DEVELOPMENT OF AN APHASIA TREATMENT TARGETING VERBS WITH LOW CONCRETENESS

by

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A dissertation submitted to the faculty of
The University of Utah
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

in

Speech-Language Pathology and Audiology

Department of Communication Sciences and Disorders

The University of Utah

December 2016

The University of Utah Graduate School

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ABSTRACT

The verb plays a critical role in sentence production, but verb production is commonly impaired in aphasia. The verb is therefore an important treatment target for aphasia treatments. The verb appears to have a network structure of meaning within the mental lexicon, and existing treatments, such as Verb Network Strengthening Treatment (VNeST) and "verb is core" treatment approach naming rehabilitation theoretically by expanding this network structure. However, these and other verb naming treatments have focused nearly exclusively on verbs with high concreteness ratings. While high concreteness verbs are useful and common, recent evidence highlights the utility and frequency of low concreteness verbs in spoken language also. Thus the focus of current verb treatments on verbs with high concreteness omits a set of verbs that are potentially useful for persons with aphasia. Therefore, a treatment was designed to improve the accuracy of low concreteness verb naming in persons with aphasia.

The novel treatment was largely based on VNeST and emphasized the network structure of the mental representation of target verbs by pairing them with common subjects and objects. Three adult persons with nonfluent aphasia participated in a single-subject research design study examining the feasibility of the treatment for improving verbal naming of low concreteness verbs. Results from the study indicated possible changes associated with the treatment for two of the three participants, though these changes were limited in magnitude. Treatment performance data suggested possible

improvements in verb processing that were not reflected in the primary outcome measure. Thus, future research is warranted and should focus on further enriching the mental verb network representations of target verbs with low concreteness and on refining relevant outcome measures.

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGMENTS

I would like to thank the many family members (especially my wife, Heather), my mentor (Dr. Wambaugh), the members of my committee, the participants, and my classmates and coworkers, who all helped me design, carry out, and complete this project. I'm also grateful to Christina Nessler and Kiera Berggren for helping with data collection in the pilot study, to Lisa Bunker for helping with reliability scoring, and to Lisa Johnson for helping with data analysis.

INTRODUCTION

Overview

This dissertation consists of two major parts. The first is a review of literature on verb processing in typical and disordered populations, and the status of the verb retrieval treatment literature in the rehabilitation of aphasia. This literature review addresses issues pertinent to the project and is provided to support the rationale for the conduct of the research. The second section is a description of the development of an aphasia treatment targeting verbs with low concreteness ratings. The methods, results, and discussions of this second study are detailed, followed by a summary conclusion.

Literature Review

The review of literature begins with discussion of the role of verbs in sentence production in general and verb retrieval in typical speakers. Next, the literature on disordered verb retrieval in aphasia is described. The status of evidence on verb retrieval treatment is also discussed, with particular focus on the limited scope of meanings of the verbs commonly used as stimuli and the need to extend verb retrieval treatment to abstract verbs, operationally defined as verbs with low concreteness ratings.

The importance of verb retrieval in sentence production

The verb plays a central role in both the meaning and the structure of a sentence, and as such, the process of verb retrieval is critical to sentence production. Verb retrieval, however, appears to be a complex issue, as verbs are, compared to nouns, mastered later during acquisition (e.g., Bornstein et al., 2004) and often impaired more severely in cases of language disorders, such as aphasia (particularly nonfluent aphasia; Mätzig & Druks, 2006; Zingeser & Berndt, 1990) and specific language impairment (SLI; Sheng & McGregor, 2010). These facts are likely due to differences in the way verbs are stored in the mental lexicon and processed during retrieval. Ultimately, increased understanding of the way in which verb meanings are organized has clinically important implications for improving the efficacy of treatments for verb retrieval. Theoretical and experimental evidence suggests that verbs have a network organization within the mental lexicon in healthy speakers, and the implications of this evidence for treatment of disordered verb retrieval in aphasia will be discussed.

Typical verb processing

Black and Chiat (2003) provide a basic paradigm that frames the approaches that have been taken and gives ideas for future directions for verb treatment research. The same basic organization will be used here in discussing typical verb processing and the network structure of verb representation in the mental lexicon. The paradigm includes syntactic, conceptual-semantic, and phonological aspects of verb processing. In addition, Conroy, Sage, and Lambon Ralph (2006) mention psycholinguistic and neuromodulary findings, topics that will also be included. However, as mentioned by Black and Chiat

(2003), these will be general categories only, as the categories tend to overlap somewhat; in particular, the syntactic domain overlaps significantly with the semantic as the scope of the discussion is on verb retrieval, as opposed to the more syntax-heavy topic of sentence production.

Syntactic processing

Theories that guided the earliest verb treatments for aphasia focus on the verb's central role in the sentence and stemmed from the case grammar system developed by Fillmore (1968). Under this model, the verb, indicating an action of some kind, is the central node, with the other elements of a sentence bearing relations primarily through the verb (Fillmore, 1968; Miller, 1972). A schematic (after Loverso, Selinger, & Prescott, 1979) demonstrating this verb-central arrangement of meaning is shown in Figure 1. Though these relations, called arguments, play large syntactic roles, with the subservient nodes serving as subject, object, instrument, etc., all in language-specific morphosyntactic relations to the verb, the items filling these subservient roles contribute semantic information to the verb. In other words, part of a verb's specific semantic information lies in its relationships with each instantiation of its specific arguments within a given sentence. Thus, argument structure may be seen as a bridge between a verb's meaning and syntactic information, as the form and position of each argument provide sentence- or event-specific information, while the semantic nature of the arguments may independently be correct or incorrect, regardless of the surface grammaticality of the morphosyntax. Take the following English sentences from Fillmore as an example (1968, p. 22):

1. “John broke the window with a hammer.”
2. *“John and a hammer broke the window.”

As Fillmore discusses, the first sentence is acceptable, while the second is unacceptable. “John” plays the role of actor, and “hammer” plays the role of instrument. While either actor or instrument can hold the sentence initial position (“John broke the window” or “A hammer broke the window”), they cannot both hold it concurrently as a conjoined construction (sentence 2). Coordination in general only allows conjoining of equivalent items; the fact that sentence two is ungrammatical speaks to the role of meaning in argument structure and syntax, or, as Fillmore describes for this specific case, “redundancies which hold between cases and lexical features (for example, Agent and animateness)” (1968, p. 22). An instrument, as well as agents, may appear at the beginning of sentences, but in general, instruments are inanimate and agents animate, so conjoining them causes ungrammaticality. This exemplifies the idea that the morphosyntactic features of a verb’s arguments and the grammatical compatibility of the arguments with a given verb do not exist independently of lexical semantic factors, such as, in this instance, animateness.

The idea of the verb playing a central role with connections to typical arguments implies it has a network structure within the mental lexicon, with numerous interconnections, as opposed to a strictly hierarchical structure with ascending and descending connections only. There are several possible argument structures, and verbs differ along this dimension. For example, “to bake” may be monotransitive or intransitive (i.e., “he bakes a cake” and “he bakes”), while “to tell” is monotransitive or ditransitive but not intransitive (i.e., “he tells a story” and “he told Tom a joke” but not

*"he tells,") and "to run" may be intransitive, monotransitive, ditransitive, or copular ("the faucet is running," "he runs a business," "he ran Peter a letter," and "the river ran dry"). Thus, these verb networks likely vary in shape and size from one another.

Conceptual-semantic processing

But what specific items are connected to a given verb's network? Evidence from reaction time tests in priming experiments by Ferretti, McRae, and Hatherell (2001) suggests that a verb is closely connected with its typical agents (entities that commonly perform the action, such as arresting-cop), patients (entities that commonly receive the action, such as arresting-crook), and instruments (entities that are commonly used for performing the action, such as ate-fork), as well as the semantic features of its typical patients (such as comforting-upset); however, a verb appears to be less closely connected to its typical locations (such as cooking-kitchen). Supporting evidence for these connections comes from a noun-to-verb generation task (McRae, Hare, Elman, & Ferretti, 2005). In this reverse direction, typical agents, patients, instruments, and locations facilitate verb retrieval. Both findings suggest that nouns typically filling the possible argument positions are part of a verb's network within the mental lexicon. In addition, Druks (2002, p. 303) suggests that the core meaning of a verb is related to its argument structure, and gives the examples of the verb "sleep" only requiring one argument (an experiencer) because of its core meaning, while the verb "kick" requires two arguments (an agent and a patient). Thus, at least to some extent, arguments are shown to be both word and concept specific, and this network may be organized on a lexical-semantic level and/or prelinguistic conceptual level of organization, as

prelinguistic concepts could be motivating the possible argument structures of a given verb. However, additional research should examine this phenomenon cross-linguistically.

The notion of collocates, or associates (also known as lexical co-occurrences), is a separate but overlapping notion to that of typical argument and has also been called part of a verb's semantic network. Arguments occur near their respective verbs on a de facto basis, and intuitively, collocates would seem to overlap nearly perfectly with that of typical argument fillers. However, research comparing human word associations with data from a corpus of spoken and written English indicates an overlap that is far less than perfect (Mollin, 2009). Mollin's comparisons suggest that the mental lexicon is biased towards the lexical open classes compared to the actual language output observed by corpora. Yet a computational analysis of a corpus of child-directed speech suggests that co-occurrence is an important cue to the acquisition of word meaning (Li, Burgess, & Lund, 2000). Methodological differences may be the source of these conflicting findings, and the effect of co-occurrence in the organization of the semantic network has yet to be fully teased apart from the fact that, by nature, typical argument fillers occur regularly in close proximity to a given verb. This primarily suggests a prelinguistic conceptual level of organization influencing the lexicon.

Other semantic relations may also connect verbs with other words within the mental lexicon. For example, synonymy and antonymy are semantic relations generally accepted as part of a word's network. These may or may not appear as collocates in production, but are related through a sharing of semantic properties, or basic units of meaning, more commonly known as features. Although both share conceptual and/or semantic features with their targets, synonyms may be described as words that share

similar senses of meaning, and antonyms as words that express oppositeness (Hurford, Heasley, & Smith, 2007). Evidence suggests that these relations are a major part of the mental lexicon (Jeon, Lee, Kim, & Cho, 2009). According to Hutchison (2003), about 38% of the word associates identified by the word association norming study of Palermo and Jenkins (1964) were synonyms or antonyms. Although verbs formed only a portion of the stimuli for the associations (there were 34 verbs among the 200 stimuli for word associations), it is probable that synonyms and antonyms are common associates of verbs.

The relations discussed above are just a subset of possible semantic relations, but support the idea that verbs occupy central roles in intricate networks within the mental lexicon. These network structures do not, however, preclude a hierarchical assembly of verbs, with subordinate and superordinate relationships, although it is unclear whether it is possible to fully organize all verbs into a single hierarchy (see Levin, 1993, p. 23). Regardless, these subordinate and superordinate connections appear to increase the intricacy of verb networks.

Various projects have imposed hierarchical organizations onto verbs by grouping them according to their meanings (Levin, 1993; Princeton University, 2010). These projects are theoretically based on decompositional theories of lexicalization, which posit a two-part event structure for each verb's meaning: an "event template," which is a basic meaning that is shared with other, semantically related verbs, and a verb "root," which differentiates a given lexical item from others that share the same event template (McKoon & Macfarland, 2002; Rappaport Hovav & Levin, 1998). Specifically, the event templates are *state*, *activity*, *change of state*, and *externally caused change of state* (McKoon & Macfarland, 2002; Pinker, 1991). The template describes the basic

dynamics of the event described by the verb—for example, whether the verb refers to a given state (e.g., *"He loves art by Picasso"*), or to a change of state (e.g., *"The sun is rising"*), or to an activity (*"He is jogging"*), or to an externally caused change of state (*"He is mincing the garlic"*). The root refers to the elements of the event that differentiate between verbs with a given event template (e.g., "*He loves art"* and *"He hates art"* both have the same event template, but different roots). Event templates range in complexity: the *state* and *activity* templates are the most basic, consisting of a single "subevent" (e.g., *I am eating*) whereas an externally caused change of state template, such as is found in resultative constructions (e.g., *They licked the platter clean*), consists of two subevents (e.g., *They licked the platter* [an activity, the causing event] and *the platter was clean* [the resultant state]). Thus *externally caused change of state* verbs have an embedded *change-of-state* template. Event templates are similar to, but may dissociate from, argument structures, as in the following example sentences: *Bill loaded cartons on the truck* and *Bill loaded the truck with cartons* (McKoon & Macfarland, 2002, p. 5). These example sentences have the same argument structure, but different event templates, with the first bearing the *activity* template, and the second bearing the *externally caused change of state* template. The verb classes in the catalog of Levin (1993) are slightly less primitive in their decomposition than the event templates discussed above, but still organize verbs according to shared meaning (a common event template), with members of a class differing from each other (the root).

Theoretical work on verb classes has intuitive appeal for characterizing the organization of verbs, but efforts have also been made towards empirical evidence. Priming research lends empirical support to the concept of verb classes. For example,

priming studies have shown interference effects for reaction times to verbs that are carried out by the same body part as a prime verb (such as *clapping* - *kneading*, which both are carried out with the hands) compared to a prime verb that is an action carried out with a different body part (such as *clapping* and *kissing*, which are carried out by different body parts), for both healthy individuals and for persons with aphasia (Faroqi-Shah, Gassert, & Wood, 2009; Faroqi-Shah, Wood, & Gassert, 2010). The occurrence of interference between congruent pairs suggests that activation for the second word could not begin until after the activation of the prime word. When incongruent verbs or congruent static images of the body part required for the action were used as primes, reaction times were faster, suggesting a lack in interference. This predictable behavior for verbs within a set suggests that the verbs involving specific body parts make up a "class" of verbs.

The ideas that verbs are organized by body part, and that action words are processed through mental simulations of the actions, are concepts based on the theory of embodiment. Embodiment is based on the mirror neuron system and the "mental simulation" concept of lexical storage (sometimes referred to as "grounded cognition"; see Barsalou, 2008). Barsalou (2008), in his review of the theoretical underpinnings of embodiment, or, as he calls it, "grounded cognition," describes the overall assertion of grounded cognition as dismissive of amodal symbolic representation within the mind, and instead congruent with multimodal states or mental simulations. These mental simulations are suggested to result in motor and perceptual activity during thought or language involving specific items, which has been corroborated by various neuroimaging studies (e.g., Amsel, Urbach, & Kutas, 2014; Sakreida et al., 2013; van Dam,

Rueschemeyer, & Bekkering, 2010).

The concept of embodiment has been measured with psycholinguistic methods. Recent work on embodied cognition has been directed towards developing ratings that focus more on simulation and sensory perception in general, as opposed to the visual information (as captured by imageability) or visual and haptic perception (i.e., concreteness, regardless of instructions to participants to include all senses; see Brysbaert et al., 2014). The sensory experience rating, or SER, is one such measure (Juhasz, Yap, Dicke, Taylor, & Gullick, 2011). Again, this correlates with imageability and concreteness, but differs in some cases: the authors give the example of "thirst," which is low in imageability, but high in SER. A similar rating was developed by Sidhu, Kwan, Pexman, and Siakaluk (2014). Their measure, called the embodiment rating, asked participants to rate how easily a verb could involve the human body, such that "leap" would be rated highly and "dissolve" would be rated low. They suggest from results of comparison of embodiment ratings to other common ratings, including imageability, that embodiment explains better the variance in response times observed in action naming and syntactic classification tasks.

The idea of embodiment lends support to differential processing of abstract (i.e., nonphysical, or low concreteness/imageability/embodiment) versus concrete (i.e., physical, or high concreteness/imageability/embodiment) actions may be represented and processed. Debate continues about the extent to which abstract words could be metaphorically grounded, and thus still mentally or grounded through related concrete concepts, although evidence so far primarily speaks against that idea, and instead supports a difference in processing related to the concreteness of a word (Sakreida et al.,

2013). This differential processing is believed to be the source of the concreteness effect, which is a processing advantage towards words with greater concreteness during lexical tasks, an effect seen in noun processing for both typical and brain-injured persons (Sandberg & Kiran, 2014a). The organization of verb networks in the mental lexicon appears to vary, at least in part, on the concreteness of the verb's meaning. Concreteness is typically measured in norming studies with healthy individuals who are asked to rate words based on how easily the referent of the word may be experienced by the physical senses (Brysbaert, Warriner, & Kuperman, 2014; Paivio, Yuille, & Madigan, 1968). Words of other parts of speech also vary along the concreteness dimension, but discussion here is primarily limited to verbs. The dual-coding model (Paivio & Csapo, 1973) is the predominant theory for explaining processing of low imageability (technically different, but very similar to, concreteness), positing a different processing pattern than that for high imageability words. According to this theory, concrete and abstract concepts are differentially stored and retrieved, the "dual-coding" referring to the primarily symbolic or linguistic processing that underlies both low- and high-imageability words, and the perceptual code concurrently supporting, thus differentially advantaging, only the high-imageability words.

Evidence for the role of imageability in language processing and production comes from deep dyslexia. Deep dyslexia is a reading disorder resulting from acquired or progressive brain injuries. It is behaviorally signaled by the production of semantic errors during oral reading words and by the mediating effects of lexical factors such as concreteness and/or word class (Saffran, 1980). Research in deep dyslexia suggests that concrete words may have rich semantic networks (i.e., more semantic features), whereas

abstract concepts have relatively impoverished semantic networks (Plaut & Shallice, 1993); in other words, abstract words appear to have less context readily available than concrete words have (Schwanenflugel, Harnishfeger, & Stowe, 1988). In the case of verbs specifically, this would suggest that concrete verbs, being physical and observable, tend to share more semantic information with their arguments than do abstract verbs. This would imply that concrete verbs have more limited and restricted sets of typical arguments, as only a limited set of nouns could share large numbers of semantic features; and abstract verbs must have a less restricted set of typical arguments, as they do not typically share large quantities of semantic information with their arguments. For example, any number of things may "affect" something else, whereas only a more limited number of things may "drink" something. This speaks to possible qualitative as well as quantitative differences in the semantic networks of abstract versus concrete verbs within the typical mental lexicon.

Phonological processing

Verbs have distinct phonological patterns that differ from nouns and from other word classes. Stress patterns, word duration, and syllable number all differ. Compared to nouns, verbs tend to have stress on the second syllable instead of the first, have shorter duration, and usually have fewer syllables (see Black & Chiat, 2003, for further details).

Disordered verb processing in aphasia

Verb processing impairments have been reported with persons with various aphasia types. For example, both persons with fluent and persons with nonfluent aphasia

showed impaired verb retrieval relative to noun retrieval in both picture naming and sentence completion tasks (Berndt, Haendiges, Burton, & Mitchum, 2002). Imageability, which is generally lower for verbs compared to nouns (Druks, 2002), may be a primary reason for this verb-noun difference. Evidence from noun research and concreteness (which is strongly correlated with imageability) suggests that, as a group, persons with aphasia (PWA), both fluent and nonfluent, have been found to experience an exaggerated concreteness effect, meaning that abstract words are disadvantaged in various tasks to an even greater extent than what is observed in typical speakers (Sandberg & Kiran, 2014a). Sandberg and Kiran (2014a) examined abstract versus concrete noun processing in three PWA and three neurologically healthy controls, finding a concreteness effect for both groups during synonym judgment and word judgment tasks, but an interaction effect between group and accuracy, with greater decrease in accuracy for the PWA. They also found fMRI evidence of differences in processing based on concreteness between the two groups. Although both groups tended to primarily process abstract words with the "verbal" network (roughly defined anatomically as left anterior perisylvian areas; see Binder, Desai, Graves, & Conant, 2009; Binder, Westbury, McKiernan, Possing, & Medler, 2005) and concrete words with a more "perceptual" network (defined anatomically as including ventral temporal lobe and association areas and greater bilateral activation; again, see Binder et al., 2009; Binder et al., 2005). In addition, PWA also activated homologous regions of the right hemisphere and other spared tissue areas. However, these results are far from conclusive in regards to the precise differences in processing of concrete versus abstract words in PWA, due to, as the authors note, small sample size. But, although Sandberg and Kiran (2014a) did not examine verbs, it is

reasonable verbs could yield a similar difference in the concreteness effect between PWA and healthy speakers, as verbs, like nouns, differ along the concreteness continuum. The effect may actually be magnified in verbs, due to the lower imageability of verbs than nouns in general (Druks, 2002).

Verb processing by aphasia type

Despite the occurrence of verb impairment in both fluent and nonfluent aphasia types (e.g., see discussion by Conroy et al., 2006), there is neuroimaging and behavioral evidence to suggest that verbs may be more commonly impaired in nonfluent aphasia than in fluent aphasia (Gainotti, Silveri, Daniele, & Giustolisi, 1995; Luzzatti et al., 2001; Mätzig & Druks, 2006). Verb impairment symptoms associated with Broca's aphasia may be due to underlying deficits in perceiving and processing perceptual input of information about human actions. Fazio et al. (2009) found experimental evidence of disordered human action encoding in a non-linguistic task in persons with damage due to Broca's aphasia. Although their primary interpretation was in regards to a general, non-domain-specific sequencing function attributable to Broca's area, it is possible that this has ramifications for the way in which persons with Broca's aphasia interpret, and thus parse, events. As event parsing is critical in language development, it is possible that it continues to bear on the success of verb retrieval and remapping following acquired impairment. Incorrect or incomplete parsing of actions could provide mixed or weak signals to the needed semantic networks, failing to produce adequate activation of target lexical items. Some evidence suggesting a connection between impairments in event processing and verb retrieval in nonfluent aphasia is given by a single case reported by

Dean and Black (2005). In summary, although Broca's aphasia is associated with relatively intact comprehension, evidence suggests that some deficits in action perception exist, and that these deficits are associated with impairment in naming actions (Hillis, Tuffiash, Wityk, & Barker, 2002; Saygin, Wilson, Dronkers, & Bates, 2004).

Verb-type usage in aphasia

Research on verb-type usage in aphasia has primarily come from studies of speakers with fluent aphasia. Armstrong (2001) found that in personal recounts, typical speakers tended to use mostly *relational* verbs such as "have" and "be," whereas persons with fluent aphasia either displayed a similar pattern, or tended to use more *material*, event-centered verbs, such as "walk" and "wreck." Interestingly, they found that differences in the imageability of the verbs used did not follow a consistent pattern: some speakers with aphasia used lower imageabilty verbs compared to typical speakers, whereas others higher imageability verbs. Similarly, Armstrong (2005), in her description of "linguistic options" for persons with fluent aphasia to express opinions and feelings, wrote that the participants with aphasia in her study used proportions of mental and relational verbs to a similar degree as their matched typical control speakers. However, although the proportions were similar, persons with aphasia used fewer mental verbs and higher frequency verbs; findings for the evaluative verbs for the participants with aphasia were mixed. Note that verb usage entails verb retrieval in addition to other processes (Armstrong, 2005). This suggests that persons with aphasia may demonstrate some impairments regarding verb access, but also demonstrate some preserved abstract verb capabilities, assuming that abstract verbs correlate with expressing emotions and

opinions. It would be highly relevant to determine whether or not this also extends to nonfluent speakers, given the difficulty they have with verbs in general (Bastiaanse & van Zonneveld, 2004). Unfortunately, research on verb-type usage has primarily focused on speakers with fluent aphasia (Cruice, Pritchard, & Dipper, 2014), and so data regarding verb-type usage in nonfluent aphasia are limited.

The limited evidence available on verb-type usage in nonfluent aphasia is in favor of the critical role of concreteness in aphasia (Roll et al., 2012). Using a computer model with semantic space analysis on language samples from a word association task, Roll and colleagues found that persons with Broca's aphasia were using vocabularies (grammatical class not specified) with increased overall concreteness in a word association task compared to a healthy control group. Although currently available additional research regarding concreteness and PWA has focused on nouns, it is highly possible that concreteness contributes to the verb deficits of PWA.

Conclusions about verb usage in general appear to depend heavily on the individual case and basic aphasia type at hand. In general, however, it is clear that verb retrieval in aphasia in connected speech is reduced, and that remediation of verb retrieval impairments is critical to successful rehabilitation of affected individuals.

Theoretical motivations for verb treatments

According to Conroy et al. (2006), there is a disparity between theoretical understanding of verb processing and the verb treatments described in the literature. Namely, there are variables affecting verb processing that, particularly at his time, had not (and some still have not) been applied to treatments for improving verb processing in

persons with aphasia. Although the picture has improved somewhat in the decade since that report, verb treatments being currently researched continue to lag behind theories of verb processing. The following section will describe verb retrieval impairments in aphasia, and treatments, if any, that are theoretically based on the various impairments.

