to improve auditory processing in deep-phonological dysphasia.

Word Count: 1,192/1,200
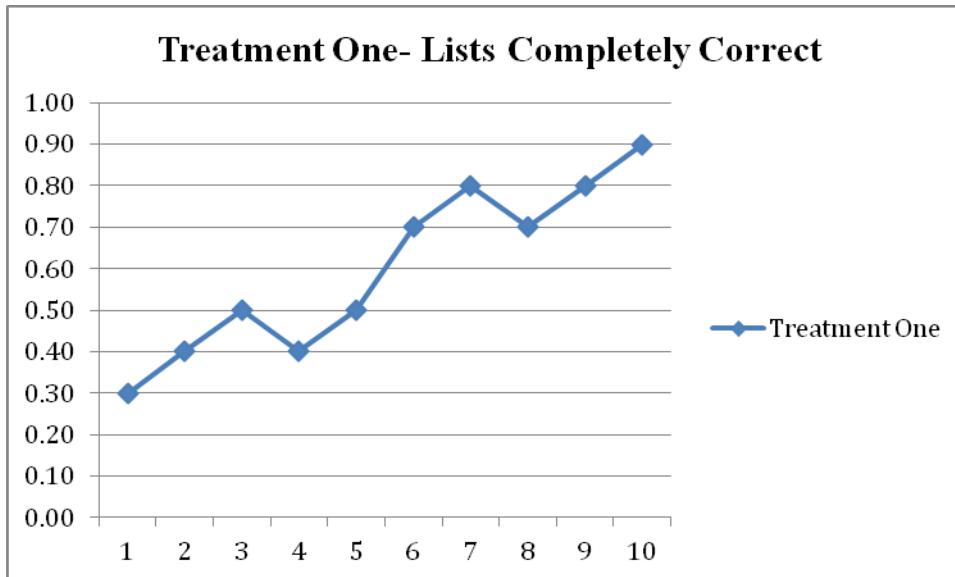
FIGURE 1
LT34 Treatment One Performance- TX1 Items

Treatment One- Lists Completely Correct

FIGURE 2
LT34 Treatment Two Performance- TX2 Items

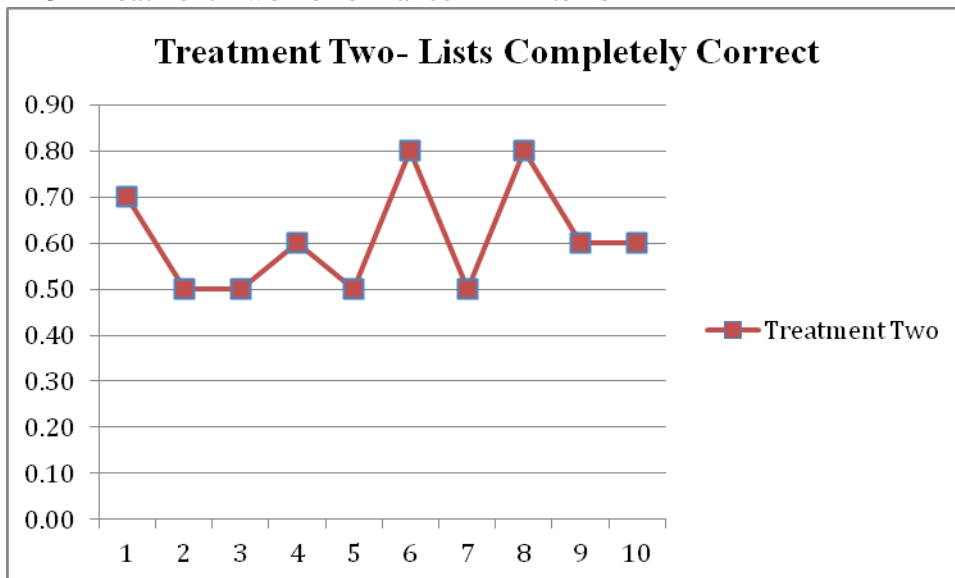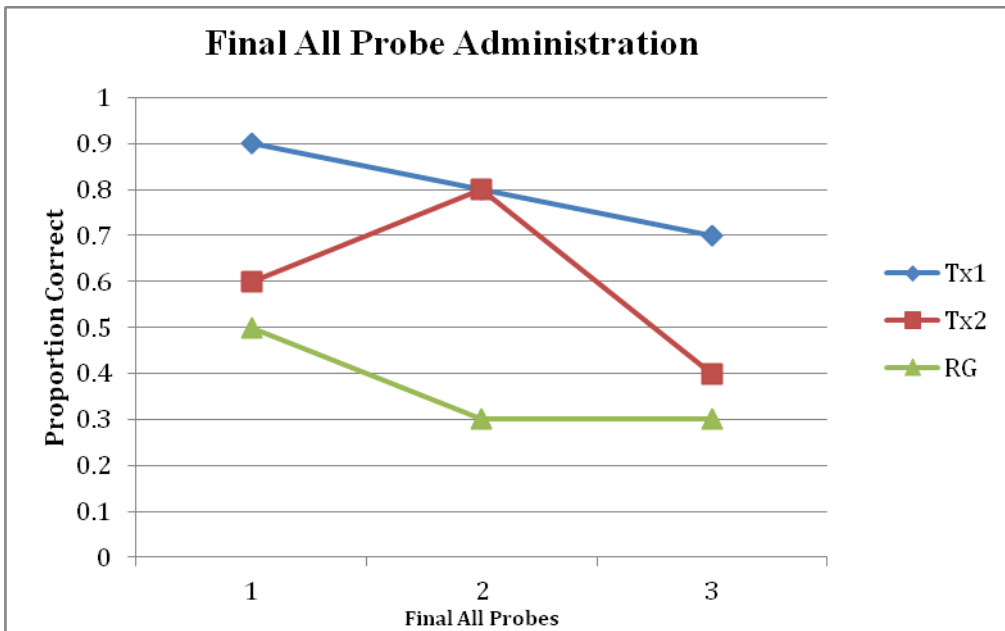**Treatment Two- Lists Completely Correct**

FIGURE 3
Final All Probe Administration

References

Ablinger, I., Abel, S., & Huber, W. Deep dysphasia as a phonetic input deficit: Evidence from a single case. (2008). *Aphasiology,* 22(5): 537-556.

Howard, D. & Franklin, S. (1988*). Missing the Meaning: A Cognitive Neuropsychological study of processing words*. Cambridge: The MIT Press.

Kertesz, A. (2006). Western Aphasia Battery Revised. San Antonio: Harcourt Assessment, Inc.

 Kiran, S., Sandberg, C., & Abbott, K. (2009). Treatment for lexical retrieval using abstract and concrete words in patients with aphasia: Effect of complexity. *Aphasiology*. 23 (7-8), 835-853.

Martin, N., & Saffran, E.M. (1992). A computational account of deep dysphasia: Evidence from a single case study. *Brain and Language*, 43, 240-274

Martin, N., Saffran, E.M., Dell, G.S. (1996). Recovery in deep dysphasia: Evidence for a relation between auditory-verbal STM capacity and lexical errors in repetition. *Brain and Language*, 52, 83-113.

McCarthy, L., Martin, N., Kohen, F. P., Kalinyak-Fliszar, M. & Berkowitz, R. (in preparation). Effects of visual presentation on auditory processing of low-imageability words in deep dysphasia.

Sandberg, C. & Kiran, S. (under revision). Analysis of abstract and concrete noun processing in persons with aphasia and age-matched controls using fMRI. *Aphasiology*.