Recently, Faroqi-Shah and Friedman (2015) performed a meta-analysis of 12 articles (143 total cases) representing seven languages and performed additional original research with 16 participants, to further investigate production of verb tense in agrammatic aphasia. They found significant advantages for nonfinite verbs (tense neutral) relative to finite (past, present, and future tenses) across the variety of studies and tasks analyzed. Logically, it appears that the added morphosyntactic marking and syntactic positioning requirements of finite verbs, particularly in sentence production, add additional layers of difficulty for speakers with agrammatism. Note, however, that the scope of the current report will be limited to the status of verb retrieval treatment literature, without specific regard for the morphosyntactic accuracy of verbs produced.

Syntactic approaches

The first verb retrieval treatments targeted verbs as the central node connecting two other sentence components together—both sequentially, as the middle word of a basic sentence, and semantically, as the director of the relationship between the other sentence constituents (Loverso, Prescott, & Selinger, 1988; Loverso et al., 1979; Prescott, Selinger, & Loverso, 1982). These treatments, known as "verb is core," or Cueing Verbs Treatment (CVT), were the primary influence on a more recent verb treatment, Verb Network Strengthening Treatment (VNeST; Edmonds & Babb, 2011; Edmonds,

Mammino, & Ojeda, 2014; Edmonds et al., 2009; Furnas & Edmonds, 2014). These verb-network treatments treat the verb as the central component of a sentence, governing sentence meaning as other meaningful words from other word classes are added to it. For example, "the cook measures flour" contains the same verb as "the builder measures lumber," and although the verb's specific meaning is nuanced by the added arguments, a core facet of meaning remains in common between the two. The theoretical strengthening of verb networks means that gains associated with treatment items also spread to untreated items, including untrained verbs and nouns (Edmonds & Babb, 2011; Edmonds et al., 2014; Edmonds et al., 2009; Furnas & Edmonds, 2014). This generalization is an important step towards the critical generalization goal of all language treatments. VNeST has also been used in conjunction with a socially oriented conversation group treatment approach, although the experimental design did not allow direct comparisons of the treatments' effects (Hoover, Caplan, Waters, & Budson, 2014).

In VNeST, the sentence context provides a frame, and additional steps are typically taken beyond elicitation of the verb, to fill the empty argument positions of this frame with semantically appropriate nouns and other words. VNeST is not alone, however, in capitalizing on the argument information associated with a given verb. Other treatments, such as Kim, Adingono, and Revoir (2007) and Thompson, Riley, den Ouden, Meltzer-Asscher, and Lukic (2013) have used the argument structure of verbs as a focal point for stimulating and practicing verbs. Practicing verbs within a viable and plausibly filled argument structure may also be making use of beneficial frequency effects, as verbs prime and are primed by likely arguments (e.g., see Ferretti et al., 2001). Results from these argument-centered treatments have also indicated positive acquisition effects,

though Thompson et al. found generalization to untreated items, whereas Kim et al. did not. Future research should experimentally compare VNeST and the approach of Thompson et al. to better understand the mechanisms behind generalization to untrained verbs.

Other approaches have treated verbs more basically as names for actions. Although the specific treatment method or cues have varied and may be related to other domains discussed, the treatment of verbs in isolation deserves mention in this discussion of syntactic approaches to verb treatments. From the research, it is evident that training of verbs as single words has led to consistent results in acquisition and maintenance of treated items (e.g., Boo & Rose, 2011; McNeil et al., 1997; Raymer et al., 2006; Wambaugh, Cameron, Kalinyak-Fliszar, Nessler, & Wright, 2004; Wambaugh, Doyle, Martinez, & Kalinyak-Fliszar, 2002; Wambaugh, Mauszycki, & Wright, 2014). In addition, training single verbs has occasionally generalized to production of untreated verbs in sentences (Edwards & Tucker, 2006; Lavoie, Routhier, Legare, & Macoir, 2015; Manenti et al., 2015; McCann & Greig, 2010). Although training verbs in a sentence context also generally leads to acquisition and maintenance effects for sentence production with treated and untreated verbs, retrieval of the verb itself, separate from retrieval of the other sentence constituents, is not clear (Edmonds et al., 2014; Edmonds et al., 2009). Some researchers have combined or compared sentence and single-word contexts for verb training. These treatments, such as that of Mitchum and Berndt (1994), typically involve single-word verb retrieval as a step towards sentence production using the target. Treatment tasks are then used to elicit nouns or other words that may appropriately accompany the verb within a sentence, as in Kim et al. (2007) and

Thompson et al. (2013). However, despite positive generalization to sentence production with untreated items recently shown in some sentence-level verb treatments (e.g., VNeST), reports experimentally comparing treatments for both contexts within subjects have yielded inconclusive results about the superiority of one or the other for both verb acquisition and for generalization to higher levels of discourse (Conroy, Sage, & Lambon Ralph, 2009a; Takizawa, Nishida, Ikemoto, & Kurauchi, 2014). The evidence called for by Webster and Whitworth (2012)—that needed to determine the superiority of single-word versus sentence-level approaches in promoting generalization—has yet to be determined.

Conceptual-semantic approaches

Event templates may have an influence on verb processing, as their compositional structure likely renders some templates, particularly the change of state templates, more difficult than others. As a rule, however, treatments for verb retrieval have focused primarily on actions and changes of state, as evidenced by a movement towards action observation in verb treatments. This is likely due to action verbs having greater temporal dynamics, whereas state verbs resemble the more static objects targeted in nouns, and have lower imageability and concreteness.

Action observation is an important arena for verb retrieval treatment that has begun to be explored in the literature. Treatments following the rationale of action observation hold that the mere observation of actions (as opposed to the physical enactment of the action) activates stored neural representations of the action; it is believed that this simulation may strengthen access to that representation over time and

with many repetitions. According to Marangolo et al. (2010), this approach may be more effective for patients with nonfluent aphasia, compared to fluent aphasia. Benefit from the observation of action has been shown to occur for human or human-like actions only, and not animal or mechanical actions (Marangolo, Cipollari, Fiori, Razzano, & Caltagirone, 2012). Bonifazi et al. (2013) demonstrated that video clips are as effective as live action performances, which greatly facilitates logistics of the technique. The technique has also been combined with cueing hierarchies with good success in inducing acquisition of targets (Bonifazi et al., 2013), though note the equivocal results of Macoir et al. (2015). Action observation, particularly through videos, bears promise for future fruitful verb retrieval therapy research.

Sensory richness is, according to Black and Chiat (2003), another aspect of the conceptual-semantic domain that differentiates the verb class in general from the noun class, but as a variable of verb processing, it appears to not yet have been tapped for developing a verb retrieval treatment. Sensory richness corresponds with how well a word's referent may be experienced by the senses. Action observation encompasses one aspect of this, as it capitalizes on providing a visual presentation of a verb's meaning; however, other elements of sensory richness are also possible for verbs, and future treatments could explore whether manipulating the sensory richness of a given action in a sentence in a sentence context allowed differentiating therapeutic effects on verb retrieval (e.g., practicing the verb "to yell" with *"The man yelled loudly"* may have more sensory richness and therapeutic potential than *"The man yelled yesterday"*).

One interesting report utilizing another conceptual-semantic approach bypassed actual lexical items and morphology in favor of a symbolic, nonlinguistic system

(Weinrich, Shelton, Cox, & McCall, 1997). This computerized system, known as C-VIC, requires users to place symbols in a logical order in order to describe a pictured event. In this case, treatment was next combined with attempts at verbalization of a corresponding sentence (linguistic information), with support from a therapist when needed. Although tense was being specifically targeted, results indicated improved verb retrieval in the three participants with aphasia. These positive findings suggest that practice with prelinguistic conceptualizations of events may, at least for some patients with aphasia, improve linguistic instantiations in event descriptions. More research could be done in this area.

Semantic approaches

Semantic approaches previously developed for noun retrieval have been modified for verbs. Foremost among these is Semantic Feature Analysis (SFA; see Boyle, 2010, for background information on the treatment.). Wambaugh and Ferguson (2007) adapted the procedure for action verbs and received promising results, including acquisition of target verbs that were maintained at 6 weeks after treatment. Subsequently, others continued the application of SFA for action names (Carragher, Sage, & Conroy, 2013; Faroqi-Shah & Graham, 2011; Knoph, Lind, & Simonsen, 2015; Kristensson, Behrns, & Saldert, 2014; Wambaugh et al., 2014). SFA clearly leads to gains in treated verbs; unfortunately, however, generalization to untrained verbs, unlike SFA for trained nouns, is generally lacking. Faroqi-Shah and Graham (2011) used Levin's verb classification system as an approach to stimuli selection in treatment of verbs for aphasia, and used SFA treatment, along with video-clip observation, to treat verbs from Levin's "cut" and

"contact" classes. These included verbs such as "mince, crush, chop, and slice" and "nudge, tickle, kiss, and bump." The aim was to identify generalization to untrained exemplars of the verb class targeted in treatment in two persons with Broca's aphasia and verb naming impairment. However, this response generalization was not observed.

Semantic cues are common tools in the verb treatment literature. Semantic cueing hierarchies (often accompanied by or juxtaposed with phonological cueing hierarchies, discussed further below) have been used multiple times as a treatment approach for verb retrieval (Links, Hurkmans, & Bastiaanse, 2010; Wambaugh et al., 2004; Wambaugh et al., 2002; Wambaugh & Wright, 2007). These hierarchies have included both errorful and errorless methods (Conroy, Sage, & Lambon Ralph, 2009b, 2009c; Conroy & Scowcroft, 2012; Raymer & Kohen, 2006). Errorful methods of treatment involve the clinician starting at a minimal cueing level and providing an increasing amount or strength of cueing to correct patients' naming errors; errorless methods involve the clinician starting at a maximal cueing level and providing a decreasing amount or strength of cueing in order to circumvent naming errors. Direct comparisons have revealed little difference in acquisition effects between errorful and errorless, although factors such as reduced administration time and reduced patient frustration make the errorless approach more appealing (Conroy et al., 2009b). The continued use of semantic cues and their logical function lends credence to their usage, and their usage will undoubtedly continue in future experiments.

Another important semantic therapy discussed is lexical-semantic activation/inhibition therapy (L-SAIT; McNeil et al., 1998). L-SAIT is unique in that it relies almost completely on semantic information, with the primary treatment task

involving generating synonyms and antonyms for target words; as such, pictures (and thus, highly imageable words) are not required as targets. Findings for acquisition were positive, but maintenance and generalization to untreated items were negligible to poor. However, being only a single case (another two cases also received L-SAIT, along with pharmacological agents, and they are discussed later), much about the therapy is still unknown.

Phonological approaches

As discussed by Conroy et al. (2006), phonological differences between nouns and verbs cause reduced acoustic markedness for verbs compared to nouns, which may make them more difficult targets. However, verb treatment approaches motivated by phonological information have primarily involved word-specific phonological information, providing models and requesting repetitions of the phonological form and/or providing phonological cues, often in cueing hierarchies (e.g., Conroy et al., 2009b; Fink, Martin, Schwartz, Saffran, & Myers, 1992; Kempler & Goral, 2011; Raymer & Ellsworth, 2002; Wambaugh et al., 2002; Wambaugh & Wright, 2007). Phonological patterns of verbs, and the effects that they have on their acoustic markedness, however, appear not to have influenced verb treatments, although it is a possible avenue for further research.

Neuromodulary approaches

Therapies for verb retrieval in aphasia have also included the instrumental methods of brain stimulation, including repetitive transcranial magnetic stimulation

(rTMS) and transcranial direct current stimulation (tDCS). Finocchiaro et al. (2006) performed high frequency (excitatory) rTMS to the left inferior frontal gyrus of a man with Primary Progressive Aphasia (PPA). The targeted area of the brain has been implicated in verb processing. Stimulation was given in conjunction with various language stimulation techniques, such as sentence completion tasks. They found that verb retrieval was better after the stimulation, compared to performance after a sham rTMS condition. Over the past few years, researchers have begun examining the effect of tDCS on response to verb retrieval therapy (verb therapy performed in conjunction with tDCS). Fiori et al. (2013) performed a group study of seven participants with aphasia in which they combined anodic (excitatory) tDCS stimulation to either Broca's or Wernicke's areas, and noted the differential effects on response to a simple objects and actions naming treatment; they found that stimulation of Broca's area improved response to the verb treatment. Broca's area was also stimulated with facilitatory effect combined with various language-based treatments in a study by Galletta and Vogel-Eyny (2015). Further evidence for the benefit of tDCS in verb retrieval treatment was recently demonstrated with stimulation to the dorsolateral prefrontal cortex (Manenti et al., 2015). Other researchers have targeted left hemisphere regions (and cathodic inhibition of right homologue areas) based on individual patients' MRI scans, and found similar success when combining it with another therapy (de Aguiar et al., 2015). Future applications building on these neuropsychological approaches may include further combinations of successful behavioral treatments with direct brain stimulation.

Pharmacological agents have been used to a very limited degree in the verb retrieval literature, and much more may be done in this arena. The single report

documented is that of McNeil et al. (1997). In this report, the semantic treatment L-SAIT was administered during alternating phases during which the two participants with aphasia were receiving either selegiline or dextro-amphetamine (which affect the metabolism of the neurotransmitters dopamine and norepinephrine) or an inactive placebo. Results were positive during all phases, including the placebo, indicating that the behavioral treatment, L-SAIT, was the primary driver of the therapeutic effect. However, with only two participants and two drugs examined within a single study, the approach has only begun to have been explored, and the remaining opportunities for pharmacological and pharmacological-behavioral combined approaches to verb retrieval treatment are plentiful.

Psycholinguistic approaches

Conroy et al. (2006) discuss the influence that psycholinguistic variables have on verb retrieval, and although many therapy studies have used psycholinguistic variables for developing balanced treatment and generalization lists, there is unmet potential for using psycholinguistic theory to design new interventions for aphasia. Specifically, persons with aphasia may be impaired in accessing the conceptual (retrieval of prelinguistic information, such as event structure), lemma (semantic and syntactic content), and/or lexeme (phonological form) levels of psycholinguistic processing (Bastiaanse, Wieling, & Wolthuis, 2015), and therapies may be developed that manipulate psycholinguistic variables and aim to improve the efficiency of their processing. For example, Kohn and Cragnolino (1998) found evidence for reduced usage of verb-noun associates in a sentence production task in persons with aphasia compared

to healthy controls and suggested that this deficit in persons with aphasia indicates a semantic network access deficit, rather than a word-finding or conceptual-semantic deficit. A therapy designed to strengthen lexical associates, particularly frequently occurring noun-verb and verb-noun associates, could therefore be construed as a potentially useful treatment strategy for improving verb retrieval in persons with aphasia.

Delivery platforms

Delivery platforms for verb retrieval treatment have ranged from low- to hi-tech. The majority of the studies involve a live, on-site communicative exchange between a clinician and his or her patient(s), with various paper stimuli and treatment materials being used in conjunction with spoken requests for naming attempts, etc. However, over the last 2 years, researchers in the field have begun developing new delivery platforms using recently developed technology. Furnas and Edmonds (2014) created a computerized version of VNeST treatment and successfully administered it remotely via teleconferencing software to two persons with aphasia. Smart tablets have also been used for the delivery of treatment, either in real time or on demand. The tablet program of Kurland, Wilkins, and Stokes (2014) was used by five participants to maintain and even build on gains in verbs acquired through earlier intensive treatment. Similarly positive results were found for treatment administered via smart tablet by Lavoie et al. (2015) and Routhier, Bier, and Macoir (2014). This small but recent evidence suggests that treatment gains may be acquired and maintained through computerized options that facilitate practice and reduce various burdens, such as travel time and costs.

State of the verb retrieval treatment literature in aphasia

Fortunately, the treatment of verb retrieval deficits in aphasia has remained a focus in aphasiology since the first verb retrieval treatment study appeared in the 1970s; there have been at least 31 in the 2010s so far. Data for the number of verb treatment reports are graphed in Figure 2.

Recent reviews by Webster and Whitworth (2012) and Conroy et al. (2006) have assessed the state of the verb retrieval treatment literature and highlighted areas for its further development. Conroy et al. (2006) take the approach of reviewing the theoretical motivations of published verb treatment reports. They begin by discussing the evidence for a noun-verb dissociation in production and comprehension in persons with aphasia, relying on the opinion of Black and Chiat (2003), who describe verbs and nouns as being ends of a multidimensional continuum rather than fully dichotomous categories. The tendencies they observed in the literature are that many with aphasia do exhibit such grammatical class differences, and that verb deficits (as opposed to noun deficits) are typically more common and severe in nonfluent aphasia compared to fluent. Further, Conroy et al. (2006) reviewed 10 verb treatment reports. In this review, they identified distinct classes of treatments: 1) those that could be applied to both nouns and verbs and targeted single words in isolation, 2) those that targeted verbs only, and 3) those that targeted verbs along with their argument structures. Though these studies represent a variety of approaches and generally result in positive acquisition of target verbs and generalization to higher levels of discourse, Conroy et al. (2006) decry a lack of generalizability due to the overwhelming predominance of single case studies, and a need to further develop theoretically driven treatments based on research regarding verb

processing in aphasia. They give psycholinguistic and cognitive verb-related findings as examples of verb processing research that has yet to be applied to verb treatment.

More recently, Webster and Whitworth (2012) performed another review of the verb treatment literature. Although Webster and Whitworth limited their review to studies examining treatments of spoken verb production only, they discussed findings from 26 verb treatment articles, more than double the number reviewed by Conroy et al. (2006), and with an overlap of only seven studies. They grouped the reviewed studies into four groups: 1) treatments for verbs in a single-word context, 2) treatments that could be applied to nouns or verbs, 3) treatments of verbs in the sentence context, and 4) treatments of verbs with their argument structures. As a whole, Webster and Whitworth (2012) found the same overall trends of the effects of verb therapy as did Conroy et al. (2006): treated verbs are usually acquired, generalization to untreated verbs typically does not occur, and generalization to sentence contexts tends to occur, although they further clarify that this is barring any co-occurring noun or sentence difficulties. However, despite the increased number of verb treatment reports, Webster and Whitworth were still hesitant to endorse one approach over another, although they stated that those emphasizing argument structure were "probably" had the strongest evidence. And although sentence context and argument structure treatments logically seem favorable to verb-in-isolation for generalizing to higher levels of discourse, Webster and Whitworth could not find sufficient experimental evidence to confidently compare them. They state in summary that although many treatments have been demonstrated to have positive results, systematic research is needed in order to compare treatments and determine which approaches best enhance discourse-level generalization, the ultimate

goal of verb therapies.

Since the aforementioned reviews, much additional research on the effects of verb retrieval therapy has been published; in addition, there are older verb treatment reports that were either overlooked or excluded from the reviews. In sum, at least 70 unique verb treatment reports (including those identified in the above reviews) have been published as of February of 2016, and the status of the literature needs reexamination. Descriptions and critical evaluations of each study are reviewed and provided in Appendix A. The purpose of this section is to provide a comprehensive and critical evaluation of this body of evidence. In summary, evaluation of the body of literature shows that although the evidence for verb retrieval treatment continues to grow in size and variety of approach, the level of evidence continues to be limited by a lack in systematic study of unified approaches. Strengths of the literature include numerous replications of certain key issues, expanding delivery platforms for verb retrieval treatment, and an ever-broadening participant pool. Hundreds of cases are now reported within the literature, representing a wide array of aphasia types and severities, languages, and levels of responsiveness to verb retrieval treatment. However, the predominance of case studies and single-subject designs indicates that the area is still in the beginning stages of development, with some notable exceptions. Note that this discussion will be primarily concerned with therapies of verb retrieval, as opposed to trainings of verb inflection.

The participant pool

The verb retrieval treatment literature has included examination of over 250 cases of therapeutic intervention. These cases predominantly included participants with

Broca's and Wernicke's type aphasia, though transcortical motor, transcortical sensory, anomic, and conduction aphasia types are also represented. Most participants are considered chronic, although many are less than 1 year post onset of precipitating brain injury.

Although all participants in the reviewed studies were judged to have room for improvement in verb retrieval, the sources of their impairment varied. More persons with nonfluent aphasias have been treated than with fluent aphasias (totals from reports where aphasia types are specified, persons with nonfluent aphasia outnumber persons with fluent aphasia 170 to 62). From a modular perspective, subtypes of verb retrieval deficit have primarily involved differentiation between phonological, semantic, or mixed deficits (e.g., Marshall, Pring, & Chiat, 1998; Raymer et al., 2006; Wambaugh et al., 2002). However, it is valid to assume that many further distinctions and subtypes exists, as semantics and phonology are both very broad domains, and the mixed domain may further house other domains of impairment. In addition, syntactical and argument structure impairments could be primary causes of verb retrieval deficits for some patients, as well as conceptual-semantic impairments of event perception and processing. Further research should explore the evidence for clusters and patterns of verb retrieval impairment.

The participants treated in the reviewed studies primarily consisted of English speakers, but speakers of other languages are also represented. Other languages spoken by participants receiving treatment include Japanese (Takizawa et al., 2014), Spanish (Maul, Conner, Kempler, Radvanski, & Goral, 2014), Dutch (Bastiaanse, Hurkmans, & Links, 2006), Italian (Marangolo et al., 2012), Swedish (Kristensson et al., 2014), and

French (Furnas & Edmonds, 2014; Lavoie et al., 2015). Although this is only a very small sampling of world languages, it is encouraging that multiple languages have been investigated and are adding to the knowledge base of verb retrieval treatment.

Strength of the level of evidence

The American Academy of Neurology (AAN)'s Classification scheme for levels of evidence (AAN, 2011) is a straightforward system for classifying individual studies to enable assessment of the literature as a whole. That system differentiates between four classes of studies, with the highest (Class I) being reserved for blinded randomized controlled trials, and the lowest (Class IV) being reserved for case studies, uncontrolled trials, and expert opinions. The other levels refer to intermediate levels of evidence, being applied, respectively, to blinded group cohort studies (Class II) and to single-subject designs or other controlled trial (Class III). This classification system was applied to the verb retrieval literature reviewed here.

For purposes of this review, studies within a class were not further analyzed for strength of design, and it should be noted that some studies, particularly among those with single-subject research designs, were lacking in critical design elements, such as the need for multiple baseline probes, the continuation of probes throughout treatment, and the requirement for stable baselines to allow attributing improvements to the effect of therapy. As an example, Furnas and Edmonds (2014) report on their two single-subject cases, but the graphs for visual analysis include just two data points each during the treatment phase.

Based on a cursory examination, the 70 articles reviewed included 24 Class IV

studies, 45 Class III studies, and one Class II study. Specific results are shown in Appendix A. According to the AAN's classification scheme (Rutschmann, McCrory, Matchar, & the Immunization Panel of the Multiple Sclerosis Council for Clinical Practice Guidelines, 2002), this indicates a level B rating of the evidence, denoting that treatment is "probably effective." Note that this rating refers to the literature as a whole, and individual therapy approaches would require separate ratings that may indicate a different rating of evidence. The lone Class II study was a double-blinded crossover group study involving transcranial direct current stimulation (tDCS) applied in conjunction with a behavioral treatment (de Aguiar et al., 2015).

A trend towards group studies in the last few years suggests that confidence in the efficacy of verb retrieval treatments is increasing. However, the number of different treatments that have been used in group studies is low compared to the total number of treatments, indicating that a small number of treatments are responsible for the confidence. Few operationalized treatment protocols have been systematically replicated. VNeST, and verb SFA are exceptions that have been examined in multiple studies. As a complementary approach, tDCS has been used in five different reports, but in conjunction with different behavioral treatments. Many studies suffer from the lack of fully replicable treatment descriptions, which are sorely needed in treatment literature. Taken as a whole, the literature is clearly still in Phase I of a five-phase model of clinical research (as adapted by Robey, 2004), which indicates that research is primarily concerned with demonstrating the presence of a therapeutic effect and exploring methods for measuring the effect. Dosage at this point is only estimated, and new hypotheses continue to be explored and tested. The prevalence of single-subject experimental designs is appropriate

at this stage, as they lend themselves to detailed exploration of therapeutic effects on the individual level. Future phases of research will involve comparing treatments, refining determination of the population receiving benefit, the dosage, and more expansive trials in more settings, including typical clinical settings. Also, there is still need for more protocols to be developed and explored.

Rationale for treating abstract verbs

In cases where treatment stimuli are described in any detail, studies of verb retrieval are overwhelmingly dominated by concrete, pictureable action verbs. A possible reason for this may be that the prototypical verb "[denotes] a concrete, kinetic, visible, effective action, carried out by and involving participants" (Hopper & Thompson, 1985, p. 155), and researchers are focused on establishing treatment methods using prototypical exemplars of the verb category. The vast majority of studies use drawings of actions; others involve photographs or video clips of people performing actions. This highlights a prevalence of stimuli high in imageability. The above "prototypical verb" definition matches the construct of embodiment well; however, embodiment is not currently easily applicable as a psycholinguistic variable, as norming data are meager and preliminary (Sidhu, Kwan, Pexman, & Siakaluk, 2014). Highly imageable action verbs are a valid starting point, as pictures provide specificity for eliciting target verbs, whereas methods for eliciting low imageability verbs are less straightforward. In addition, persons with aphasia may process high imageability words more readily than low imageability, abstract verbs (Sandberg & Kiran, 2014a). Sandberg and Kiran (2014a) used fMRI imaging to compare processing of abstract and concrete words (most likely

nouns) in persons with aphasia and healthy controls. Although the words used were most likely nouns (the specific stimuli are not listed), the findings likely would also apply to verbs. Sandberg and Kiran (2014a) found differences in abstract word processing that were more pronounced for persons with aphasia compared to the healthy controls, which led them to suggest the possibility of an "exaggerated concreteness effect" in aphasia (p. 361). However, the proposed relative difficulty for abstract words does not affect their status as common words used in conversation and functional communication; low imageability words are also common in functional communication (Renvall et al., 2013a). In addition, as discussed by Armstrong (2005) and Cruice et al. (2014), a wide variety of verbs, including mental and evaluative verbs, presumably including some verbs of low concreteness, may already be found in discourse-level language samples of persons with aphasia. Thus, the lack of low concreteness verbs as stimuli in verb retrieval treatment studies is likely not due to the exaggerated concreteness effect or other capabilities of speakers with aphasia; rather, the lack is most likely an artifact of methodological difficulties in eliciting abstract verbs in isolation.

A few notable exceptions to the high-imageability stimuli pattern may be found within the verb retrieval treatment literature. Lexical-semantic activation inhibition (L-SAIT) is a treatment reported by McNeil et al. (1997). L-SAIT involves coming up with "internally generated" synonyms and antonyms for targets (p. 386), and thus pictures are not required for eliciting responses. This expands the semantic content of possible target words to those with low imageability. Although specific stimuli for the study are not available, it is likely that abstract words are found, or at least possible, on L-SAIT treatment lists. Loverso et al. (1988), who developed CVT, did not used pictured stimuli

either, and a review of their stimuli list of 30 verbs reveals at least four verbs that could easily be considered to have abstract meanings (*learn, want, think,* and *like*). Pictures of these verbs could not be easily drawn and resolutely labeled if pictured, and yet they represent interesting, useful, and common verbs. Other exceptions include Goral and Kempler (2009), who had a few semantically light verbs among their targets ("having" and "doing"), though they did not probe specific verbs; and Marshall et al. (1998), who included a set of "nonaction" verbs (e.g., "bore" and "pity"); interestingly, these studies apparently still included pictures of targets, though it is somewhat unclear whether patients responded to these pictures with less ease than pictures of more concrete verbs. However, note that all of these studies demonstrated some success with abstract verbs.

The mismatch between targets that are easy to use and manipulate and targets that represent functional communication is a problem shared by other fields as well. Alternative and augmentative communication is a field that frequently deals with issues of vocabulary selection. Stuart (1997) recorded a corpus of everyday conversations between typical, non-brain-damaged older adults and analyzed vocabulary by frequency. The list they report includes abstract words that would not be easily pictured: words such as *need*, *think*, and *like*. These common verbs, used by typical adults, are logical targets for treatment, and yet to date, no verb retrieval or sentence production study has specifically targeted verbs with abstract meanings. Research by Bastiaanse et al. (2015) suggests that verb retrieval in aphasia may not be affected by frequency, meaning that despite these abstract verbs' high frequency, they are not necessarily easier to produce for that reason.

Recent research by Sandberg and Kiran (2014b) confirms the feasibility of

training abstract words in persons with aphasia. Further, recent discussion has reaffirmed the need for abstract words to be included among treatment stimuli (Renvall et al., 2013a). Although previous research, such as Loverso et al. (1988), McNeil et al. (1997), and a few others, successfully treated a few abstract verbs among other verbs, no study yet has specifically targeted them. A treatment for retrieval of abstract ***verbs*** is a logical progression of the literature, and would make an important contribution to the verb retrieval treatment literature.

Pilot study

A pilot study was carried out as the first step in the development of a treatment to specifically targeted verbs with low concreteness. The treatment was largely based on the VNeST (Edmonds et al., 2009) and "verb is core" treatments (Loverso et al., 1988), which involve sentence production around a core target verb. The treatment was designed to provide opportunities for verbal practice of target verbs in a sentence context, as well as to encourage deeper semantic processing, theoretically expanding the target verbs' networks.

The treatment was piloted with three persons (one female, two males) with chronic Broca's aphasia and AOS due to CVA. These persons were enrolled as participants in a single-case experimental design with multiple baselines across behaviors and across participants. Each participant received two phases of the treatment, with 16 sessions per phase.

The target behavior under repeated observation was sentence production using a target verb as the central word. A clinician provided a verbal and a written model of the

target verb, as well as a simple visual sentence frame, and instructed the participant to create a sentence with it, making sure to include a subject and an object. Sentences were scored based on a novel system that emphasized semantic relatedness, plausibility of arguments, and order of sentence elements. In order to provide control for changes in overall sentence repetition ability, sentence repetition probes were administered occasionally. Occasional discourse probes were also used to examine generalization from isolated sentence production to connected speech. To examine pre-post changes, pretreatment assessments were repeated following the cessation of all treatment.

The target stimuli for the treatment were lexical verbs with high frequencies (Brysbaert & New, 2009). These verbs were sorted by concreteness rating (Brysbaert et al., 2014) into three low concreteness verb lists (verbs with concreteness ratings less than 2.5) and one high concreteness verb list (verbs with concreteness ratings greater than 3.5). Two of the low concreteness lists received treatment, and the third low concreteness list and the high concreteness list were used for measuring response generalization only.

Results indicated improved sentence production with target verbs attributable to the treatment for the first phase of the two phases for two of the three participants (Participant 1 and Participant 3). The increases began with the initiation of treatment, despite the difference in number of baseline sessions for the two participants. Where there were treatment effects, there was also considerable generalization to untreated sets of items during the first treatment phase. Unfortunately, utilization of sentence production as an outcome measure made it difficult to differentiate whether the therapeutic effect involved only improvements in production of the SVO structure, or whether it also led to improvements in verb retrieval.

Overall, the results of the pilot study were positive; they showed that the novel treatment may improve sentence production in persons with aphasia, even when using target verbs with low concreteness ratings. In addition, general measures of word retrieval (both object and action naming) also appeared to improve with the treatment. Given these promising findings, further research was warranted.

The present investigation was designed as a direct extension of the pilot study. Note that various aspects of the treatment were modified for the present investigation as a direct result of the pilot investigation. In particular, the primary outcome measure was changed from the novel sentence production scoring to accurate verb production in response to a sentence completion prompt. This change will be detailed below. The theoretical basis for the treatment itself remained unchanged: the treatment still focused on improving access to verbs with low concreteness by stimulating the semantic network of the verb and providing feedback and practice for production attempts. The final therapy protocol and outcome measures are discussed in detail in the methodology section.

Research questions

The experimental questions addressed in the current investigation were as follows:

1. Will application of the novel treatment for verbs with low concreteness result in increased accuracy in the verbal naming of verbs with low concreteness (i.e., positive acquisition effects) on sentence completion probes? It was predicted that retrieval of treated verbs with low

concreteness would improve, as evidenced by improved accuracy on verb retrieval probes following the application of the treatment.

2. Will treatment result in increased accuracy in the verbal naming of untreated verbs of varying levels of concreteness (untreated verbs with either high, moderate, or low concreteness) (i.e., response generalization effects) on sentence completion probes? Based on the pilot study results, this was predicted to occur, though improvement in the accuracy of retrieval of untreated verbs was predicted to be less robust.
3. Will verbal naming gains associated with treatment be maintained following the cessation of treatment, at 2- and 6-week follow-up points (i.e., maintenance effects)? It was predicted that the extensive practice performed in treatment would be associated with maintenance of treatment gains in verb retrieval, although possibly with some decrement.
4. Will the treatment be associated with improvements in more formal assessments (namely, naming and language discourse measures), when pre- and posttreatment scores are compared? Based on the results of the pilot study, it was predicted that verbal object and action naming would improve modestly after the treatment, but that overall language would be unaffected.

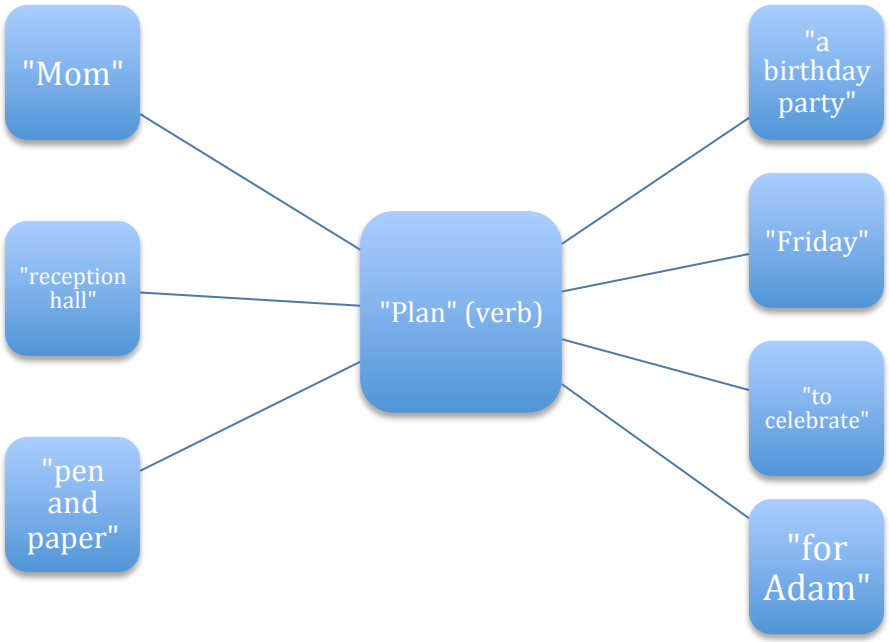

Figure 1. Example Schematic of Verb-Central Meaning (Based on Loverso et al., 1979)

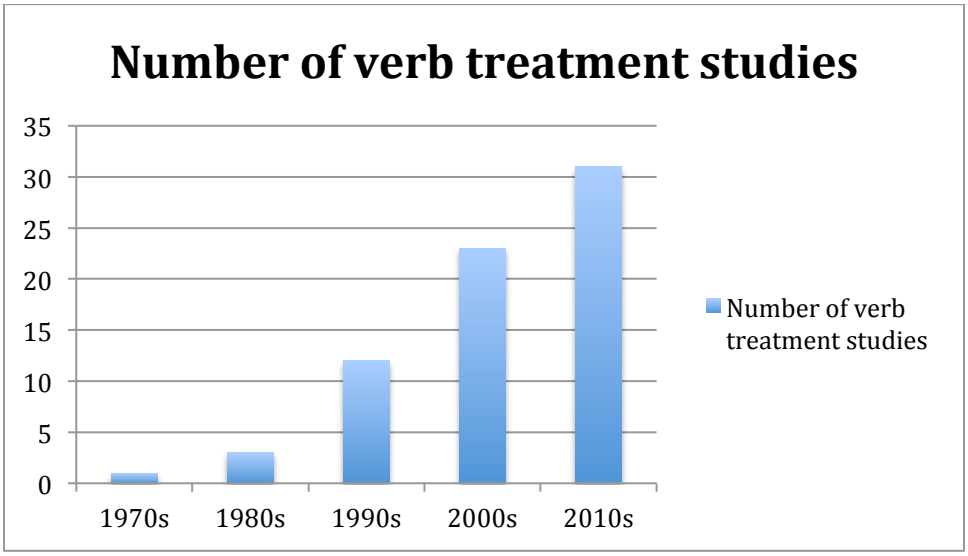

Figure 2. Number of Verb Treatment Studies in Aphasia by Decade

METHODS

Participants

Three persons (two men and one woman) with chronic aphasia participated in the treatment study. These participants met the following inclusion and exclusion criteria.

Criteria for inclusion were the following:

- age between 30 and 65,
- a stable medical condition,
- at least 12 months post-language-dominant hemisphere CVA,
- mild to severe aphasia as determined by the WAB-R,
- impaired verb retrieval on the action naming portion of the Object and Action Naming Battery (Druks & Masterson, 2000),
- minimal auditory-verbal comprehension deficits (defined as WAB-R auditory verbal comprehension subscale scores between 4 and 10), and
- average or near average nonverbal cognition as measured with the Test of Nonverbal Intelligence, Fourth Edition (Brown, Sherbenou, & Johnsen, 2010).

Exclusionary criteria included the following:

- WAB-R aphasia quotients in the unimpaired range (over 93.8) or very severe range (equal to or less than 25),
- a diagnosis or history of neurological disease or brain injury other than the

CVA that resulted in aphasia,

- depression as measured by a score greater than five on the Geriatric Depression Scale short form (Yesavage & Sheikh, 1986), including unsuccessfully treated cases,
- other untreated, or unsuccessfully treated, mental illness as documented in the medical records
- native language other than English as per participant report,
- history of speech, language, and/or learning disorders other than caused by the CVA as per participant report,
- current enrollment in other speech and language therapy, and
- participation in the pilot study.

Participants were recruited from a database of potential participants maintained in the Aphasia and Apraxia Research Program at the Salt Lake City VA Healthcare System; these individuals had provided consent to be contacted concerning upcoming research projects. Enrollment efforts continued until the goal of three participants was reached. In total, five persons with aphasia were provided with information about the study. One was excluded based on current enrollment in other speech and language therapy. The other initially expressed interest, but later stated a loss of interest prior to the consent process. Three persons met the selection criteria for the study and provided informed consent for participation in the study.

Basic demographic and pertinent brain injury data are given in Table 1. Participant ages at the beginning of the study ranged from 32 to 61. Two had a history of single-episode ischemic stroke (Participants 1 and 2), and one had a history of a

hemorrhagic stroke (Participant 3). All had chronic aphasia, with time post onset ranging from 50 to 116 months. Participant 2's significant other reported that he had had dyslexia prior to his stroke, but had never been diagnosed; however, he had graduated from high school, took classes for a year beyond high school, and demonstrated basic reading skills sufficient for the reading requirements of the experimental treatment and on par with the other participants in formal pretreatment testing (see score on the Reading Comprehension Battery for Aphasia-2, Table 2).

At the onset of study procedures, the clinician administered assessments for determining the speech, language, and cognitive profiles of the participants; these data are shown in Table 2. According to WAB-R criteria, all participants were classified as having Broca's aphasia, with severity being moderate for two participants (Participants 1 and 2) and severe for the third (Participant 3). All three demonstrated substantial word retrieval impairments, with impaired verb retrieval as well as noun retrieval. Reading abilities for all three participants indicated some impairment, as indicated by scores on the Reading Comprehension Battery for Aphasia, Second Edition (LaPointe & Horner, 1998), but the participants demonstrated residual reading comprehension abilities appropriate for the requirements of the treatment (i.e., they had largely preserved silent reading comprehension abilities at the single-word level). Some aspects of lexical processing were largely spared for all three participants, as evidenced by their high performance on the Psycholinguistic Assessment of Language Processing in Aphasia (PALPA) lexical decision tests; however, semantic word association was moderately impaired for all three participants, particularly for low imageability items. Word repetition was also impaired in particular for Participant 1 and Participant 3, though

comorbid apraxia of speech (mentioned below) likely influenced their repetition performance. Lower performance on low imageability items compared to high imageability items suggested an imageability effect on their word repetition abilities. Note that frequency did not appear to influence word repetition in any of the participants.

The informativeness and efficiency of language in narrative language sampling varied widely, with Participant 1 and Participant 2 producing more than 15 CIUs per minute, and Participant 3 producing fewer than 2 CIUs per minute.

All participants were classified as having either average or near average non-verbal cognition as determined by the Test of Nonverbal Intelligence, Fourth Edition (Brown et al., 2010). Short-term verbal memory, as measured by digit and word span testing, indicated diverse short-term verbal memory abilities.

Single-word speech intelligibility was measured with the Assessment of Intelligibility of Dysarthric Speech (Yorkston & Beukelman, 1981), with judges orthographically transcribing the participants' by the percentage of words orthographically transcribed, which also varied widely among the participants, ranging from 54% to 90%. All three participants also demonstrated symptoms of apraxia of speech, as determined by presence of slow speech rate, speech sound distortions, and disturbed prosody (McNeil, Robin, & Schmidt, 2009), as observed on a measure of speech motor programming capacity (Duffy, 2013).

Experimental Design

Design overview

In order to examine the effects of treatment on naming of treated and untreated verbs of low-concreteness, a single-case experimental design (SCED) was employed. Specifically, a multiple baseline design (MBD) across behaviors and participants was used. For each participant, the experimental design included a baseline phase, two sequentially applied treatment phases, and follow-up probes around 2 and 6 weeks following the last treatment session. Pretreatment assessment, unrelated to experimental probes, occurred prior to the baseline phase, and posttreatment assessments occurred during the follow-up phase.

Design rationale

This design was selected because it provides strong internal validity while examining application of a treatment for each individual participant. Internal validity involves the degree to which experimental control is demonstrated in a study by the experimenters. SCEDs permit detailed and systematic observations of an individual's performance throughout the course of an experiment. As the participants are likely to exhibit intrasubject and intersubject variability in the behaviors of interest, multiple probe measures through all phases of the study (i.e., baseline, treatment, and follow-up phases) allow the experimenter to observe the patterns and range of variability for a given participant on the selected measure of interest (McReynolds & Thompson, 1986). Then, once the pattern is understood, the experimenter may manipulate the application of the treatment, the independent variable, to examine its effect. Thus, SCEDs allow for strong

experimental control when examining the effects of treatment on behaviors that are variable within an individual. Experimental control is provided by a MBD through replication of the observation of a participant's performance predictably changing only at the time that treatment is applied. That is, stability is required in behaviors of interest prior to the application of treatment, with repeated demonstrations of improvements in performance associated with application of treatment. Consequently, intersubject variability is also made more transparent with an SCED, for if a participant's scores do not change as expected at the time that treatment is applied, the detailed observations afforded by the SCED may provide useful information about who may be a nonresponder to the treatment (McReynolds & Thompson, 1986). This individual response to treatment may be particularly important to observe in the beginning stages of the development of an intervention (Robey & Wambaugh, 1999).

It was anticipated that an enrollment of three participants would allow a sufficient number of treatment effect replications to provide support for the experimental treatment. In their establishment of SCED design standards, Kratochwill et al. (2010) call for at least three replications of an effect of the independent variable on the outcome measure in order to demonstrate positive evidence. Three was selected based on a "conceptual norm" of existing research and provides a means for minimizing threats to internal validity Kratochwill et al. (2010). Based on the results of the pilot study, it was anticipated that three separate participants would be needed in order to demonstrate the minimum of three replications of an effect. Although with two treatment phases, two participants could be considered sufficient (making four replications possible), a third participant was also enrolled. This was done in part because of the generalization observed between sets

during the pilot study; this generalization made replications within a given participant very difficult; thus, a multiple baseline design across behaviors and across participants, with extended numbers of baseline phases, would provide an opportunity for at least three demonstrations of an intervention effect through the three participants, regardless of any generalization between the behaviors (Connell & Thompson, 1986).

Design phases and probe schedule

Baseline phases

During the baseline phase, verbal naming of four sets of verbs was measured repeatedly in sentence completion probes. The number of baselines was extended across participants (a minimum of five, seven, and nine probes for the three participants). This alternation of the number of baseline sessions was done so that the treatment would be initiated at different points in time (Kratochwill et al., 2010). Five was the minimum number of baseline probes, as at least five probes are required for calculation of the conservative dual criterion method (Swoboda, Kratochwill, & Levin, 2010). Stability of baseline performance was defined as a nonascending or downward trend. In order to prevent excessive numbers of baseline sessions, slowly ascending trends were also accepted, with the anticipation that treatment effects could still be demonstrated through increases in slope at the time treatment was applied.

Treatment phases

Following baseline stability and the initiation of treatment, 16 probes were administered per treatment phase, occurring three to four times per week (prior to every

treatment session). The untreated sets were probed on a reduced exposure schedule: once prior to session nine and again following the last treatment session of the phase. Extended baselines for the second treatment set began to be measured during the last five treatment sessions of the first treatment phase, and a minimum of five extended baseline probes were required prior to initiation of the second treatment phase. A sixth extended baseline probe was obtained for Participant 1 in order to reach stability of probe performance.

During the second phase of treatment, the second treatment set was probed prior to every session, while the first treatment set and the three untreated sets were on a reduced probing schedule. As with the untreated sets in the first treatment phase, this second treatment phase reduced probing scheduled included probes prior to the ninth treatment session and following the last session.

Maintenance and follow-up phases

During the second phase of treatment, probing continued on a reduced schedule for the experimental set that had previously received treatment in order to measure maintenance of treatment gains. For follow-up, all four sets were probed around 2 and 6 weeks following the cessation of treatment.

Experimental Stimuli

Stimuli development

Stimuli were selected from among the lexical verbs within the top 1000 most frequently occurring words according to the SUBTLEX-US corpus (see list compiled by

Renvall, Nickels, & Davidson, 2013b). These verbs varied by concreteness rating (Brysbaert et al., 2014), ranging from low concreteness to high concreteness. Verbs were selected from this list if they were monotransitive, taking a simple object. In other words, verbs with primarily intransitive forms or that primarily allow only complex objects (such as an entire clause—e.g., "to seem" or "to think") were excluded. The excluded verbs were primarily nonagentive, mental state verbs such as "to exist" and "to think," as they typically either do not take an object, or take entire clauses as objects (Hernandez, Fairhall, Lenci, Baroni, & Caramazza, 2014). An additional four verbs were removed for other reasons, one for having an outlying high frequency (*know*), and three for having negative emotional content (*kill*, *hate*, and *hurt*). The verbs with negative emotional content were removed to avoid repeating the incidence of negative and interfering reactions to the stimuli, which one participant in the pilot study had had with similar verbs; this emotional reaction had interfered to the point that further administration of therapy had to be ended early and resumed on a later occasion, and so negative targets were omitted at this time.

Stimuli selection

Sentence completion stems were created for each word on the final list. The sentence completion stems was designed specifically for this study, though they were modeled after the sentence completion task used by Berndt et al. (2002). The sentence stems were two sentences long, with the second sentence ending in the target verb (which has been omitted for the task). These sentence completion stems were sent via an online survey tool to a convenience sample of adult English speakers (between 31 and 37

individuals responded to each item). None of these speakers had a history of neurological pathology. All the adults were over the age of 18, although additional data on age and gender were not collected. All had at least a high school education, although information on specific education levels was not gathered. The speakers were instructed to type into the online form the word that was missing for each sentence stem; the survey software automatically collected the answers. On the basis of the performance of these speakers, items with cloze probabilities lower than 50% were excluded from consideration as experimental stimuli for the participants with aphasia. The remainder constituted the pool of experimental stimuli.

During pretreatment testing with each participant with aphasia, the entire pool of sentence completion stems was administered twice. Each time, the clinician read each item aloud, audio-recording and transcribing the participant's responses. Stimuli lists were then assembled individually for each participant on the basis of his/her performance with these items so that ceiling effects were avoided. That is, included items were those that were inaccurately named on at least one occasion, with most being missed on both administrations.

Four lists of sentence completion stimuli for verb retrieval were created for each participant. Each list included 10 target verbs. Two of the lists contained verbs with low concreteness, defined as verbs with concreteness ratings of less than 2.5 out of 5.0 (Brysbaert et al., 2014). The other lists included one of verbs with high concreteness (ratings greater than 3.5), and one of verbs with medium concreteness (ratings between 2.5 and 3.5). All of the lists were balanced for frequency, cloze probability, and number of syllables, and the low concreteness verb lists were balanced for concreteness. Stimuli

lists for each participant are provided in Appendix B.

Dependent Variables

Sentence completion probe

The primary outcome measure was accurate verbal production of verbs, elicited via a sentence completion probe. The scoring system for responses was a modified version of the one used by Wambaugh and Ferguson (2007). The scoring system used is shown in Table 3. The scoring system included both multidimensional and binary scores, with each item receiving a multidimensional score between 0 and 9, and scores seven and above being considered "correct" and those below seven being considered as "incorrect." The multidimensionality was added in hopes that it would allow closer analysis of possible changes in error patterns over the duration of the study. A participant's response was considered correct if it was either 1) a production of the target verb; 2) a semantically appropriate equivalent (a synonym to the target); or 3) included in the list of responses given by the non-brain-damaged adults in the stimuli development task described previously (the lists of acceptable responses for each participant's stimuli lists are provided in Appendix B), and it received a score of seven or higher according to the above table. Responses were given a time limit of 30 s, starting at the end of the clinician's presentation of the stimulus. If the response was a nonspecific general all-purpose verb (namely, want, go, get, do, put, need, come, did, look, make or work; Rice & Bode, 1993), the clinician requested a more specific response. No cues or feedback, other than basic reinforcers complimenting patient effort and task compliance, were provided. Up to two repetitions of the stimulus were allowed if the participant requested,

if a distraction occurred in the environment, or if no verbal attempt was made by the participant.

The primary reason for the change from the sentence production probe that was used in the pilot study was to further constrain the behavior under observation. Verb retrieval in the sentence production probe task used in the pilot study was often difficult to judge for accuracy. Briefly, it was often difficult to determine whether or not the participant was accessing the meaning of the verb or merely imitating the verbal model, as the accompanying sentence constituents were often ambiguous as to the verb. For example, one participant sometimes produced sentences such as "I guarantee cookies," which is a possible correct usage of the target verb "guarantee," but not fully informative (without any additional context) as to whether it represents true access of the semantic representation of the target, or rather represents repetition of the stimuli from the prompt. Using a sentence completion task instead removes the subjectivity of clinician's evaluation of the participant's utterances during the probe task, as he or she only has to judge to whether or not the correct item is retrieved in the provided opportunity to do so. This also made the probe task more analogous to the confrontation naming task that predominates in the verb retrieval treatment literature.

Pre/post measures

Following completion of the second phase of treatment, a subset of the pretreatment tests was repeated for posttreatment comparison. These posttreatment tests were selected as they measure those behaviors that were judged likely to improve with treatment, such as object and action naming. Improvements in object and action naming

were noted in the pilot study for two participants, and increases in digit and word span and changes in functional communication were noted for all three pilot study participants. One participant also improved substantially in the pilot study in CIUs per minute, and so the same measures were retained. The WAB-R AQ was also included as a posttest measure to allow comparison with results of Edmonds et al. (2014), who noted significant AQ increases in 7 of 11 participants. The list of posttreatment measures administered is shown in Table 4.

Treatment performance variables

Despite the shift to verb retrieval in isolation, some information relevant to sentence production performance was still documented, owing to the results of the pilot study and to the emphasis on sentence production in the therapy being provided. In regards to independent verbal naming, the probe task was the only task administered that required access and production of the target verbs without prior models. However, related tasks were performed during treatment, and performance on these tasks may provide further insight into the participants' responsiveness to the treatment. Specifically, each participant's ability to produce an appropriate subject or object for the target verbs was tracked throughout both treatment phases.

Verb and sentence repetition data were also gathered directly from the treatment sessions. During treatment, the clinician tracked whether or not the participant was able to do this unassisted, or needed any cueing to do so. Data collected from treatment sessions also included data on target verb repetition (after the clinician modeled an SVO sentence including the target verb) and sentence repetition (repeating an SVO sentence

containing the target verb after a 5-second pause). The verb repetition task was presumed to involve at least a basic level of lexical access, as the participant was required to select the verb from among the three main constituents of an SVO sentence, followed by verbal production of that word. The sentence repetition task was also presumed to involve lexical access, as it was done following a delay, and no orthographic model of the sentence was available during sentence repetition. These data were compiled post hoc to supplement the sentence completion probe data.

Treatment (Independent Variable)

Treatment protocol

As mentioned above, the treatment protocol used in the pilot study was altered. There was also some reordering of remaining treatment steps to improve the efficiency of the protocol. Elements removed from the pilot study protocol included a synonym generation step, which had proved prohibitively difficult for all three participants in the pilot study, as well as Response Elaboration Treatment techniques (Kearns, 1985; Wambaugh, Wright, & Nessler, 2012), which had been used to expand well-formed initial utterances, but required too much time in treatment. The main theoretical premise and certain elements of the treatment were retained. Elements added for the finalized protocol included an increase in the number of opportunities for retrieval and production of the target verb itself during treatment, as well as incorporation of a clinician-produced example sentence for each target verb. This last element was added in order to better improve the quality and specificity of the input being received by the person with aphasia, for, as noted above in the reasoning for the change to a sentence completion

probe, it had frequently been difficult to determine successful access of the target when the subject and object were not specific to the verb. Thus, at times, participants may have been practicing target verbs with subjects and objects not necessarily informative to the specific meaning of the target verb. The finalized treatment steps are displayed in Table 5, and the full treatment protocol may be found in Appendix C.

Essentially, the treatment consisted of opportunities for retrieving the target verb after a verbal sentence model, followed by clinician-guided sentence production practice, practice repeating a sentence with the target from memory, the elicitation of utterances of a practice sentence with contrastive stress at alternating positions in the sentence (thought to provide practice evaluating the meaning of the verb with plausible versus implausible referents), and finally, sentence repetition practice from memory following a 5-second delay.

The target sentence structure, subject-verb-object (SVO), was used in treatment because it has canonical word order and because it requires two arguments. Although having one argument requires only one thematic role, having two arguments allows "thematic role combinations," and having multiple combinations for a single verb is believed to improve access to the semantic representations of verbs (Edmonds, 2014). Thus, the SVO structure is a compromise between enhancing the semantic activation and limiting the word-finding requirements of the sentence.

Treatment application

Each target verb in the list designated for treatment was submitted to the treatment protocol one time during each session. The order of stimuli was randomized for

each session. Treatment was administered by a supervised clinical fellow with a master's degree in communication disorders. Treatment took place at a location chosen by the participants (Participants 1 and 3 received treatment in their homes; Participant 2 received treatment in our VA research laboratory). For all three, treatment was administered in a quiet location, 3 to 4 days per week, with only one treatment session per day. Treatment session duration ranged from about .5 hours to 1.25 hours. All treatment sessions were audio recorded to allow later review for analysis of treatment session data, and to allow a reliability check of treatment administration by another SLP.

To meet recommendations for allowing replication of the treatment design, the treatment dosage (total number of trials per session and total number of sessions per phase) was controlled for each participant at one trial per target per session (10 total trials per session), 16 total treatment sessions per phase, and two treatment phases total. A predetermined 16 treatment sessions per phase was selected in order to control for the amount of treatment administered.

Treatment fidelity

Prior to initiation of treatment, efforts were made to maximize fidelity of treatment application. Borrelli et al. (2005) describe five aspects of treatment fidelity, and provide a list of strategies for researchers to incorporate and report in order to maximize treatment fidelity. Relevant strategies listed by Borrelli et al. (2005) were incorporated in the proposed investigation. The clinical fellow providing the treatment reviewed the treatment steps described in Appendix C prior to initiating treatment with the first participant. Then, during 100% of the treatment sessions, the fellow kept track of

adherence to the main treatment steps on an itemized paper checklist (provided in Appendix D). Note that the treatment receipt and treatment enactment aspects of treatment fidelity (Borrelli et al., 2005) were built into the design: repeated measures through sentence completion probes had the effect of allowing regular checks of the participants' progress with acquiring the verb retrieval skills being targeted.

Reliability

Reliability of the dependent variables

The reliability of the measurement of the primary outcome measure, the dependent variable, was assessed. As per the single-subject design guidelines given by Kratochwill et al. (2010), 20% of the sentence completion probes were scored a second time by a therapist not involved with the delivery of the treatment. Another therapist, a certified SLP, performed the reliability measurement following training in the probe scoring system. The probes for reliability measurement were a pseudo-randomly selected sample of probes from all phases and from all three participants. Reliability between the two raters was calculated according to the binary scores given (i.e., correct versus incorrect for each item). Cohen's kappa was calculated between the two sets of scores in order to calculate interrater reliability, and ranged from 0.95 to 0.99 for all three participants, indicating "almost perfect" interrater agreement (Viera & Garrett, 2005).

As a further measure of reliability, an SLP blinded to the treatment status of the lists and not involved with treatment administered the same sentence completion probes of all four sets on three separate occasions: once at the end of the first baseline phase, after the first treatment phase, and after the second treatment phase. This blinded

examiner received prior training from the primary clinician on the scoring system, but scored the probes independently. These data were graphed along with the primary probe data to allow visual examination of possible experimenter bias.

Reliability of the other dependent variables was also assessed by having a therapist not involved with the delivery of treatment examine the scoring of the pre- and posttreatment testing. No scoring discrepancies were observed.

Reliability of the independent variable

As a further check on the consistency of the treatment administration, 20 of the 96 total treatment sessions were reviewed by a therapist other than the therapist who administered treatment. This SLP tracked adherence to the treatment protocol steps by making sure the original clinician had performed all major steps, in the proper order, for each treatment item. A total of 81 points of agreement between the original clinician and the reviewer were possible for each session. In sum, there were 1617 of 1620 possible points of agreement, which indicates excellent reliability (99.8%) in administration of the major ingredients of the treatment.

Table 1

Participant Demographic Data

Part.	Sex	Age	BI location/type	MPO	Years education	Premorbid handedness	Hemi-paresis	Race/ ethnicity
1	M	61	L MCA / ischemic CVA	116	11	R	R UE, LE	White-nH/L
2	M	32	L MCA / ischemic CVA	55	13	R	R UE, LE	White-nH/L
3	F	57	L BG / hemorrhagic CVA	50	10	R	R UE, LE	White-nH/L

Notes: Part. = participant ID. BI = brain injury. MPO = months post onset. MCA = middle cerebral artery. CVA = cerebrovascular accident. UE = upper extremity. LE = lower extremity. nH/L = not Hispanic or Latino. BG = basal ganglia.

Table 2

Pretreatment Assessment Results

	Participant		
Measure	Part. 1	Part. 2	Part. 3
COGNITION			
TONI-4 (Brown et al., 2010) %ile	21st	55th	21st
descriptor	"below average"	"average"	"below average"
LANGUAGE			
WAB-R AQ (Kertesz, 2007)	65.6	65.7	42.3
Spontaneous speech subscore	12	11	9
Auditory Verbal Comprehension subscore	9.2	7.45	7.05
Repetition subscore	4.2	7.6	1.3
Naming and Word Finding subscore	7.4	6.8	3.8
Aphasia type	Broca’s	Broca's	Broca’s
OANB (Druks & Masterson, 2000)			
Actions (A + B) (100)	50	57	2
Objects (A + B) (162)	78	110	18
PALPA (Kay et al., l992)			
#5: Auditory Lexical Decision			
high image/high freq (20)	20	20	20
high image/low freq (20)	20	19	18
low image/high freq (20)	19	19	17
low image/low freq (20)	20	18	14
nonwords (80)	47	70	55
#9: Repetition: Imageability x Frequency			
high image/high freq (20)	9	20	13
high image/low freq (20)	13	19	12
low image/high freq (20)	3	17	6
low image/low freq (20)	7	19	7
nonwords (80)	10	62	15
#25: Imageability x Frequency Visual Lexical Decision			
high image/high freq (15)	14	15	14
high image/low freq (15)	15	14	12
low image/high freq (15)	14	12	14

Table 2 continued

	Participant		
Measure	Part. 1	Part. 2	Part. 3
low image/low freq (15)	11	15	10
nonwords (60)	19	29	52
#51: Semantic Word Association			
high imageability (15)	6	7	8
low imageability (15)	2	4	4
NAVS (Thompson, 2011)			
Sentence Comprehension Test	27/30	20/30	16/30
N&B Discourse Task--CIUs / min. (Nicholas & Brookshire, 1993)	19.52	15.89	1.76
CIUs--total	232	304	23
TALSA Digit and Word Span (Martin et al., 2010)			
Digits--repetition	3.05	6.3	0.15
Words--repetition	2.05	4.1	1
RCBA-2	67%	61%	58%
SPEECH			
AOS severity (Dabul, 2000; Duffy, 2013)	Mod-severe	Mild	Moderate
AIDS (Yorkston & Beukelman, 1981)	54%	90%	61%
FUNCTIONAL COMMUNICATION			
ACOM (Hula et al., 2015)	52.25 (1.88)	56.36 (1.58)	30.83 (1.82)

Notes: Part. = Participant. TONI-4 = Test of Nonverbal Intelligence, 4th Edition. %ile = percentile. WAB-R = Western Aphasia Battery, Revised. AQ = aphasia quotient. OANB = Object and Action Naming Battery. PALPA = Psycholinguistic Assessment of Language Processes in Aphasia. Image = imageability. Freq = frequency. NAVS = Northwestern Assessment of Verbs and Sentences. CIUs = correct information units. TALSA = Temple Assessment of Language and Short-Term Memory in Aphasia. RCBA-2 = Reading Comprehension Battery for Aphasia, Second edition. AOS = apraxia of speech. AIDS = Assessment of Intelligibility of Dysarthric Speech. ACOM = Aphasia Communication Outcome Measure. GDS = Geriatric Depression Scale.

Table 3

Modification of the Multidimensional Scoring System from Wambaugh and Ferguson (2007)

Binary scoring	Multi-dimensional scoring	Description
Correct	9	accurate, immediate (<5 seconds)
	8	accurate, delayed (>5 seconds)
	7.5	incorrectly inflected (still verb form)
	7	self-corrected
Incorrect	6.5	phonemic paraphasia with one sound substitution, deletion, or insertion
	6	phonemic paraphasia: recognizable word, more than one sound in error, but at least 50% of sounds correct
	5.5	partial retrieval (noun form of the word, word embedded in a more complex form)
	5	semantic paraphasia (any word semantically related to target or topic of sentence completion stem)
	4.5	semantic paraphasia with phonemic paraphasia (mixed)
	4	appropriate gestural response or written response
	3	circumlocution
	2.5	tangential speech or incorrect verb
	2	neologism or unintelligible word
	1	perseveration
	0	no response, “I don’t know”

Table 4

Pre/Posttreatment Measures

Measure
LANGUAGE
WAB-R AQ (Kertesz, 2007)
Spontaneous speech subscore
Auditory Verbal Comprehension subscore
Repetition subscore
Naming and Word Finding subscore
OANB (Druks & Masterson, 2000)
Actions (A + B) (100)
Objects (A + B) (162)
N&B Discourse Task--CIUs / min. (Nicholas & Brookshire, 1993)
CIUs
TALSA Digit and Word Span (Martin et al., 2010)
Digits--repetition
Words--repetition
NAVS (Thompson, 2011)
Sentence Comprehension Test
FUNCTIONAL COMMUNICATION
ACOM (Hula et al., 2015) T-score (SEM)

Notes: WAB-R = Western Aphasia Battery, Revised. AQ = aphasia quotient. OANB = Object and Action Naming Battery. NAVS = Northwestern Assessment of Verbs and Sentences. CIUs = correct information units. TALSA = Temple Assessment of Language and Short-Term Memory in Aphasia. ACOM = Aphasia Communication Outcome Measure.

Table 5

Summary of Treatment Protocol

Step 1 Request for imitation of the target verb after a verbal model of the verb in an SVO sentence

Step 2 Creating sentences with the abstract verb

Step 3 Production practice with alternating contrastive stress placement

Step 4 Sentence repetition from memory

RESULTS

Sentence Completion Probe Results

Graphic analyses

In keeping with SCED conventions, the probe data for each participant were displayed graphically for visual analysis. These graphs may be found in Figures 3-5 (Figure 3 shows data for Participant 1, Figure 4 for Participant 2, and Figure 5 for Participant 3). Each figure contains four graphs, each displaying data on probe performance for a given list, or set of verbs; the x-axis of each graph represents individual probe sessions, and the y-axis represents percentage accuracy of verbal naming in response to sentence completion items for a given set. The sets of low concreteness verbs designated for treatment are Sets 1 and 2, with Set 1 being treated in the first phase, and Set 2 in the second. The set of moderate concreteness verbs for measuring response generalization is Set 3, and the set of high concreteness verbs, also for measuring response generalization, is Set 4. For each participant, the top graph displays Set 1, with Set 2 below, and so on, in sequence.

Visual analysis of the data was performed according to the single-subject experimental design (SSED) standards described by Kratochwill et al. (2010). Namely, the level, trend, and variability of the probe data in each phase were compared within and across participants. In particular, baseline and treatment phases were compared via visual inspection.

The Conservative Dual Criterion (CDC; Fisher, Kelley, & Lomas, 2003) was used to aid in visual inspection of the graphed probe data. This CDC adds objectivity to the visual inspection. It involves calculating two lines based on baseline data (an adjusted mean line and an adjusted trend line) and extending these lines through the treatment phase data (as a prediction of performance sans treatment). In the figures, the adjusted mean levels are represented by red long-dash lines, and the adjusted trend lines are represented by red medium-dash lines. As per the CDC, the lines were based on the probe performance data of the preceding baseline phase and include an adjustment of 0.25 SD in the expected direction of the treatment effect. In this study, the CDC lines were based on the entire set of baseline probe values for a given set. Published standards dictate the number of treatment probe performance points that must be above these lines in order to state with certainty that there was systematic behavioral change associated with the application of treatment (Swoboda et al., 2010). For the present investigation, these standards required that at least 12 of the 16 probe points per treatment phase be above both lines in order to declare a treatment effect for that particular phase for that particular participant.

Effect sizes

As a measure of the magnitude of change, *d*-index effect sizes (Beeson & Robey, 2006; Busk & Serlin, 1992) were also calculated following the data collection. These effect sizes were calculated to quantify the magnitude of the effect of treatment. Note that these effects were calculated for both treatment phases for all three participants, even when effects were not demonstrated using the CDC.

Effect sizes were calculated for both the end of treatment and follow-up phases. The treatment phase effect sizes were calculated using all baseline probe data and the last two treatment phase probe values. For the second treatment set, the extended baseline probe data were also included. Effect sizes were also calculated for observation of the magnitude of effects in the follow-up phase; for these, the same set of baseline probe values were used and compared with the mean of the two follow-up probe values. Both types of effect sizes were calculated for the two treated low concreteness verb sets; only follow-up effect sizes were calculated for the untreated response generalization sets. The formula used for calculating effect sizes was the *d* statistic used by Beeson and Robey (2006) and Busk and Serlin (1992):

$$d = \frac{\bar{x}_{A_2} - \bar{x}_{A_1}}{S_{A_1}}$$

Participant 3 had zero variance in baseline scores for the first treatment set; in this case, the variance from the second treatment set was substituted. The calculated effect sizes are shown in Table 6 and are discussed relative to each participant's performance in the following sections.

Ideally, these effect sizes would be interpreted according to benchmarks, which provide qualitative judgments of the magnitude of effect sizes (i.e., a small effect versus a large effect; Beeson & Robey, 2006). Unfortunately, such benchmarks for verbal naming of verbs are not currently available, and so the primary utility of these effect sizes is for estimating relative effects among the study participants.

Participant 1 sentence completion probe results

Participant 1 completed nine baselines probes prior to the initiation of the first treatment set. Baseline values for Set 1 increased from the third to the sixth points, but then decreased continually to the ninth point, with the maximum probe value being 20% accuracy. Baseline values for Set 2 varied around the 20% level during the original baseline phase. Baseline values for Set 3 appeared to be rising slowly, while those for Set 4 appeared to be also rising slowly, though with marked variability.

It should be noted that there was a procedural error at the first treatment session of this phase; 5 of the 10 verbs designated for treatment were inadvertently replaced by five that had not received baseline measurement. In other words, at the first treatment session, treatment was applied to 10 verbs, but only five of them had been designated for treatment. This error was discovered prior to the second treatment session, and the five omitted verbs received treatment in a make-up treatment session before the second treatment session. Following that makeup session, the second treatment session, and all other treatment sessions afterwards, proceeded as planned, with treatment being applied only to the original list of 10 verbs that had received baseline measurement.

Participant 1 showed an improvement in performance starting with the very first sentence completion probe during the first treatment phase (prior to treatment session 2). Despite occasional performance at baseline levels, accuracy was at or above the highest baseline value for most probes during this phase, with 7 of 16 values at 30%. Then when treatment was being administered with Set 2, two probes were administered for Set 1 to measure maintenance. On these maintenance probes, Set 1 performance returned to baseline levels. However, performance on the 2- and 6-week follow-up probes returned

to the highest levels of the first treatment phase, indicating maintenance of treatment gains at that point.

Extended probing was completed with Set 2 prior to application of treatment with that set. Despite an overall slightly ascending slope for the six extended baseline probes, performance over the entire set of baseline probes was slightly descending, and was deemed stable enough to begin treatment. When treatment was applied with this set, improvements over the highest baseline level (30%) were not noted until the 11th probe, reaching a maximum of 40% at the last probe. It appears that the overall trend was rising, though slowly. Performance on Set 2 was near the mean baseline level at the 2- and 6-week follow-up intervals.

As seen in the third and fourth graphs, performance did not improve with Sets 3 or Set 4, the moderate and high concreteness generalization sets, with the exception of the one follow-up data point; the 6-week follow-up probe accuracy for Set 3 was higher than that of any other probe (60%).

As seen in the top graph for Participant 1, all probe values for the Set 1 fell above both CDC lines in the first treatment phase, indicating systematic behavioral change associated with treatment. For Set 2, however, the CDC criteria for demonstration of a treatment effect were not met, with only 8 of the 16 data points falling above both lines. Effect sizes for Participant 1 varied considerably. The effect size for the first treatment phase was fairly small (d = 0.18). In contrast, the follow-up effect size during the follow-up phase was considerably larger (d = 3.51), although the levels did not exceed the highest levels achieved during the treatment phase. The Set 2 effect size from the second treatment phase was more moderate (d = 1.02), and the follow-up effect size was actually

negative (d = -0.87). Effect sizes for Sets 3 and 4, the response generalization sets, were calculated at 0.42 and -1.09, respectively.

Participant 2 sentence completion probe results

Participant 2 completed seven baseline probes prior to the first treatment phase. Although an increase of one item occurred on the fourth probe of Set 1 (increasing from 0% to 10% accuracy), there was no change in performance between the fourth and seventh baseline probes, stabilizing at 10% accuracy. Similarly, Sets 2, 3, and 4 initially increased before leveling off at 20%, 10%, and 20%, respectively.

As seen in the top graph of Figure 4, there appeared to be an initial positive response with the application of treatment to the first set of low-concreteness verbs: the initial trend of the first three treatment probes rises rapidly by one item for two consecutive probes to a high of 30% accuracy. However, the remaining probes did not continue this trend or stay at the higher values, eventually returning to the baseline level of 10% accuracy.

Due to the apparent limited response to treatment in the probe scores, the question was raised as to whether Participant 2 (and Participant 3, discussed below) understood the connection between the treatment and the regular probes (i.e., that the treatment involved practicing the words being probed). The treating clinician decided to make this connection overt, and did so through brief discussions prior to the 10th treatment phase probe and following the 11th treatment session (which both occurred on the same day). No increases in accuracy were noted following this change in probe procedure.

Performance during the maintenance phase for Set 1 (during treatment of Set 2),

was variable (30% and 10%). The 2- and 6-week follow-up probe performance was then stable at 20%, which was slightly above the highest levels achieved in baseline (10%). There were no increases in accuracy noted with untreated sets following Set 1 treatment, with the exception of a slight increase with Set 4, which increased from 20% to 30%.

Treatment was initiated with Set 2 after relatively stable performance was observed with five extended baseline probes. Upon the application of treatment, performance with Set 2 vacillated between 10% and 20%, which did not exceed the highest baseline level. There were no sustained changes in performance with untreated Sets 3 and 4.

CDC criteria were not met for the first treatment application with only 2 of the 16 probe data points falling above both lines. Thus, a treatment effect was not demonstrated in this instance. For Set 2, 7 of the 16 data points during the treatment phase fell above both CDC lines. Therefore, a systematic behavior change did not appear to be associated with treatment. Follow-up probes at 2 and 6 weeks posttreatment remained at baseline levels for Set 2. Effect sizes were mostly positive. Set 1 showed an effect size of 0.8 for the first treatment phase, and 2.67 for the follow-up phase. Effect sizes for Set 2 were -0.05 and -.59 for the respective treatment and follow-up phases. The effect size for Set 3, the moderate concreteness generalization set, was nil ($d = 0.00$), but positive for Set 4, the high concreteness generalization set ($d = 0.94$).

Participant 3 sentence completion probe results

As shown in Figure 5, Participant 3 completed five probes in the baseline phase with low, stable levels of performance demonstrated for all sets. During the treatment

phase, a few probes showed improvement of one item; as with Participant 2, the lack of a more robust or sustained response to the treatment raised the question of whether the participant understood the connection between the probes and the words practice in treatment, and the clinician attempted to elucidate this point. The clinician had a brief discussion with Participant 3, prior to the 10th treatment phase probe and following the 11th treatment session, which both occurred on the same day. Response to treatment appeared unaffected by this discussion. The maintenance phase and follow-up phase probes were all at the 0% accuracy level.

The second treatment set of low concreteness verbs for Participant 3 received five extended baseline probes, with the highest being at 20% accuracy. The overall trend for these five extended baselines was nonascending and flat, and so stability was demonstrated and treatment was applied to this set. The initial three probes of this second treatment phase were higher than the last extended baseline, although the same as the highest extended baseline value. After these first three probes, probe performance decreased and leveled out at 10% for the 8th through 16th probes. In order to encourage gains beyond the highest baseline level, following the 10th session, the patient was again reminded by the clinician about the identity of the treatment targets being the probe targets; however, probe performance remained unchanged. Set 2 probe performance at the 2- and 6-week follow-up probes was identical to the last nine probes of the treatment phase (10% accuracy). Sets 3 and 4, the moderate and high concreteness verb lists, displayed no evidence of any persistent change in performance.

Despite the CDC lines for the first treatment phase being collinear with the x-axis, only 5 of the required 12 probes for Set 1 were over both lines, and so a treatment effect

was not demonstrated. In the second treatment phase, the levels of these lines were such that 14 of the 16 probe scores were higher, and so a treatment effect was technically demonstrated for Set 2 according to the CDC, despite no treatment phase probe surpassing the level of the highest baseline probe. Effect sizes for Participant 3 were somewhat small relative to those of the other participants. The treatment phase effect size for Set 1 was 0.74, while that of the follow-up phase was nil ($d = 0.00$). Both Set 2 effect sizes, the treatment phase and follow-up phase effect sizes, were an identical 0.54. The untreated generalization sets, Sets 3 and 4, had a very small ($d = 0.18$) and a nil ($d = 0.00$) effect size.

Sentence completion probe results summary

In summary, two of the three participants demonstrated an acquisition effect for the targets during one of their respective treatment phases: Participant 1 in treatment phase one, and Participant 3 in treatment phase two. In the other treatment phases for Participants 1 and 3, and for both treatment phases for Participant 2, fewer than 12 of the 16 total probe values were higher than both CDC lines, and so a treatment effect was not demonstrated. The Set 1 gains for Participant 1 were maintained at the 2- and 6-week follow-up intervals. Participant 2 had no demonstrated gains associated with treatment, though follow-up levels for Set 1 at 2- and 6-week intervals were slightly higher than baseline levels, being at 30% accuracy. Participant 2's other sets did not show any changes from baseline levels. Despite systematic change associated with the second phase treatment according to CDC criteria, Participant 3 showed no changes above baseline levels for any of the sets.

The absence of sustained change in accuracy in sets not receiving treatment indicates a lack of response generalization. For all three participants, there was a lack of response generalization to Set 2, a low concreteness set, while Set 1 was receiving treatment, as well as a lack of response generalization to Sets 3 and 4 during both treatment phases.

Pre-Post Assessment Results

In addition to the follow-up sentence completion probes, the planned post-treatment assessments were also administered. The results of these assessments are shown in Table 7. Note that the table also includes the corresponding pre-treatment scores for the posttreatment assessments to facilitate comparison.

Participant 1 showed a 7.2 increase in WAB-R AQ. This increase in AQ was larger than the standard error associated with the WAB-R standardization sample (SEM = 2.52; Holland, Fromm, Forbes, & MacWhinney, 2016). The improvements included increases on spontaneous speech, repetition, and naming and word finding subscores. On the OANB, action naming change was negligible, but object naming increased from 78/162 to 93/162, a 15-point increase. This change is greater than two standard deviations of the mean score of the sample described in the test manual (Druks & Masterson, 2000), which was the criterion used to detect change by Furnas and Edmonds (2014). On the Nicholas and Brookshire task, CIUs per minute decreased less than the standard error (Boyle, 2014), although total number of CIUs increased slightly. Standard error data from Boyle (2014) were used for comparing CIU-related measures instead of the original Brookshire and Nicholas (1994) data because Brookshire and Nicholas did

not include data on CIUs per minute, which Boyle had found to be stable enough for measuring change on the individual level. Note that according to Boyle, total number of CIUs may not be stable enough for comparing individual pre-post measurements, and so an individual increase on this measure in the current study was not considered significant. Normative data are not available for the version of the TALSA that was administered, and so it is not clear whether the increase in digit span was significant or not, though the word repetition span increase was most likely negligible. Sentence comprehension according to the Sentence Comprehension Test of the NAVS improved slightly, though again, normative data are not available. Functional communication, as measured by the patient-reported ACOM survey, decreased slightly, but more than the standard error.

Posttreatment test comparisons indicated that Participant 2 also increased in WAB-AQ, with a modest 4.4 increase. This increase is also larger than the instrument's reported SEM of 2.52 (Holland et al., 2016), and was primarily due to a large increase in the spontaneous speech subscore. Both object and action naming were essentially unchanged. Participant 2 showed a large increase in CIUs per minute during the Nicholas and Brookshire discourse tasks (greater than the standard error), suggesting an increase in informativeness efficiency, even though the total number of CIUs changed less than the standard error (Boyle, 2014). The relatively small changes in digit and word span, as measured by the TALSA, were again difficult to interpret, due to the paucity of normative data. Sentence comprehension appears to have improved slightly, as measured by the Sentence Comprehension Test, but normative data are not available for full comparison. The ACOM score was within the standard error when the times were compared.

Participant 3 showed a negligible change in WAB-R AQ. Action naming on the OANB improved more than two *SD* of the sample described in the test sample (see above). Object naming decreased slightly more than two *SD*. Informativeness efficiency, as measured by CIUs per minute on the Nicholas and Brookshire tasks, improved slightly, but less than the standard error, while the total number of CIUs changed as much as, but not more than, the standard error (Boyle, 2014). Digit span improved and word span decreased. Communicative effectiveness, as measured by the ACOM, increased by more than the standard error, suggesting an improvement post treatment.

Treatment Performance Data

Various treatment data were gathered from performance during the treatment sessions themselves in hopes that they would provide insight into the development of the verb networks for the participants over the course of the treatment. The central therapy task involved clinician-supported production of SVO sentences using the target verb, and throughout treatment, data were collected as to the independence of the participant in producing a subject for a given verb-object pairing, or an object of a given subject-verb pairing. The data collected involved tracking the independence of the participant in producing these, i.e., whether or not clinician support was needed prior to successful production of a plausible subject or object. The data collected from these steps are displayed in Figure 6. These data are grouped by participant, and both phases are averaged together; data points on the "beginning," "mid-treatment," and "end" positions in treatment refer to the average ratios of independent production in sessions one through three, eight and nine, and 14 through 16, respectively. These subject and object

production data show that two of the three participants improved in subject production, and the same two, or possibly all three, participants improved in object production, when comparing different positions in time across the treatment phases.

Figure 7 shows the verb repetition treatment data for all three participants, with three stages of the treatment phases on the x-axis, and each participant's ratio for independent performance. Data for the two treatment phases were collapsed (averaged at each time point) for each participant. The "beginning" of the phase was calculated as the average ratio of performance of the first three sessions in each phase, "mid-treatment" was the average ratio of treatment sessions eight and nine, and the "end" was the average of the last three sessions in each phase. The three participants varied in their abilities to perform this task; these abilities varied between participants and stage of the treatment phase. The data show that Participant 1 improved over the course of treatment in his ability to produce the target verb in response to an SVO sentence, going from 25% independent accurate productions to nearly 75%. It appears that Participant 2 and Participant 3 may have also improved, but only marginally. Ceiling and floor effects may have interfered.

The sentence repetition treatment data are displayed in Figure 8. These data are graphed in the same way as the immediately preceding graph. Similar to the verb repetition data from step one, these data also show that Participant 1 improved over the course of treatment (37% to 60%), and that Participant 2 and Participant 3 both remained near ceiling and floor, respectively. From these two graphs, it appears that Participant 1 improved in treatment task performance throughout the treatment phases, whereas Participant 2 and Participant 3 did not.

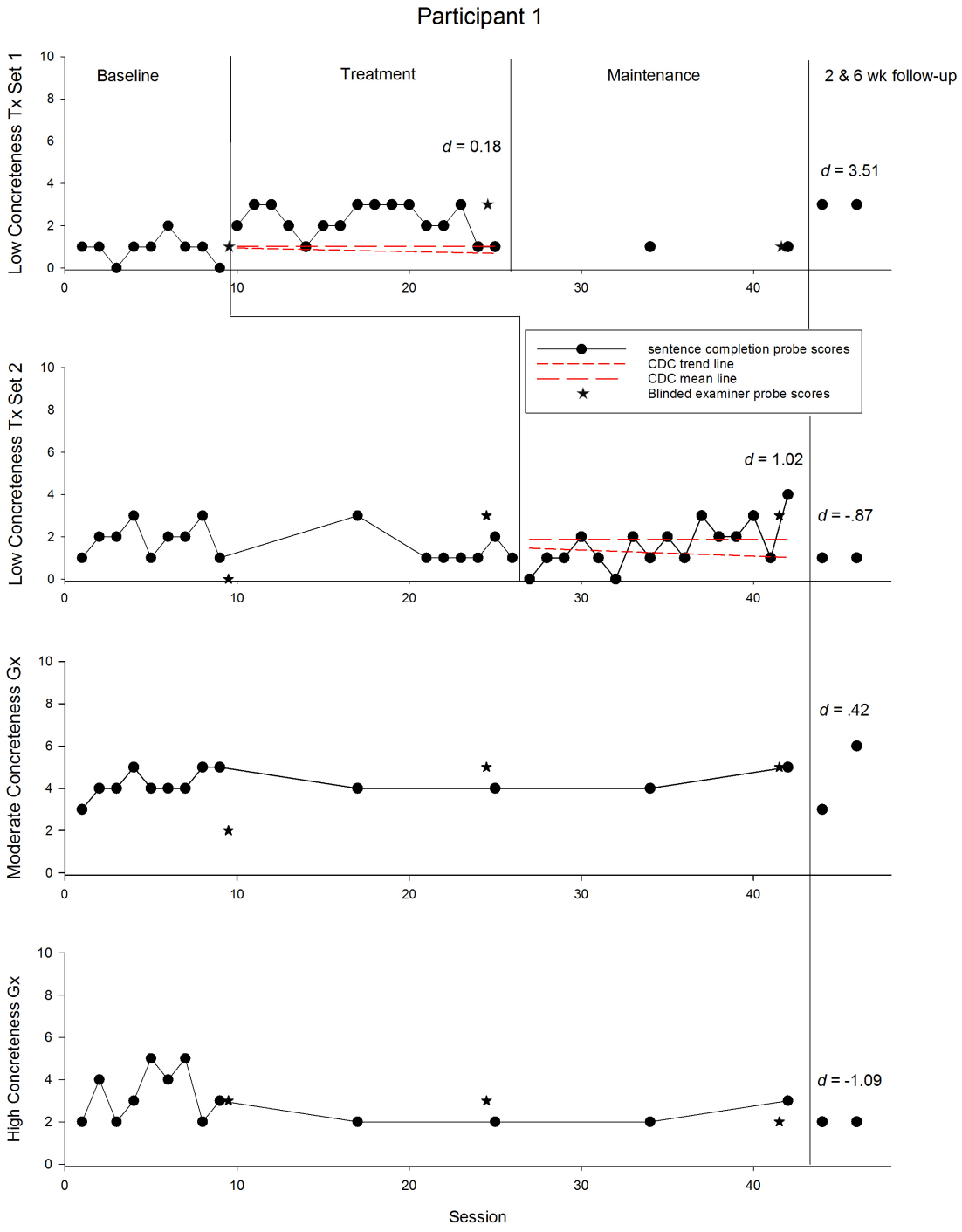

Figure 3. Sentence Completion Probe Graphs for Participant 1

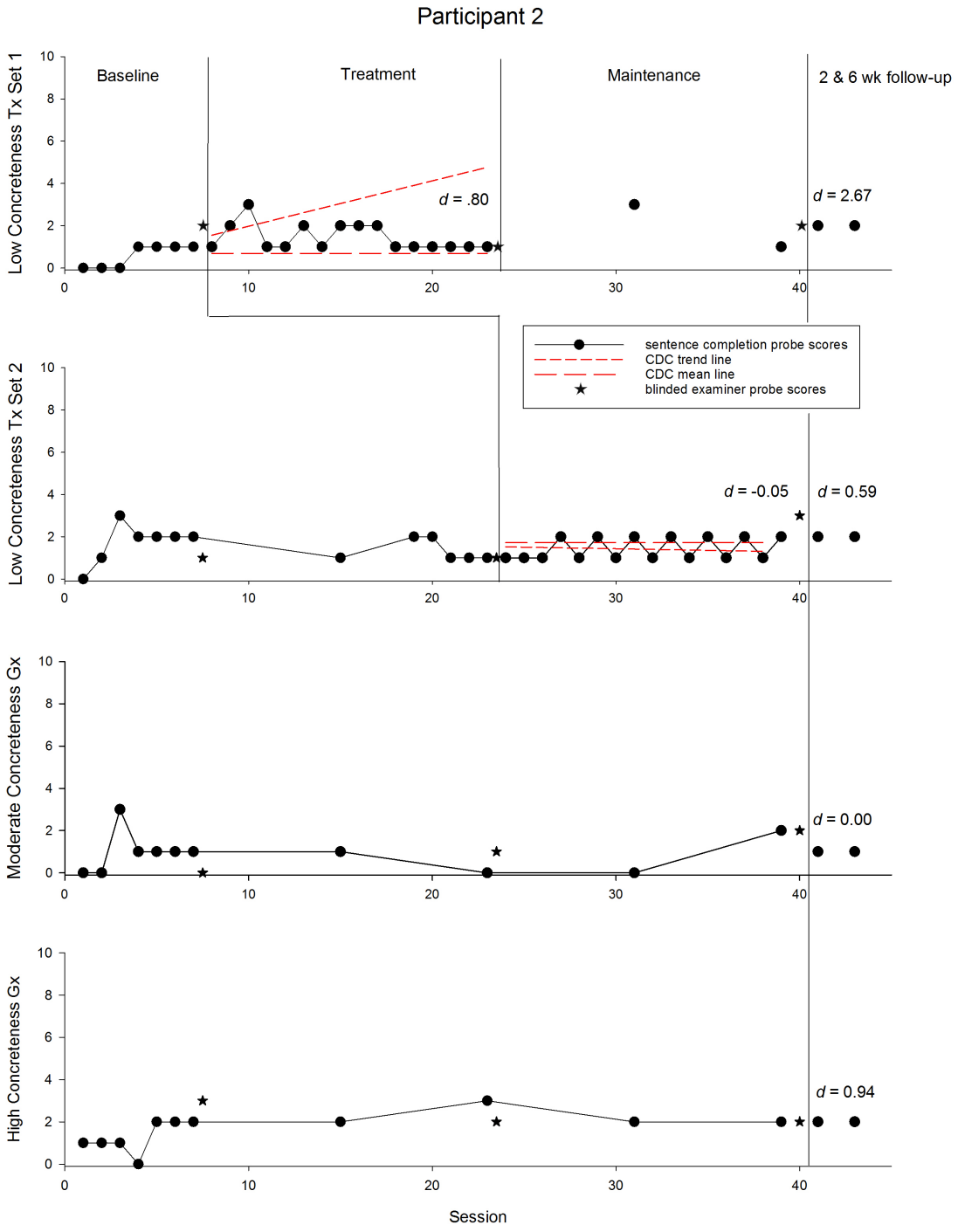

Figure 4. Sentence Completion Probe Graphs for Participant 2

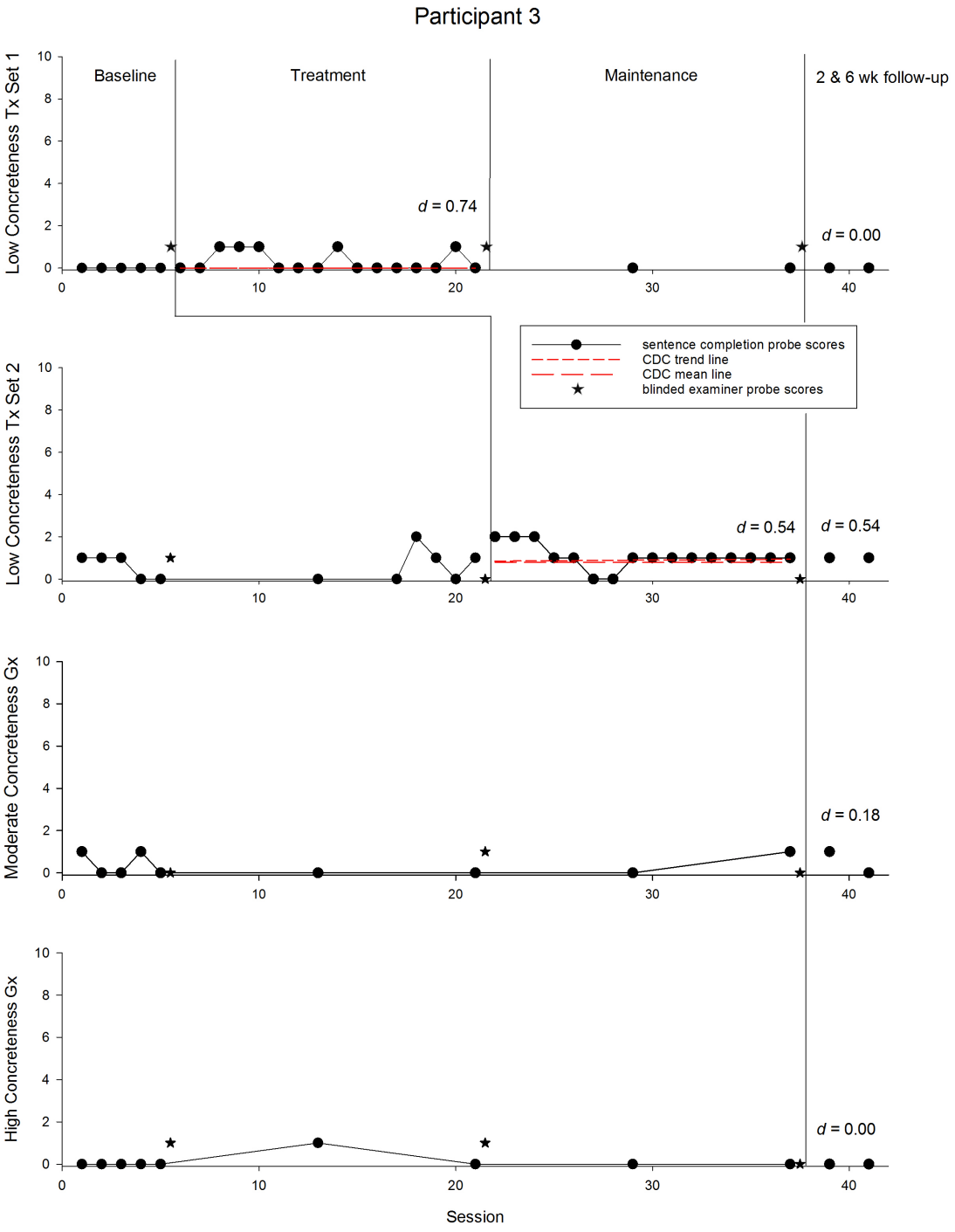

Figure 5. Sentence Completion Probe Graphs for Participant 3

Table 6

Sentence Completion Probe Effect Sizes by Phase and by Participant

	Low Conc. Tx Sets				Untreated Gx Sets	
	1st Low Conc Tx Set		2nd Low Conc. Tx Set		Mod. Conc. Gx Set	High Conc. Gx Set
Partici-pant	Tx ES	Follow-up ES	Tx ES	Follow-up ES	Follow-up ES	Follow-up ES
Part. 1	0.18	3.51	1.02	-0.87	0.42	-1.09
Part. 2	0.80	2.67	-0.05	0.59	0.00	0.94
Part. 3	0.74*	0.00	0.54	0.54	0.18	0.00

*Notes: Tx = treatment. ES = effect size. Gx = generalization. Conc. = concreteness. Moderate = mod. Part. = participant. * Uses variance from 2nd list baselines due to zero variance.*

Table 7

Pre- and Posttreatment Assessment Results

	Participant					
	Part. 1		Part. 2		Part. 3	
Measure	Pre-tx	Post-tx	Pre-tx	Post-tx	Pre-tx	Post-tx
LANGUAGE						
WAB-R AQ (Kertesz, 2007)	65.6	72.8*	65.7	70.1*	42.3	41.7
Spontaneous speech subscore	12	13	11	14	9	7
Auditory Verbal Comprehension subscore	9.2	9.8	7.45	6.45	7.05	7.95
Repetition subscore	4.2	5.2	7.6	7.8	1.3	1.8
Naming and Word Finding subscore	7.4	8.4	6.8	6.8	3.8	4.1
OANB (Druks & Masterson, 2000)						
Actions (A + B) (100)	50	48	57	56	2	7**
Objects (A + B) (162)	78	93**	110	112	18	13**
N&B Discourse Task--CIUs / min. (Nicholas & Brookshire, 1993)	19.52	17.12	15.89	23.03*	1.76	2.63
CIUs	232	242	304	299	23	29
TALSA Digit and Word Span (Martin et al., 2010)						
Digits--repetition	3.05	4.05	6.3	6.2	0.15	1.05
Words--repetition	2.05	2.2	4.1	5	1	0.15
Sentence Comprehension Test, NAVS (Thompson, 2011)	27/30	29/30	20/30	25/30	16/30	15/30
FUNCTIONAL COMMUNICATION						
ACOM (Hula et al., 2015) T-score (SEM)	52.25 (1.88)	45.96* (1.48)	56.36 (1.58)	55.18 (1.62)	30.83 (1.82)	35.52* (1.45)

*Note: * = change is greater than standard error of measurement. ** = change is greater than 2 SD of the mean as described in the OANB manual (Druks & Masterson, 2000). WAB-R: Western Aphasia Battery-Revised. AQ: aphasia quotient. OANB: Object and Action Naming Battery. N&B: Nicholas and Brookshire. CIUs: correct information*

Table 7 continued

units. TALSA: Temple Assessment of Language and Short-term Memory in Aphasia. NAVS: Northwestern Assessment of Verbs and Sentences. ACOM: Aphasia Communication Outcome Measure. SE: standard error.

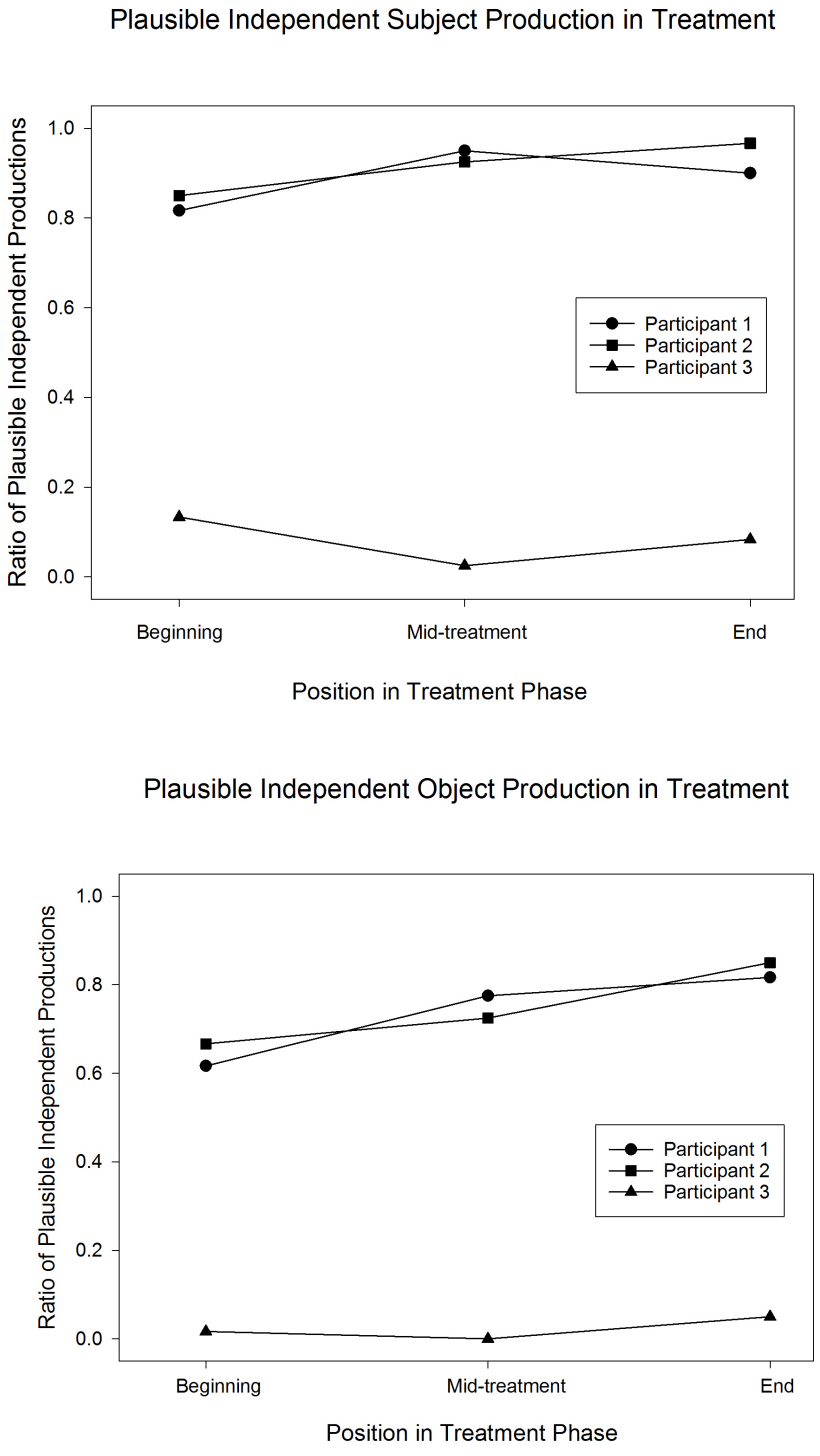

Figure 6. Treatment Data on Subject and Object Production

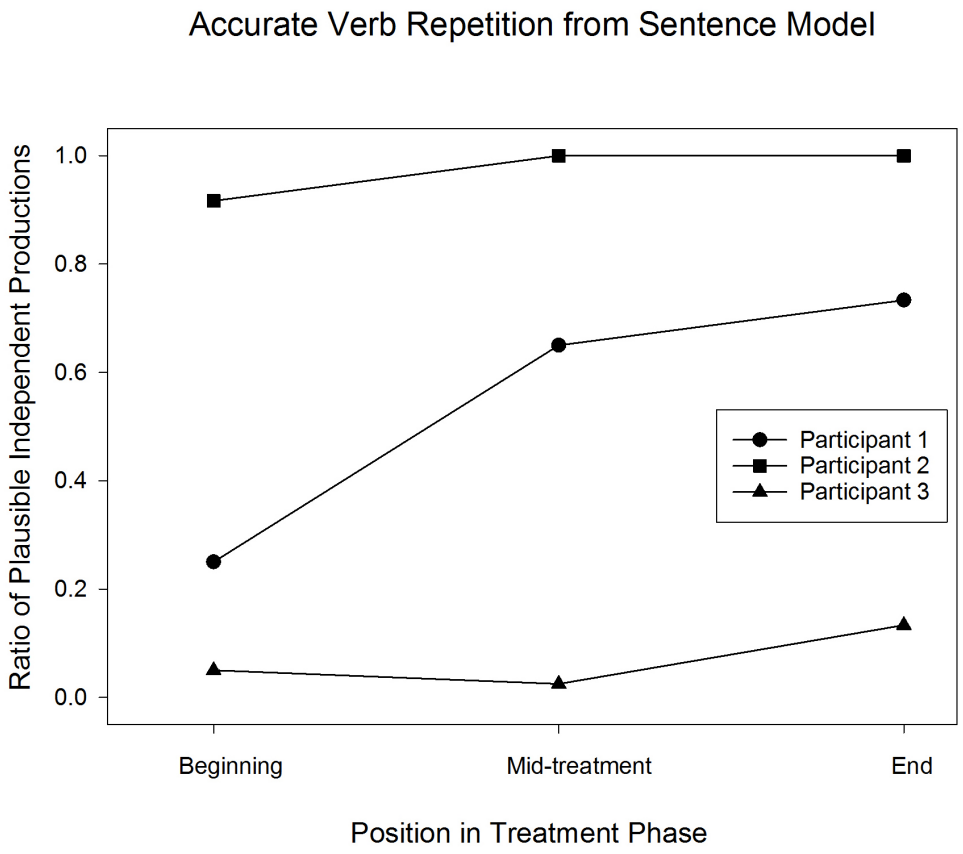

Figure 7. Target Verb Repetition During Treatment

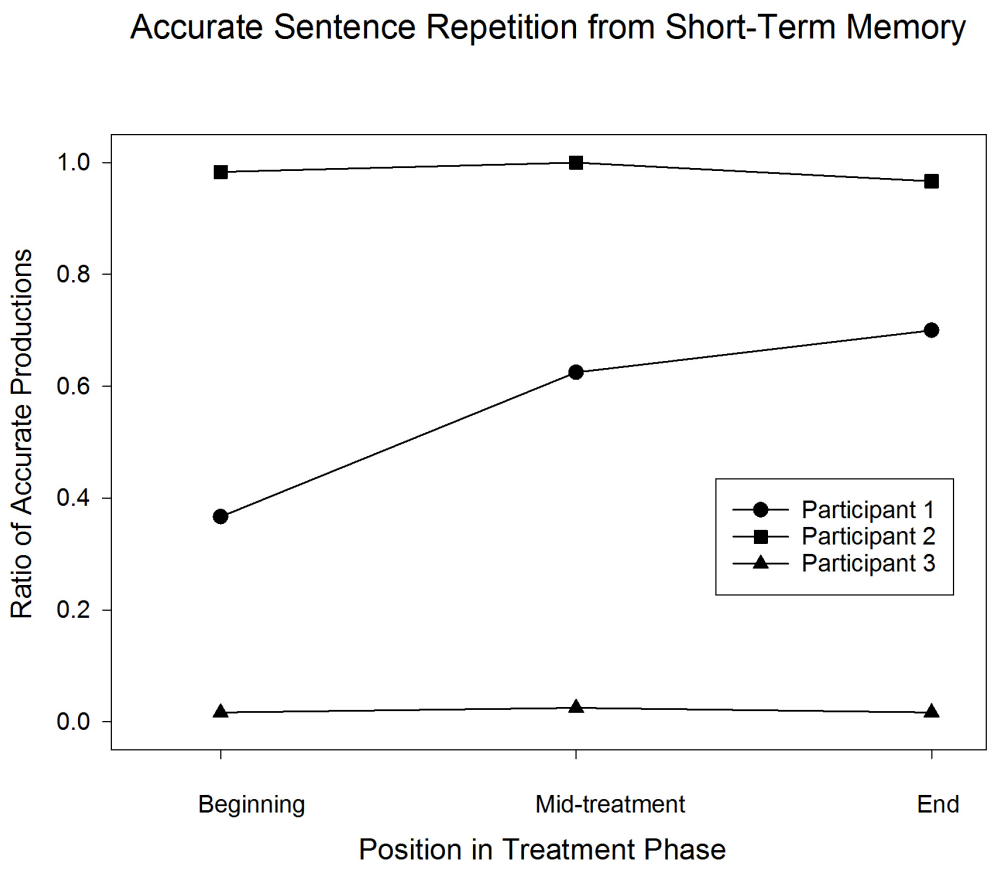

Figure 8. Sentence Repetition During Treatment

DISCUSSION

This treatment study was designed to answer a specific set of research questions centered on the efficacy of a novel aphasia treatment for low concreteness verbs. The results of the collected data for each research question are discussed in turn.

Question 1: Acquisition Effects

The first question focused on the effect of the treatment on verbal naming of verbs with low concreteness in the study participants. The primary measure designed for this purpose was the sentence completion probe, which was administered to the participants as discussed above in the methods. The results of the probes indicated that according to the CDC (Fisher et al., 2003), systematic change was demonstrated for two of six applications of treatment, or one phase each for two of the three participants; this is problematic, as it shows no replication within participants and little across participants. Also, the two replications fall one short of the recommended standard of at least three replications (Kratochwill et al., 2010).

Further, even in the two cases of systematic change observed with the help of the CDC, the clinical impact of the changes observed was small or nonexistent. In other words, although the differences in probe data for the baseline and treatment phases suggest systematic changes associated with the treatment, these changes appear to have little or no clinical significance. To illustrate, Participant 1's highest treatment phase data

show an increase of only 10%, or a single item, over the highest baseline value. Likewise, Participant 3's second treatment phase probe data technically met CDC criteria, but without clinical effect, as the difference between "effect" and "no effect" in this case was much smaller than the unit of measurement, a single word. From a clinical perspective, it is also concerning that the final level Participant 3 achieved on the last 11 probes for the second treatment list was lower than the highest baseline value. These illustrations suggest an inadequacy of the treatment in effecting sustained and clinically meaningful improvements in performance on the sentence completion probes.

Despite the limitations, the two positive replications provide support for the concept of the treatment, and further analysis of the probe data suggests that the participants' verb retrieval skills were impacted by the treatment, even when systematic change did not occur. Item-level data from the probes show that after missing them in the initial baseline phase, all three participants correctly answered multiple probe items at least one time; most of these items were from the treatment lists. Treated items that were never answered correctly in baseline probes, but were answered correctly at least once in the probes following, are listed in Table 8. These data suggest possible transitory effects of the treatment on retrieval of the target verbs. Note that these probes were all administered at least 1 full day after the previous treatment session, and several days in many cases, and so they may be said to represent a short-term maintenance of the trained behaviors (Wambaugh et al., 2014). Interestingly, changes in the reverse direction (items answered correctly in baseline but missed during treatment probes) were relatively few, numbering five total for all three participants combined ("tackle", from Participant 1's moderate concreteness list; "tune," from Participant 1's high concreteness list; "explain"

and “gain,” from one of Participant 2’s low concreteness lists; and “enter,” from Participant 3’s high concreteness list). In addition, this latter set of verbs appeared more random, with less emphasis on the low concreteness verbs from the treatment lists. Thus from the former example, it appears that in the probes, participants were inconsistently accessing verbs practiced in treatment; i.e., the verbs occasionally received activation due to the effects of the treatment.

For Participant 1 and Participant 2, the errors in response to a given sentence completion probe stimulus were largely consistent and predictable: for example, all of Participant 1’s errors for the low concreteness item “maintain: While running a race, keep a steady pace. Too fast a pace may be difficult to—” involved some form of “to breathe” such as “breathe” or “breathing.” The verb “to breathe” is topically relevant to the meaning of the sentence stem (running in a race), but it is not a synonym of “to maintain,” nor was it one of the responses given by the healthy adults in the norming study. With no feedback during any of the probes, many of Participant 1’s and Participant 2’s responses became rote during later baseline probes, respectively. This may have caused resistance to further change. Therefore, if sentence completion items are used in the future, some element of feedback and/or reduced probing schedule should be used in order to prevent habituation to incorrect responses, especially those that are topically related to the sentence but unacceptable as answers to the sentence completion stems. Specific feedback during probes is contrary to the basic idea of probes, but sentence completion practice could be built in to the treatment in order to encourage regular re-analysis of the sentence completion stems and to avoid rote responses.

Although the data on naming improvements are limited, examination suggests

that semantic paraphasias made in baseline measurements were more resistant to change than phonological paraphasias. Participant 1 made improvements on two verbs as a result of the first phase of treatment; these improvements appeared to involve the resolution of phonological paraphasia baseline responses. As an anecdote, during one treatment phase probe, Participant 1 made a comment that suggested he was habituated to a specific (semantically incorrect) response despite beginning to acquire a given target verb. For the low concreteness item "mourn: My neighbor just lost his grandmother. Her death we all—" Participant 1 had been responding "miss her" very consistently. "Miss her" shows a certain amount of comprehension of the sentence stem and is a semantically relevant response; however, it is not a synonym of "mourn," nor is it a response that anyone in the norming sample gave, and so it was not counted as accurate. Then in his response on probe 4 of the treatment phase in which "mourn" was being treated, Participant 1 said: "mourn…[pause]…miss her. Same thing." In subsequent probes, he returned to answering with "miss her" until the 11th probe, at which point he started responding consistently with "mourn." This comment may also suggest a level of satisfaction with the habituated response. With this satisfaction, and with the lack of specific feedback from the clinician, there appeared to be little motivation to change responses from probe to probe. In the case of Participant 1 and the target, "to mourn," with additional practice in treatment, Participant 1 eventually strengthened the representation of "mourn" to the point that he could use it more reliably, although at probe number 11, it was too late to maximally impact overall treatment response as measured on the phase level. However, this eventual self-correction late in the course of the treatment phase suggests that continual therapy may eventually correct habituated patterns of semantically incorrect

responses as well. It may be worthwhile in the future to select treatment targets based on a dynamic assessment that favors selection of stimuli that elicit phonological paraphasias, as these may be most responsive to the treatment.

On the other hand, Participant 1's comment on the equivalence of two responses may also suggest he had fine-grained sentence comprehension or semantic deficits: while the response shows comprehension of the gist of the sentence stem, the participant's specific response was not among those used by the norming study participants. The phenomenon could also be due to incomplete mental representations as to the selectional restrictions for the target verbs and for their incorrect responses. For example, acceptable objects of "to mourn" include a specific person, or the death of a specific person or loss of a certain item. Acceptable objects of "to miss" also include a specific person, but not the death of a person or loss of an item. Thus, the selectional restrictions of the verbs incompletely overlap, such that while they are similar in meaning, they are not reliably interchangeable. Thus, improvements in accuracy of verbal naming could be masked by penalizing responses that show gist comprehension without showing knowledge of specific selectional restrictions. Evaluation of the source of the retrieval errors (i.e., examination of impairments in level of lexical processing) appears to be warranted.

A separate issue has to do with the variety of correct responses given by the norming participants to individual sentence stems, and therefore, accepted as correct answers when given by the participants during probes. For example, acceptable answers for the item, "The firefighters tell the girl to jump and they will catch her. The firefighters are who the girl needs to—", there were a variety of answers by the norming participants, including "trust," "watch," "follow," and "fear." Regardless of their interchangeability by

healthy speakers in response to a single sentence stem, these verbs do not appear to be parts of the same verb networks; therefore, repeated access, practice, and attempts to expand the verb network in treatment, which focused on "to trust," would not be expected to generalize to other verbs outside the network. Thus, it could be said that treatment was biased towards a specific interpretation of the sentence completion stems, and assuming a participant was interpreting the sentence stem in a different way, there would be little chance for retrieval improvement as the verb network being targeted would be different from the one the participant was attempting to access according to their interpretation of the sentence stem.

Further evidence in support of positive effects of treatment, despite response habituation or other factors dampening probe response accuracy, comes from treatment data. These data come with a few caveats: Treatment data are typically considered less authoritative, as they represent data collected in a more supported environment; for instance, performance on the second item may be influenced by the treatment steps recently rehearsed with the clinician in response to the first item. Further, session-initial probe data represent short-term maintenance of target behaviors, with probes taking place anytime from 1 to 3 days following a treatment session, while treatment data are not separated in time from the treatment session and its accompanying clinical support, and therefore, do not represent short-term maintenance. However, Wambaugh et al. (2014) found high correlations between verb naming in probes and in treatment in three of their four participants. Although a fourth participant showed gains in therapy that were not reflected in probes, the findings overall suggest the potential utility of treatment data for understanding responsiveness to treatment. It is assumed then that the treatment data may

provide insight into how a participant's need for clinical support in the selected therapy tasks may have evolved over the course of treatment.

Theoretically, improved abilities to accurately select appropriate subjects and objects for a given word could have involved expansion of or increased flexibility with the mental representations of verb networks in the absence of verbal naming improvement in the sentence completion probes. These treatment data suggest that Participants 1 and 2 improved in this area, whereas Participant 3 did not. This finding does not match the sentence completion probe results, as Participant 2 did not show treatment-associated improvements in verbal naming, and Participant 3, though technically having demonstrated a treatment effect on accurate verbal naming on sentence completion probes, failed to improve on baseline performance.

The treatment data on verb repetition from a sentence model, and sentence repetition after a 5-second delay, highlighted the fact that only Participant 1 appeared to be responding to the treatment. Participants 2 and 3 did not improve on these measures. These data are arguably the most similar to the verbal naming task the treatment was directed towards. This appears to be a reasonable assumption as Participant 1 was the only one to show a systematic change in the sentence completion probe data, although, as discussed, this systematic change was lacking in clinical meaningfulness.

Participant 2 improved in subject and object production, but not in verb and sentence repetition. It is likely that the verb and sentence repetition tasks were more sensitive to ceiling effects, and that subject and object production provided a challenge with room for improvement.

Only Participant 3 appears to have had minimal to no changes in response pattern

from the beginning of treatment phases to the end. There may have been multiple reasons for this difference. For one, Participant 3's probe responses rarely consisted of a single word, unlike Participant 1's and Participant 2's. Participant 1's sentence completion probe responses typically included multiple unrelated words and paraphasias. Occasionally, her responses contained circumlocutory phrases or words semantically relevant to the topic of the sentence stem, but typically, they were strings of words unrelated to the topic of the sentence. This was a qualitative difference in response type, but it may be reflective of underlying neurological differences contributing to a differential response pattern. Participant 3's stroke was hemorrhagic in origin and impacted the basal ganglia; Participant 1's and Participant 2's strokes were ischemic, and damage to the basal ganglia was not mentioned in medical records, although actual scans were unavailable for all three participants. Participant 3 also had the lowest aphasia quotient, the most impaired object and action naming at the outset of the study, more impaired sentence comprehension, and drastically reduced informativeness efficiency as measured by CIUs. These may have reduced her response to treatment as seen on probes and in the treatment data.

Question 2: Response Generalization Effects

The second hypothesis question asked what response generalization effects the treatment would have. Overall, there does not appear to be evidence to suggest that response generalization occurred; untreated verbs did not improve during the treatment phases, as seen on the probes of all sets. This would suggest that response generalization was not occurring. Although one of the three participants, Participant 3, improved a

small amount on the action naming subtests of the OANB, there was no apparent pattern of increased accuracy in naming of untrained verbs for the three participants. Thus, it does not appear that the treatment led to increases in untreated verb retrieval.

This lack of response generalization reflects the vast majority of the other verb retrieval treatment literature (Webster & Whitworth, 2012). In a few studies, it has been shown that response generalization may be possible. The authors of the VNeST articles have claimed positive response generalization to untrained verbs in persons with aphasia as a result of their treatment (Edmonds et al., 2014; Edmonds et al., 2009). However, note that there are protocol differences between probes and stimuli, including between the VNeST studies and the present study, that likely affect response generalization results. The VNeST studies specifically design untreated generalization stimuli to be semantically related to treated target stimuli, whereas the present study did not deliberately set up semantic pairings between treated and untreated verbs. Also, the VNeST studies overwhelmingly use verbs with high concreteness for treatment and generalization, whereas the present study used only low concreteness verbs in treatment, and a variety of concreteness levels for examination of response generalization. In addition, the elicitation procedure differed, with VNeST eliciting verbs via a picture presentation and a request to produce an SVO sentence, whereas the present study used sentence completion stimuli and required only the verb. Thompson et al. (2013) also found response generalization to untreated verbs as the result of an argument structure enhancing treatment; however, this generalization is relatively unspecified: little more is known about the process of generalization other than that it occurred from treated three-place verbs to untreated two- and one-place verbs. It is not clearly specified if there are

specific semantic criteria necessary in list formation in order to replicate the effect. It is possible that future modifications to the present study, such as pairing treated and untreated lists by semantic relatedness, could enhance response generalization to verbs. Various items in the present study were semantically related by happenstance; however, the general lack of response in probes precludes the usage of this study's data as an adequate comparison to these other studies. For now, response generalization to unrelated verbs remains elusive.

Question 3: Maintenance Effects

The third research question was whether the treatment would be associated with maintenance effects. With the selected design, maintenance data were collected for the first treated set while the second set was receiving treatment, and follow-up data were collected on all four verb sets 2 and 6 weeks following the end of the second treatment phase.

Maintenance during the second treatment phase

Maintenance of improvement during the first treatment phase was measured for all lists for all participants, but only Participant 1 had a phase one systematic change, and so he alone had an opportunity to maintain change in the first treatment set while the second set was receiving treatment. The two probes of the first set administered at this time showed poor performance, suggesting the changes associated with treatment had already reversed. However, note that the maintenance phase included only two probes.

Follow-up probes

Follow-up probes were completed for all four sets of verbs for all three participants. These probes were completed as close as schedules would allow to 2 and 6 weeks following the last treatment session (between 11 and 16 days for the 2-week probe, and between 39 and 49 days for the 6-week probe). Participant 1's follow-up probes for the set treated first showed recovery of original phase one changes, although they had been reversed during the maintenance phase. Note that Participant 1's follow-up probes for the set treated first actually occurred closer to 6 and 10 weeks following the end of the first treatment phase. Participant 3's 2- and 6-week follow-up probe scores for the second treated set were the same as the last nine probes of the immediately preceding treatment phase. Further opportunities for describing the maintenance of treatment changes at specified follow-up points were limited, as treatment-associated changes were only demonstrated for two of six possible opportunities. These data are too limited to make reasonable generalizations about maintenance of changes associated with the treatment.

Question 4: Effects on Formal Speech and Language Assessments

The final research question centered on the effects the treatment would have on formal speech and language assessments, especially naming and discourse measures, performed prior to and following the two treatment phases.

Overall, two of the three participants, Participant 1 and Participant 2, showed significant increases in WAB-R AQ and possible increases in sentence comprehension on the NAVS. These results are similar in pattern, though smaller in size, than those reported

for several of the participants in a group study examining the effects of VNeST (Edmonds et al., 2014). As with Edmonds et al. (2014), these increases appeared spread over multiple subscores on the WAB-R. There may be many reasons for the smaller changes in WAB-R AQ scores seen in the present study. Aside from differences in the VNeST treatment administration protocol and the present treatment administration protocol, other differences included the participants' aphasia types and severities, as well as the possible larger total dosage of treatment in the VNeST studies. The present study involved only persons with moderate Broca's aphasia, whereas Edmonds et al. predominantly involved milder cases of aphasia, with anomic aphasia being the most frequent diagnosis in their sample. It appears that persons with moderate or severe cases of aphasia may respond less to treatment than those with more mild cases, as Edmonds and Babb (2011) demonstrated with VNeST.

Changes in naming performance following the treatment were mixed and unpredictable. As mentioned previously, Participant 3 showed gains in action naming accuracy on the OANB, while Participant 1 improved in object naming and Participant 3 decreased in object naming accuracy. These findings are too limited to make confident generalizations about the effect of the treatment on naming of actions or objects.

Table 8

Items Missed in Baseline but Answered Correctly During Other Probes

Participant 1 low conc. tx list 1	enforce, expect, mourn
Participant 1 low conc. tx list 2	appoint
Participant 2 low conc. tx list 1	keep, save, trust
Participant 2 low conc. tx list 2	describe, forget
Participant 2 high conc. gx list	push
Participant 3 low conc. tx list 1	forget, keep, gain
Participant 3 low conc. tx list 2	like, guess
Participant 3 high conc. gx list	hit

CONCLUSION

The present project was an investigation of a novel aphasia treatment designed to target low concreteness verbs. The theoretical basis was that of expanding verbs' semantic networks and increasing the verbs' concreteness through pairing with common and plausible subject and object referents. While the sentence completion probe data suggested limitations in the treatment's ability to consistently improve accuracy of verbal naming in response to sentence completion stems, data from the treatment sessions themselves suggest that true improvements in verbal production of target verbs may not have been adequately measured. Clearly, further research in this area is warranted.

Limitations of the Study and Directions for Further Research

There were several limitations of the study, as well as many possible avenues for further work in the line of this treatment approach. As discussed at length above, there is a gap in the verb retrieval treatment literature for treating verbs with low concreteness, which verbs are important and common in functional communication. Therefore, this line of research should be continued.

Limitations in the study included apparent habituation of response to probe items; future studies may circumvent this by reducing probing frequency or by promoting re-analysis of sentence completion stems by the participants each time they hear each

stimulus. Further, the sentence completion method for eliciting verbal production of target verbs appeared to have limitations. For the reasons discussed above, the sentence completion stimuli appeared to have varied excessively in their potential for eliciting the target verbs and measuring change in verbal naming, and measuring verbal naming of verbs with low concreteness proved to be the foremost challenge of the present study. Therefore, the most important direction would appear to be the further refinement of outcome measures for the treatment. Typical picture confrontation methods do not work well for verbs with low imageability. Sentence production with a target verb is a possible option; however, as in the pilot study, sentence production scoring is difficult to operationalize. Nevertheless, additional options exist that may be explored as potential outcome measures for future studies. For example, Bastiaanse et al. (2015) use a combination of pictures and orthographic sentence completion prompts in order to constrain the cloze probabilities of sentence completion items. Additional options include naming to definition or to lists of synonyms or other semantic associates. Development of outcome measures for verb retrieval with verbs with low concreteness should include norming of these and other potential techniques with typical speakers and population-based samples in order to better understand typical performance for comparison and to develop stimuli for such treatment studies.

Additional future directions for this treatment research include implementing strategies to further elaborate the mental networks of abstract verbs. The SVO structure emphasized in the present study appeared to lend itself well to practicing low concreteness verb targets with relevant words that likely strengthened the mental representation of those verbs within the minds of the participants. Judging from

incomplete acquisition of target verbs, however, it is likely that the approaches described herein did not go far enough in developing the impoverished or damaged networks in aphasia. The therapeutic techniques in this study focused on SVO sentence production with target verbs. However, the related VNeST treatment (Edmonds et al., 2009) stimulates additional relevant words beyond subject and object pairings through the use of wh- questions. It may be fruitful to adopt this strategy in future implementations of the treatment in order to further elaborate verb networks in the mental lexicon.

This treatment study shows initial evidence that treatment with low concreteness verb targets is feasible for persons with aphasia. Based on this initial evidence, further research into aphasia treatments for verbs with low concreteness is warranted. Such treatments may be important for expanding the communication opportunities for persons with aphasia (Armstrong, 2005) and are likely to be of benefit to their functional communication.

APPENDIX A

VERB RETRIEVAL TREATMENT

LITERATURE REVIEW TABLE

Study	Study description
Loverso, F. L., Selinger, M., & Prescott, T. E. (1979)	Context for tx: SP Number of Participants: 2 Aphasia types: fluent assumed (posterior lesion) Brief description of Participants: two left posterior lesion participants; at or above 50th %ile on PICA; had demonstrated significant changes on PICA for 3 consecutive months AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): two case studies Therapy type/tasks: two-level program; provided verbs, asked wh- questions to elicit actors and objects Basic treatment approach (domain): semantic/syntactic Stimuli: "30 verbs" Reliability: none Author's interpretation: participants improved on PICA scores pre-post; "communicative improvement" and anecdotal family member evidence of improved communicative ability; additional linguistic analyses needed Critiques--my interpretation: stimuli, tx not clearly defined; participants not thoroughly described (esp. MPO--may have included spontaneous recovery; not single-subject design (but only two participants); strong theoretical basis for tx, needs more direct evidence of proof of concept
Prescott, T. E., Selinger, M., & Loverso, F. L. (1982)	Context for tx: SP Number of Participants: 1 Aphasia types: fluent assumed (posterior lesion) Brief description of Participants: left posterior temperoparietal hemorrhage AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors, four tx phases; criterion for changing levels based on 90% correct using a modified PICA scale Therapy type/tasks: level one of the two-level program in the 1979; provided verbs (auditory and verbal), asked wh- questions to elicit actors and objects Basic treatment approach (domain): semantic/syntactic Stimuli: 40 verbs with similar frequencies (Thorndike and Loge) Reliability: none Author's interpretation: gx to untreated lists with tx of one list (so much so that the fourth list reached 90% accuracy criterion before tx); excellent maintenance at two-months post tx Critiques--my interpretation: more detail than previous study, stronger design, good baselines, but gx across behaviors
Kearns, K. P., & Salmon, S. J. (1984)	Context for tx: SP Number of Participants: 2 Aphasia types: nonfluent (Broca's)

	Brief description of Participants: P1 = 36, male, gunshot wound, Broca's by BDAE; P2 = 31, MCA CVA, Broca's by BDAE; both several years post ictus AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): ABAB reversal design Therapy type/tasks: request for repetition after verbal model of a correct response Basic treatment approach (domain): phonological Stimuli: 30 line drawings showing 10 3rd person singular auxiliary is sentences, 5 plural auxiliary are sentences, and 15 copula is sentences; sentences provided in appendix Reliability: high inter-rater reliability for 30% of sessions Author's interpretation: gx to untrained copula w/predicate adjective is after only limited training on auxiliary is; variability on gx to copula w/predicate noun or locative; however, reversal training did not generalize across the constructions; good maintenance, but very limited stimulus gx to spontaneous speech Critiques--my interpretation: well thought-out, use of reversal phase unique, theoretically grounded on response class idea, shows gx between grammatical uses for the same phonological form
Loverso, F. L., Prescott, T. E., & Selinger, M. (1988)	Context for tx: SP Number of Participants: 2 Aphasia types: fluent Brief description of Participants: at least 6mpo, at or above 50th %ile on PICA, stable PICA score for last 3 months, left-hemisphere lesion AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): two case studies (statistical comparison of PICA scores pre/post) Therapy type/tasks: multi-level program; levels involving repetition after a model, use of verbal and graphical cues Basic treatment approach (domain): phonological Stimuli: 30 verbs (most concrete, some abstract [learn, think, want, like); controlled for frequency, imagery, and concreteness (but note that they used Paivio's noun norms for these verb stimuli) Reliability: none Author's interpretation: statistical improvement on overall PICA scores (and both on the spontaneous speech subtest); suggest that nonfluent may not benefit as much as fluent; cite anecdotal evidence that functional communication improves Critiques--my interpretation: used noun norms for concreteness balancing of the verb stimuli; claims nonfluent may not benefit, but didn't report on any nonfluent cases; more detail than previous report, but not a strong design (PICA overall scores primary outcome measure)
Fink, R. B., Martin, N., Schwartz, M. F., Saffran, E. M. and Myers, J. L.. (1992).	Context for tx: SP Number of Participants: 1 Aphasia types: severe nonfluent with AOS Brief description of Participants: 10 years post CVA, LMCA w/BG AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): case study Therapy type/tasks: "Direct Verb Training" (sentence production after coming up with the components) and "Verb Priming" (repetition of a sentence with a verb target shared with the DVT target). Modeling and phonemic cueing are primary facilitations. Basic treatment approach (domain): phonological Stimuli: 10 verbs from an assessment that he continually missed; roughly balanced for frequency and argument structure; Set 1: give, throw, blow, put, lock Reliability: none Author's interpretation: List 1 received direct tx (no gx to List 2). Then List 1 received 2 priming tx. Little acquisition and gx. Then List 2 received direct tx and performance improved somewhat. Direct training improved verb retrieval in a picture description task and generalized to untrained tokens and was maintained at seven weeks. No gx to untrained targets, but there was decrease in verb omissions with priming tx. Verb priming had a short term effect on verb retrieval during a picture description task, but not long-term (7 weeks) Critiques--my interpretation: Evaluated the possibility of benefit of phonemic priming to facilitate verb retrieval in sentence production. Nice theory, but only a single case, without multiple baselines.
Marshall, J., Pring, T., & Chiat, S. (1993)	Context for tx: SP Number of Participants: 1 Aphasia types: nonfluent

	Brief description of Participants: female, 64, 14 years post, left school at age 14 AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): case study Therapy type/tasks: clinician directed questions to highlight information about the argument structure of a pictured event, then stimulated (through mention and discussion) the arguments and action verb involved. Basic treatment approach (domain): semantic Stimuli: 50 action pictures depicting various actions (reversible, non-reversible, and change of possession, both trained and untrained) Reliability: significant improvement on a post-treatment confrontation naming compared to pretreatment (32/50 compared to 18/50). Author's interpretation: Improvement on two-place (SVO) treated and untreated verbs, maintained at a one-month follow-up. Critiques--my interpretation: Evidence that training argument structure enhanced verb retrieval in sentences for this patient.
Mitchum, C. C., Haendiges, A. N., & Berndt, R. S. (1993)	Context for tx: SVR AND SP Number of Participants: 1 Aphasia types: nonfluent Brief description of Participants: male, 60, 8 years post-onset, 18+ years education, poor naming AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): case study Therapy type/tasks: repeated written naming (with semantic or grapheme cues as needed) Basic treatment approach (domain): semantic/phonological Stimuli: line drawings of 16 transitive verbs Reliability: none Author's interpretation: Acquisition of written naming of the target verbs in isolation and in sentences, but not an increase in well-formedness of sentences (morphology) Critiques--my interpretation: The tx was effective for improving written naming of actions in isolation and in sentences.
Mitchum, C. C. and Berndt, R. S., (1994)	Context for tx: SVR AND SP Number of Participants: 1 Aphasia types: mixed (expressive/receptive), severe Brief description of Participants: 7 years post, CVA L frontoparietal; analysis of his language indicated a reliance on only a few high frequency verbs (compared to normal speakers). AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): case study with two experiments Therapy type/tasks: exp. 1: training single-verb retrieval (confrontation naming of action pictures)--through blocked and random repetitions; exp 2: order 3 sequential pictures (about to, is, already) and produce sentences for the pictures including the appropriate activity--repetition with verbal models as needed until acquired. Basic treatment approach (domain): phonological Stimuli: exp 1: 8 pictures of transitive verbs controlled for frequency, past tense regularity, phonological complexity, and "ease of depiction" exp 2: pictures of 14 activity verbs in three different aspects (past, present, future). Reliability: none Author's interpretation: Exp. 1: No improvement in sentence production with training of verb retrieval in isolation; improvement on untrained pictures of same action. Training action naming does not appear to generalize to retrieval in sentence production. Exp. 2: Training verbs in sentences in three aspects led to perfect acquisition as well as gx to untrained picture sets. There was also gx to sentence formulation based on a spoken word (not on a picture stimulus). Training in active voice did not generalize to passive voice when pre/post performance was compared. Limited gx to narrative speech. Critiques--my interpretation: attempts to deepen and explore the mechanisms behind the theory behind "CVT" or "Verb is Core" tx. Discusses multiple levels involved in sentence production, and reasons that sentence production errors could results from impairment of any of these levels, and so tx that only targets one or two of these levels is only going to help patients with impairments of those specific levels. exp. 1: training single-verb retrieval (confrontation naming of action pictures) increased in accuracy, but did not gx to using the verbs in sentence production. exp. 2: significant as

	to gx from pictured to unpictured, but not from active to passive voice. Excellent design to examine many different facets of gx.
Fink, R. B., Schwartz, M. F., Sobel, P.R., & Myers, J. (1997).	Context for tx: SVR AND SP Number of Participants: 5 Aphasia types: nonfluent (2 nonagrammatic nonfluent, 3 agrammatic nonfluent) Brief description of Participants: all performed better on noun naming than verb naming; AAN classification of level of evidence: III Experimental design (basic): G Experimental design (detail): group study (compared pre to post scores) Therapy type/tasks: exp. 1: comprehension pretest with a naming attempt (no feedback) before each session, then "sentence assembly" in which argument and verb information is provided, but in separate sentences and a question, and the patient assembles a sentence from the components. Gestures for the target verb modeled and encouraged. Exp. 2: 10 verbs were exposed only (a sham treatment applied, like conversation, etc.). Basic treatment approach (domain): phonological/conceptual-semantic Stimuli: a set of 10 from a pre/post test of 30 verbs; the one example is "carried" Reliability: none Author's interpretation: exp. 1: patients improved on verb naming for both trained and untrained sets that had received exposure. exp. 2: Verb naming improved with exposure only and was maintained above baseline levels. This also implies that the training procedure was superfluous. Critiques--my interpretation: good follow-up study to examine the effect of one of the elements of their study (similar exposure of treated and untreated items). This follow-up (exp. 2) suggests that naming attempts (no feedback given) improves verb naming as it does for nouns (find citation). Benefit of the training procedure should be directly compared in greater detail before writing it off.
McNeil, M. R., Doyle, P. J., Spencer, K. A., Goda, A. J., Flores, D., & Small, S. L. (1997).	Context for tx: SVR Number of Participants: 2 Aphasia types: both anomic w/AOS Brief description of Participants: P1 m, 55, 3 years post onset, L MCA CVA. P2 m, 63, 19 years post onset, L MCA CVA AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): single-subject double blind placebo multiple-baseline design Therapy type/tasks: three three-week treatment conditions: L-SAIT (lexical-semantic activation-inhibition therapy, which consists of generating synonyms and antonyms for target words and a cueing hierarchy to support when needed), L-SAIT + pharmacological treatment (dextro-amphetamine or selegiline), or placebo + L-SAIT. Basic treatment approach (domain): semantic/pharmacological Stimuli: lists of adjectives, verbs, nouns, and prepositions Reliability: none reported Author's interpretation: Just P2 received tx for verbs, and just his results are summarized here: the verb list was targeted with L-SAIT while P2 was receiving the placebo; improvement on verbs for the synonym and antonym tasks coincided with initiation of L-SAIT. No gx to other form classes or to untrained verbs. Trained verb increases were maintained following tx. Gains (for both participants) can't be ascribed to the pharmacological agent. Critiques--my interpretation: Extremely powerful design, especially for just two participants. Provides nice evidence that verbs can be treated in the absence of pictures.
Reichman-Novak, S., & Rochon, E. (1997).	Context for tx: SVR Number of Participants: 1 Aphasia types: "mixed" fluent/nonfluent Brief description of Participants: male, agrammatic, severe verb retrieval deficit AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): case study Therapy type/tasks: "repeated presentations" Basic treatment approach (domain): phonological Stimuli: "20 pictureable action verbs" Reliability: none Author's interpretation: tx was associated with an increase in action naming, with no positive gx for untrained verbs (which actually went down) or sentence production. Critiques--my interpretation: Sparse information available, but apparently a very simple tx led to acquisition of action names.

Weinrich, M., Shelton, J. R., Cox, D. M., & McCall, D. (1997).	Context for tx: SP Number of Participants: 3 Aphasia types: nonfluent (one with severe AOS) Brief description of Participants: at least 3 years post L CVA (temporal and temperoparietal); one patient gave written responses in place of verbal AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): three case studies Therapy type/tasks: C-VIC, a computer symbolic system for creating "sentences" without words, followed by a verbal or written production of the sentence in English. Focus on tense marking. Basic treatment approach (domain): conceptual-semantic Stimuli: 22 verbs (concrete actions), list included in the text Reliability: none Author's interpretation: The focus on tense marking was associated with an increase of verb retrieval (apparently within sentences) for regular and irregular verbs. One patient even generalized to untrained irregular verbs, which was surprising, but suggests that the training increased their efficiency of or attention to matching functional information to verb "notions" (corresponding syntactic fragments, or grammatical morphemes) Critiques--my interpretation: fascinating approach on how a symbolic system can be used to facilitate language production; nice description on how targeting tense may also improve retrieval.
Linebaugh, C. W., Baron, C. R., & Corcoran, K. J. (1998).	Context for tx: SVR Number of Participants: 3 Aphasia types: fluent (P1 Wernicke's, P2 anomic, P3 transcortical sensory, P4 Wernicke's) Brief description of Participants: P1 female, 3 weeks post; P2 male, 8 months post; P3 male, 52, 2 weeks post; P4 female, 73, AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors and across participants Therapy type/tasks: "pre-stimulation cueing hierarchy for anomia" including confrontation naming, sentence completion, sentence generation, and combined sentence generation of both nouns and verbs. Basic treatment approach (domain): semantic Stimuli: nouns and verbs balanced for frequency. Three sets of targets, each with 10 nouns and 10 verbs from two semantic categories. Reliability: none Author's interpretation: P1: Strong pre/post WAB change and control task change means that improvements on nouns and verbs can't be confidently attributed to the therapy itself. P2: gx on control tasks invalidates potentially strong tx. P3: tx terminated after 11 due to minimal response to tx, but then 3 months later probed much higher without having had tx. P4: took 50 sessions to reach criterion for confrontation naming, then reached criterion for the other tasks relatively quickly; perhaps her tx needed to be deferred. Critiques--my interpretation: The tx may be effective; however, chronicity/acuity is a potent factor in the design of a study (and the point of their inclusion in this article). It is difficult to ascribe improvements to tx during the acute period.
Marshall, J., Pring, T., & Chiat, S. (1998).	Context for tx: SVR AND SP Number of Participants: 1 Aphasia types: nonfluent (Broca's) Brief description of Participants: several years post, independent living, shows noun advantage in verbal naming but not written, excellent comprehension of single words and reversible-role verbs, good comprehension of sentences including reversible role sentences, and sentence completion. Apparently has a problem with phonological access of verbs. Her narrative speech is lacking in verbs and verb structure. Verb cues helped her sentence production more than noun cues. AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): case study Therapy type/tasks: began with matching written words to pictures or semantic judgments of written verbs; later involved naming verbs from provided nouns or answering a scenario with a verb. Basic treatment approach (domain): semantic Stimuli: 35 verbs divided into 5 categories: nonaction verbs, verbs of exchange and communication, locative verbs, change of state verbs, and movement verbs. Reliability: none

	Author's interpretation: The patient improved on verb retrieval and sentence production with the target verbs, as well as a little insignificant improvement on sentence production with untrained verbs. Improving verb retrieval apparently improves sentence production with those verbs. Critiques--my interpretation: Only a case study. Shows a proof of concept, but provides no information about the generalizability of the findings to other persons.
McNeil, M. R., Doyle, P. J., Spencer, K., Goda, A. J., Flores, D., & Small, S. L. (1998).	Context for tx: SVR Number of Participants: 1 Aphasia types: anomic by WAB, Broca's by clinical judgment Brief description of Participants: male, 63, 19 years post onset, L MCA CVA (same participant as P2 in McNeil et al, 1997) AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors Therapy type/tasks: L-SAIT (lexical-semantic activation-inhibition therapy, which consists of generating synonyms and antonyms for target words and a cueing hierarchy to support when needed) Basic treatment approach (domain): semantic Stimuli: 10-word lists of adjectives, verbs, nouns, and prepositions Reliability: none Author's interpretation: Positive acquisition associated with tx for antonyms and synonyms; possible gx to an untreated antonym list. It was hoped, but not convincingly shown by the evidence, that tx of multiple form classes concurrently would lead to improved gx compared to the 1997 article, which showed no gx and treated form class sequentially. Antonyms are generally easier than synonyms, and adjectives easier than nouns and verbs, etc. Maintenance was initially good, but then dropped to a low level. Critiques--my interpretation: Lots of baselines. Nice design and follow-up to 1997 article. Negative findings are disappointing but are informative for the state of the science (what doesn't seem to work/happen) in order to avoid future researchers doing the same thing.
Pashek, G. (1998).	Context for tx: SVR Number of Participants: 1 Aphasia types: nonfluent (with moderate-severe AOS) Brief description of Participants: male, frontoparietotemporal CVA, 27, 36mpo, AOS, AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): alternating treatments design Therapy type/tasks: pairing meaningful (pantomime) limb gestures with repetitive verbal production of nouns and verbs Basic treatment approach (domain): gestural/phonological Stimuli: 28 verbs (hand-drawn, Helm-Estabrooks, 1981); 28 nouns from Snodgrass and Vanderwart, 1980. Reliability: Verbal-Only no different from Gesture+Verbal for nouns, but Gesture+Verbal better for verbs. However, nouns generalized to discourse contexts while verbs did not. Author's interpretation: Verbal-Only no different from Gesture+Verbal for nouns, but Gesture+Verbal better for verbs. However, nouns generalized to discourse contexts while verbs did not. Critiques--my interpretation: lends support to a motor basis for verb meanings; good evidence for lack of verb retrieval gx to sentence context
Murray, L. L., & Karcher, L. (2000).	Context for tx: SVR AND SP Number of Participants: 1 Aphasia types: fluent (Wernicke's) Brief description of Participants: male, 50, moderate aphasia, L frontotemproparietal CVA, 26mpo AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): "modified" multiple-baselines across behaviors Therapy type/tasks: targeted written retrieval and sentence production; used a cueing hierarchy to elicit a written sentence, using word prompt (auto-complete) software, and home practice (consisting of naming actions from pictures using the software) Basic treatment approach (domain): phonological Stimuli: 50 verbs from the Picture Communication System, divided into 5 lists; words matched for length and frequency; contained optional and obligatory two- and three-place verbs Reliability: high inter-rater reliability Author's interpretation: written retrieval and sentence construction improved with tx; improved

	quality of incorrect answers (more correct letters); positive gx to written discourse; limited but positive gx to spoken discourse Critiques--my interpretation: replicates several previous findings (response gx), but applied to writing, and involving computer software support
Raymer, A. M., & Ellsworth, T. A. (2002).	Context for tx: SVR Number of Participants: 1 Aphasia types: nonfluent (transcortical motor w/mild AOS) Brief description of Participants: female, 54, L CVA--dorsolateral frontal, anterior insular lesion, 7th grade education, showed a semantic naming impairment for nouns and verbs AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): a phonologic tx (questions to highlight phonological info about the target), a semantic tx (questions to highlight semantic info about the target), and a rehearsal tx (rep x3, silent rehearsal, another naming attempt, then rep x3 again). Therapy type/tasks: phonological/semantic Basic treatment approach (domain): phonological/semantic Stimuli: 60 verbs (b/w line drawings) divided into 20 word lists Reliability: high inter-rater reliability for 30% of probes Author's interpretation: improvement with all three tx types for naming and sentence production; order effects, psycholinguistic variable differences between sets, and theoretical overlap between txs make it difficult to parse out differential effects. Critiques--my interpretation: needs replication across more participants; very nice experimental control, good idea to add the third (rehearsal) tx phase
Wambaugh, J. L., Doyle, P. J., Martinez, A. L., & Kalinyak-Fliszar, M. (2002).	Context for tx: SVR Number of Participants: 3 Aphasia types: two mixed nonfluent, the other unspecified Brief description of Participants: 43-122mpo, 12+ education, P1&2 mixed semantic-phonologic deficit, P3 phonologic deficit AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors and participants for P1 & P2; ATD for P3 Therapy type/tasks: response contingent cueing hierarchies for both semantic cueing therapy (SCT) and phonologic cueing therapy (PCT); both were preceded by a comprehension prestimulation task (a target among either semantic or phonologic foils). SCT used a variety of semantic cues, and PCT, phonologic cues. Basic treatment approach (domain): phonological/semantic Stimuli: line drawings depicting actions (3 sets of 12 verbs for P1 & P2, 3 sets of 6 verbs for P3) Reliability: none Author's interpretation: P1 improved during both SCT phases w/gx to untrained items. P2 improved during the first PCT phase, but not the second, then lost phase one gains during phase two; no gx to untrained items was observed. P3 improved with both SCT and PCT with no gx, but high maintenance at 2 and 6 weeks. Critiques--my interpretation: provides initial evidence that the effectiveness of type of cue in a cueing hierarchy may not align directly with the nature of verb retrieval deficit in a participant; e.g., P3 had a primarily phonologic deficit but improved with both PCT and SCT. A possible reason could be overlap of the two hierarchy types.
Schneider, S. L., & Thompson, C. K. (2003).	Context for tx: SVR AND SP Number of Participants: 7 Aphasia types: nonfluent (Broca's) Brief description of Participants: 39-132mpo, 12+ education, L CVA AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): single subject crossover with multiple baselines across behaviors and participants Therapy type/tasks: two treatments: semantic verb retrieval (ST) and argument structure verb retrieval treatment (AST). ST involved a model, a definition, and a request for naming. AST involved a model, a description of the verb's argument structure requirements, and a request for naming. Basic treatment approach (domain): semantic/syntactic Stimuli: b/w line drawings of 102 verbs, including 40 3-place and 40 2-place for targets and 22 for

	generalization; half were motion verbs, half were change-of-state verbs Reliability: high inter-rater reliability for 19% of probes; perfect inter-rater reliability for treatment fidelity in one tx session per phase; high inter-rater reliability for coding of 25% of narrative language samples Author's interpretation: all seven participants improved on verb retrieval with both ST and AST for treated verbs. gx varied: P4 only showed gx to within-category untreated exemplars, P3 & P4 showed some gx to across-category untreated exemplars, and all seven participants generalized to sentence production and maintained this gx; statistically non-significant increases were seen in various SALT analyses of narrative language samples. Taken as a group, WAB and Northwestern Verb Production Battery scores were significantly higher post-tx compared to pre-tx. Critiques--my interpretation: Again, as the authors recognize, theoretical overlap between the two txs may have masked or eliminated differences between the two txs. Both txs are effective for improving verb retrieval and sentence production with verbs with a variety of structures and meanings, though all mostly concrete.
Wambaugh, J. L., Cameron, R., Kalinyak-Fliszar, M., Nessler, C., & Wright, S. (2004).	Context for tx: SVR Number of Participants: 5 Aphasia types: one Broca's (P1), two anomic (P2 & P4), two Wernicke's (P3 & P5) Brief description of Participants: 4m, 1f; 2 PhD, others 12+; 1 focal head injury, 3 CVA, 1 tumor + CVA AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): P1 & P2: ATD with multiple baselines; P3, P4, & P5: multiple baselines across behaviors and participants Therapy type/tasks: response contingent cueing hierarchies for both semantic cueing therapy (SCT) and phonologic cueing therapy (PCT); both were preceded by a comprehension prestimulation task (a target among either semantic or phonologic foils). SCT focused on semantic content of the target, while PCT focused on phonological content of the target Basic treatment approach (domain): phonological/semantic Stimuli: 40 b/w line drawings of actions for each participant (from OANB and from Fiez and Tranel, 1997, stimuli) Reliability: high inter-rater reliability for 10% of probes Author's interpretation: P1 & P2 improved verb naming with both txs in both sequential and ATD formats; P3 demonstrated small increase verb naming with the first phase of SCT, but negligible increases with additional SCT and PCT phases; P4 received PCT first, but showed the same pattern of responding to the txs as P3; P5 demonstrated no improvements and requested an end to tx. No response gx for any participants. Good maintenance for P1 & P2, negligible maintenance for P3 & P4. Both txs appear equally effective when effective, but response appears to vary and be weaker than response to the txs for object naming. Those with mild semantic deficits may be most appropriate. Critiques--my interpretation: SCT and PCT may not be appropriate for all persons with aphasia.
Webster, J., Morris, J., & Franklin, S. (2005).	Context for tx: SVR AND SP Number of Participants: 1 Aphasia types: not specified, but apparently nonfluent Brief description of Participants: 6ypo, CVA, <12 years education, fair comprehension, impaired production AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): case study Therapy type/tasks: 3 component tx: 1) verb retrieval (semantic task requiring access of the target, then looking at a picture and naming it. 2) verb and noun association requiring choosing written nouns that go along with written verbs. 3) sentence generation involving sentence production with support from therapist regarding the verb's argument structure, appropriate arguments and associated non-arguments, etc. Basic treatment approach (domain): semantic Stimuli: 48 self-selected verbs; included in appendix; action verbs Reliability: none Author's interpretation: good acquisition of target verbs during tx; poor maintenance at 12 weeks post; no gx to formalized pre-post verb naming measures; good gx to sentence production Critiques--my interpretation: yet another replication showing acquisition of verbs in naming, without gx to untreated verbs, and with gx to verbs in sentences. Nice use of self-selected verbs for high salience and motivation; apparently used some abstract verbs in sentence generation. Sentence

	generation task included some abstract verbs…gx from the tx's concrete verbs to abstract verbs in sentences? Also, nice inclusion of argument structure training in tx
Bastiaanse, R., Hurkmans, J. and Links, P. (2006).	Context for tx: SP Number of Participants: 2 Aphasia types: Broca's (P1 mod AOS, P2 mild AOS) Brief description of Participants: P1, M, 57, 8mpo, L frontal CVA. P2, F, 53, 3mpo, L frontal CVA, AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors and across participants Therapy type/tasks: steps 2-4 of the Verb Production at the Word and Sentence Level program (just the sentence levels). This includes sentence completion with the target verb in infinitive, then finite forms, and then sentence production when confronted with a picture. Basic treatment approach (domain): syntactic Stimuli: 60 pictured verbs (half transitive, half intransitive). Reliability: "high", but not further specified Author's interpretation: Counterbalancing of order allowed a test of the CATE. P1 did not improve during infinitives training or finite verbs training. Increase on finite verbs at the end compared to last baseline score (but observe very high penultimate baseline). P2 improved in finite verbs at the fourth and final week of finite verb training, then no improvement on infinitives with infinitive training, and a negative change (decrease) in performance on finite verbs. Reported improvements in spontaneous speech as rated by a blind examiner at end of tx and follow--up, but concurrent group therapy could be responsible. Training of infinitives does not generalize to untrained infinitives. Critiques--my interpretation: Problems with baselines (P1 finite baseline higher than any tx probe, rise in P2 infinitives during baseline), rise in unrelated non-word repetition control task for P1; delay in tx effect in P2 for finite verbs. Overall, I think all you can say is that the sequence of all 3 steps of the program improved infinitive and finite verb usage for P2 (baseline compared to end of tx and follow-up probes). Could be spontaneous or unrelated recovery for P1, but the stable control task for P2 provides control despite the acuity of her injury. Also, yet again, there is evidence that gx to untrained verbs does not occur. Participation in concurrent group therapy also obscures results.
Edwards, S., & Tucker, K. (2006).	Context for tx: SVR Number of Participants: 3 Aphasia types: fluent (1 anomic, 2 Wernicke's) Brief description of Participants: all 3 male; CVA; 37, 63, 75; at least 6mpo; all had verb retrieval and sentence production impairments AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): three case studies with multiple baselines Therapy type/tasks: "regular systematic language exercises": 3 tasks for each group of verbs, including sentence completion, naming to definition, and picture naming. As needed, support was given for verb retrieval via a cueing hierarchy (semantic and phonologic cues). Also gave related home practice worksheets. Basic treatment approach (domain): semantic/phonological Stimuli: 100 pictured verbs from the OANB (50 for tx, 50 for measuring gx) (listed in the appendix). Grouped for tx according to transitivity (transitive, intransitive/unergative, optional transitive/unergative, and optional transitive/unaccusative). Reliability: none reported Author's interpretation: P1 showed small, non-significant changes in verb retrieval without gx to untrained verbs, a significant increase in naming speed, no changes in verb comprehension, improvements in sentence production for untreated verbs, and no change in sentence comprehension. P2 showed improvement for treated and some untreated verbs, increase in retrieval speed, no changes in verb comprehension, increase in sentence production for untreated verbs that was not maintained at follow-up, no change in sentence comprehension, negligible changes in connected speech measures. P3 showed improved verb retrieval and gx to untrained verbs, slight decrease in naming speed, no change in verb comprehension, no changes in sentence production or comprehension, and an increase in TTR following tx. Critiques--my interpretation: Very clinical focus, nice to include variability in baseline test scores besides main outcome measure. Possible, but inconclusive results on gx to sentence production. Nice that it represents common clinical conditions better than other studies (e.g., limited assessment and tx).
Finocchiaro, C., Maimone, M.,	Context for tx: SVR Number of Participants: 1

Brighina, F., Piccoli, T., Giglia, G., & Fierro, B. (2006).	Aphasia types: Primary Progressive Aphasia (PPP w/frontotemporal deterioration--more pronounced in left) Brief description of Participants: male, 60, normal cognition, impaired language AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines withdrawal design (ABA) Therapy type/tasks: high frequency (excitatory) rTMS stimulation to the left inferior frontal gyrus, which has been implicated in verb processing. The tasks included sentence completion to measure performance on verbs (hypothesized to improve) and nouns (hypothesized to not change) as well as memory span control tasks (also reasoned to not change). Basic treatment approach (domain): neuropsychological Stimuli: Not explicitly stated, though examples include common concrete actions Reliability: none reported Author's interpretation: Main effect of session for verbs (real rTMS higher than Sham), but no main effect of session for nouns or the memory control task. Critiques--my interpretation: a promising introductory study suggesting feasibility of high frequency rTMS on the left inferior frontal gyrus for improving verb naming in PPA
Raymer, A. M., & Kohen, F. (2006).	Context for tx: SVR AND SP Number of Participants: 2 Aphasia types: P1 fluent (Wernicke's), P2 nonfluent (transcortical motor) with moderate AOS Brief description of Participants: P1 male, 80, 5 years post, L temperoparietal CVA. P2 male, 69, 6 years post, L frontal subcortical CVA. AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors and across participants Therapy type/tasks: errorless training in production of target verbs in sentences, then a barrier game to encourage self-production. Daily at-home practice. Basic treatment approach (domain): phonological Stimuli: 60 pictures from a set depicting actions; 30 chosen for noun targets, and 30 chosen for verbs (available in online appendix) Reliability: high inter-rater reliability for 10% of probes (dependent variable) and 10% of service delivery (independent variable Author's interpretation: P1: minimal gains in trained nouns during noun training, but no gx; no apparent changes in verbs during verb training, and no improvement on sentence production; however, pre/post tests (WAB, ANT, RCBA). P2: large improvement on verbs during verb training, with gx to untrained verbs and nouns, but no gx to sentence production; with noun training, noun retrieval improved, as well as sentence production, though not for untrained nouns; he also improved on all three pre/post measures. Critiques--my interpretation: provides limited evidence for verb retrieval in a sentence context for nonfluent aphasia. As they discuss, it is difficult (or impossible) to target verbs or nouns only when eliciting them in a sentence context.
Raymer, A. M., Singletary, F., Rodriguez, A., Ciampitti, M., Heilman, K. M., & Rothi, L. J. G. (2006).	Context for tx: SVR Number of Participants: 9 Aphasia types: 1 conduction, 2 Wernicke's, 6 Broca's Brief description of Participants: 6m, 3f; 8-14 years education, ages 49-70, 5-62mpo; variety of phonologic, semantic, and mixed word-retrieval deficits, with two having different patterns for nouns versus verbs AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors and across participants Therapy type/tasks: gestural+verbal treatment (GVT), consisting of clinician models and requests for repetition of pantomime gestures and verbal names, with repetition, cueing, repetition after a pause, and reinforcement for correct responses. Basic treatment approach (domain): gestural/phonological Stimuli: 80 b/w line drawings (40 for verbs, 40 for nouns) that could be pantomimed. Reliability: high inter-rater reliability for 10% -25% of sessions for all participants but one Author's interpretation: For spoken naming: positive acquisition effects for nouns and verbs for P2 & P7, for nouns only for P3 & P6, and for verbs only for P2 & P7, with large group effect sizes for nouns and for verbs; no significant difference between gains on nouns versus verbs; no gx to untrained nouns or verbs for any participant; maintenance of trained items above baseline for four of five participants tested. For gestured naming: positive acquisition effects for nouns for 8/9

	participants, and for verbs for 6/9 participants; gx to untrained nouns in one participant, to untrained verbs in another, and to both in a third; one-month maintenance positive for four of five participants tested. Critiques--my interpretation: This large study gives some preliminary indications on effect of aphasia type on response to GV tx of nouns versus verbs (fluent gaining in noun better than verb, and nonfluent gaining in both, but possibly verbs better). Important contribution is the idea that nouns and verbs seem to respond to GVT similarly, though not to all persons with aphasia, and that they may improve independent with one another; gesture acquisition may take place without spoken acquisition, which arguably is still functionally communicative.
Rodriguez, A. D., Raymer, A. M., & Gonzalez Rothi, L. J. (2006).	Context for tx: SVR Number of Participants: 4 Aphasia types: two conduction, one Wernicke's, one Broca's (w/moderate AOS) Brief description of Participants: 3m, 1f; >8mpo, L CVA, verb retrieval impairments (one semantic, one phonologic, two mixed) AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors and across participants, with crossover design Therapy type/tasks: comparison of gestural+verbal treatment and semantic-phonologic treatment. GVT as in Raymer et al, 2006. Semantic-phonologic treatment consisted of various phonologic and semantic cues/questions to highlight information about the target, as well as models and opportunities to practice the target and receive feedback. Basic treatment approach (domain): gestural/phonological and semantic/phonological Stimuli: 60 b/w line drawings portraying verbs that could be pantomimed (10 for gestural+verbal, 10 for semantic-phonologic treatment, and 10 for untrained control). Reliability: high inter-rater reliability for 10% -25% of sessions Author's interpretation: Semantic-phonologic therapy was associated with gains in spoken naming of trained verbs for one participant, but no gains in untrained verbs for any participant. GVT was associated with gains in spoken naming for the same participant (P1), but no gx to untrained verbs for P1 or any participant; gains in gesture usage for three of four participants for trained verbs, but not for untrained verbs for any participant. Suggest time post onset may be less important than severity as far as response to intervention, with milder cases responding better. Critiques--my interpretation: Strong design, good comparisons, valid claims. Important to note the functional implications of gestural improvements in action naming without spoken naming improvements, which was the case for two of the four participants in this study.
Kim, M., Adingono, M. F., & Revoir, J. S. (2007).	Context for tx: SVR AND SP Number of Participants: 2 Aphasia types: nonfluent (Broca's) with mild (P1) and moderate (P2) AOS Brief description of Participants: P1: 50, male, 16mpo L MCA CVA. P2: 41, male, L CVA. Greater difficulty with verbs compared to nouns. AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across participants Therapy type/tasks: a series of tasks that emphasized the argument structure and possible arguments of the target verb. Included picture naming, story completion, using the target to answer a question containing an argument, then a second story completion of the target with a new set of arguments, then a final picture naming step. Basic treatment approach (domain): semantic/syntactic Stimuli: 4x6 color photographs of actions, normed on adults with normal language. Treatment targets and control stimuli were verbs the participants had consistent difficulty with in pre-tx testing (30 for P1, 20 for P2). Lists matched for frequency, number of syllables, and argument structure. Reliability: high inter-rater reliability for scoring participant performance and perfect inter-rater reliability for treatment fidelity in 33% of probes and sessions; high inter-rater reliability for transcription and coding of 100% of narrative language samples Author's interpretation: P1: Good acquisition of target verbs, no gx to untrained verbs; improved sentence production with trained, but not untrained, verbs; improved sentence quality in the narrative. P2: good acquisition of target verbs despite plateau and diminished motivation; no gx to untrained verbs; no improvement in sentence production for trained or untrained verbs; maintenance of verb retrieval gains at 5 weeks; some improvements in sentence quality in the narrative. Critiques--my interpretation: Concurrent tx (esp. for P2, who was receiving tx for noun retrieval in clinic) lessens the strength of the results for gx to sentence production.

Raymer, A. M., Ciampitti, M., Holliway, B., Singletary, F., Blonder, L. X., Ketterson, T., et al. (2007).	Context for tx: SVR Number of Participants: 8 Aphasia types: six Broca's, one Wernicke's, one anomic Brief description of Participants: 6m, 2f; 38 to 81, 4-120mpo, L CVA; five had semantic impairments for nouns and verbs; the other three had mixed impairments. AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors and across participants Therapy type/tasks: semantic-phonologic treatment for nouns and verbs, which consisted of various phonologic and semantic cues/questions to highlight information about the target, as well as models and opportunities to practice the target and receive feedback. Two phases: one targeting nouns, the other targeting verbs. Order counterbalanced. Basic treatment approach (domain): semantic/phonological Stimuli: b/w line drawings from a large in-lab corpus. transitive and intransitive verbs. Sets of 40 nouns and 40 verbs for each participant, chosen based on <30% performance in baselines. Reliability: high inter-rater reliability for 10% -30% of probe sessions Author's interpretation: 5 of the 8 participants showed gains in word retrieval, both for nouns and verbs, with no gx to untrained items. One-month maintenance for all, with slight decreases in verbs for two participants. Those with the best outcomes had moderate word retrieval impairments, and those with the worst had severe impairments. Strong relationship between verb improvements and CETI scores pre- compared to post-tx. Critiques--my interpretation: The study, with its large number of participants, gives nice evidence that the tx is effective for improving the retrieval of the targets in most PWA, esp. those with moderate retrieval deficits. Give replication that gx does not occur to untrained items. Verb improvements may increase communicative functioning more than noun improvements.
Wambaugh, J. L., & Ferguson, M. (2007).	Context for tx: SVR Number of Participants: 1 Aphasia types: anomic Brief description of Participants: female, 74, 50mpo, L parietal CVA AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors Therapy type/tasks: Semantic Feature Analysis (SFA) modified for action names and designed to describe thematic roles Basic treatment approach (domain): semantic Stimuli: 40 b/w line drawings from the OANB (listed in online appendix), balanced for argument structure, 10 per list (two treatment lists and two generalization lists (one for limited exposure). Reliability: high inter-rater reliability for 20% of probes; perfect inter-rater reliability for treatment fidelity in 17% of sessions Author's interpretation: Increase in target retrieval with application of tx (but less than desired); slight gx to one untrained list (the repeated exposure control list) that were not maintained; maintenance of phase 1 tx gains during phase 2 tx and maintenance of both tx lists at two and six weeks post tx; improvement in various discourse measures, possibly due to improved abilities with targets' argument structures. Critiques--my interpretation: clear, logical theoretical basis. Very positive results for a pilot study.
Wambaugh, J. L., & Wright, S. (2007).	Context for tx: SVR Number of Participants: 1 Aphasia types: fluent (Wernicke's) Brief description of Participants: female, 72, 9 years post hematoma evacuation secondary to head injury; semantic and phonologic word retrieval deficit, poor reading skills, but good visual lexical decision skills AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): two sequential multiple baselines across behaviors designs (one for SCT w/orthographic cues, one for PCT w/orthographic cues) Therapy type/tasks: Semantic Cueing Treatment w/orthographic cues and Phonologic Cueing Treatment w/orthographic cues; similar to that in Wambaugh et al., 2004, except for the addition of the orthographic word form to the picture stimulus. Basic treatment approach (domain): semantic/phonological Stimuli: 40 b/w line drawings from the OANB (listed in appendix), balanced for argument structure, 10 per list (one treatment list and one generalization lists for each study).

	Reliability: high inter-rater reliability for 25% of probes; very high inter-rater reliability for treatment fidelity in 14% of sessions Author's interpretation: Positive acquisition effects with both txs; no gx to untrained verbs; some decreases at 2- and 6-week maintenance probes Critiques--my interpretation: Nice example of a design tailored to an individual; clear effects of the tx demonstrated
Rose, M., & Sussmilch, G. (2008).	Context for tx: SVR Number of Participants: 3 Aphasia types: nonfluent (Broca's) Brief description of Participants: 3f, 45-55, 3-7 years post onset CVA AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): pseudo-ATD multiple baselines across behaviors and across participants (pseudo-ATD because treatments apparently run simultaneously, but without mention of alternating the order or giving a break in between treatments within a day). The three-treatment phase was followed by a replication of the most effective treatment for a within-subjects replication. Therapy type/tasks: a semantic treatment (based on SFA), semantic+gesture treatment, and gesture-only treatment (for P1, but repetition-only treatment for P2 & P3) Basic treatment approach (domain): semantic/gestural/phonological Stimuli: 100 b/w line drawings--pictured verbs from the OANB (5 lists of 20). Grouped for tx according to familiarity, syllable length, age of acquisition, presence of homophonous noun, and argument structure. Reliability: high inter-rater reliability for 20% of probes; high inter-rater reliability for treatment fidelity in 20% of sessions Author's interpretation: P1 (KC) showed positive acquisition for all three txs, with some gx to untreated verbs. P2 (MW) showed positive acquisition for all three txs, with slight gx to untreated verbs. Fair maintenance at 1-month, and reduced at 3-months. P3 showed minimal acquisition of tx targets, even after the number of targets was reduced. Repetition-only appears to benefit to a certain extent. Critiques--my interpretation: nice homogenous group of participants; very unique design.
Conroy, P., Sage, K. and Lambon-Ralph, M. A. (2009a).	Context for tx: SVR AND SP Number of Participants: 7 Aphasia types: three fluent (two anomic and one jargon) and three nonfluent (1 agrammatic) Brief description of Participants: 5f, 2m; 43-85; 16-65mpo; all with some, though impaired, word and sentence repetition ability AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): multiple case studies, with both treatments performed at the same sessions (in parallel) Therapy type/tasks: decreasing cueing hierarchy (maximal to minimal), starting with full modeling of the target and a picture, and progressing over the phase to just a picture presentation. One treatment used only a single target word, and the other used a full sentence with the target word. Basic treatment approach (domain): semantic/phonological Stimuli: 60 failed items from OANB or the International Picture Naming Project (available online), divided into three sets of twenty (one for each treatment and one for control) Reliability: none reported Author's interpretation: All participants improved in post-tx action naming compared to pre-tx for lists subjected to both txs. A five-week follow-up indicated that gains were maintained. ANOVA comparisons of group means for the two therapies suggests a slight advantage for the word-cue hierarchy. There was some minimal gx to untreated verbs. Gains generalized to video stimuli of the same target verbs. Critiques--my interpretation: Looked for and found stimulus gx to video clip naming.
Conroy, P., Sage, K. and Lambon-Ralph, M. A. (2009b).	Context for tx: SVR Number of Participants: 7 Aphasia types: three fluent (two anomic and one jargon) and three nonfluent (1 agrammatic) Brief description of Participants: 5f, 2m; 43-85; 16-65mpo; all with some, though impaired, word and sentence repetition ability AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): multiple case studies, with both treatments performed at the same sessions (in parallel)

	Therapy type/tasks: Decreasing and increasing cueing hierarchies. The decreasing cueing hierarchy (maximal to minimal), started with full modeling of the target and a picture, and progressed over the phase to just a picture presentation. The increasing cueing hierarchy (maximal to minimal), started with just a picture, and progressed over the phase to full modeling of the target. Basic treatment approach (domain): semantic/phonological Stimuli: 120 failed items from OANB, VAST, & BNT, divided into three lists of forty (twenty nouns and twenty verbs; one list for each treatment and one list for control) Reliability: none reported Author's interpretation: All participants improved in post-tx action naming compared to pre-tx for lists subjected to both txs. One- and five-week follow-ups indicated that gains were maintained. There were no statistical differences between the two txs. There was minimal to no gx to untreated verbs. Nouns were responded better to tx than verbs. There was no effect of therapy type on naming speed. Naming for nouns was faster than for verbs. Critiques--my interpretation: Looked at a different aspect again--speed of retrieval. Although the two txs were equally effective, one, the decreasing cues, was more liked by participants and faster than the other tx. This provides a case for a decreasing cueing hierarchy.
Conroy, P., Sage, K. and Lambon-Ralph, M. A. (2009c).	Context for tx: SVR Number of Participants: 9 Aphasia types: three fluent (two anomic and one jargon) and six nonfluent (1 agrammatic) Brief description of Participants: 6f, 3m; 42-84; 7-136mpo; all with some, though impaired, word and sentence repetition ability AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): multiple case studies, with both treatments performed at the same sessions (in parallel) Therapy type/tasks: Errorless therapy (designed to prevent errors in naming; very specific cues [starting with "say target"]) and errorful therapy (designed to allow for errors (broad, nonspecific cues) Basic treatment approach (domain): semantic/phonological Stimuli: 120 failed items from OANB, VAST, & BNT, divided into three lists of forty (twenty nouns and twenty verbs; one list for each treatment and one list for control) Reliability: none reported Author's interpretation: All participants improved in post-tx action naming compared to pre-tx for lists subjected to both txs. Gains were partially lost by the follow-up. There was a slight advantage for the errorless tx. There was minimal to no gx to untreated verbs. Nouns were responded better to tx than verbs. There was no effect of therapy type on naming speed. Naming for nouns was faster than for verbs. Critiques--my interpretation: The errorless therapy appears to be very efficient (20 minutes per session). Being shown to have greater likability and shorter time for administration while preserving effectiveness, the errorless is probably a better option for most cases.
Edmonds, L. A., Nadeau, S. E., & Kiran, S. (2009).	Context for tx: SP Number of Participants: 4 Aphasia types: two nonfluent (moderate conduction w/mild-mod AOS), two fluent (moderate transcortical motor) Brief description of Participants: 3f, 1m; 52-75; 10-96mpo AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors and across participants Therapy type/tasks: Verb Network Strengthening Treatment (VNeST), which consists of requesting 3-4 agent-object pairs that go with each provided verb. Written options (among foils) were provided if the patient was unable to self-generate an appropriate item. Basic treatment approach (domain): semantic/syntactic Stimuli: Ten verbs were selected from a set of 24 for treatment. They were hand-drawn colored pictures of the target verbs, typically with specific a specific agent-patient pair. The verbs were divided into two sets, with each verb being semantically related to a verb in the other set. Verbs were matched for frequency, imageability, familiarity, and number of syllables, though several frequency and imageability values were missing. Reliability: high inter-rater reliability for 25% of sessions for the dependent and independent variables Author's interpretation: P1: Positive acquisition with tx, and positive gx to untreated items; good maintenance. P2: Moderate acquisition with tx, good gx to untreated items; fair maintenance. P3:

	Positive acquisition with tx, and positive gx to untreated items; good maintenance. P4: Positive acquisition with tx, and positive gx to untreated items; no maintenance probes administered. Critiques--my interpretation: Excellent tx indicating gx to untrained verbs. Possibly an impact of the flexibility encouraged (learning the sentence production process as opposed to learning just an isolated verb or isolated sentence. Very minimal baselines, though.
Goral, M., & Kempler, D. (2009).	Context for tx: SP Number of Participants: 1 Aphasia types: nonfluent Brief description of Participants: male, 60, 12 years post CVA AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): case study Therapy type/tasks: constraint-induced therapy emphasizing verbs Basic treatment approach (domain): semantic/phonological/syntactic Stimuli: 57 verbs from various semantic groups, including both heavy and light verbs; stated idea was to "enhance verb production generally" rather than a predetermined list of target verbs Reliability: high inter-rater reliability for 30% of narrative data Author's interpretation: Verb usage in a narrative task was higher post-tx compared to pre-tx. Maintenance ten weeks later was reduced, but still higher than baseline. The verb-noun ratio improved with tx, but remained below normal levels. The participant improved in verb production as evidenced by verb usage post-tx including verbs never used in baseline or introduced in therapy. A group of twenty naïve listeners rated the post-tx samples more favorably than the pre-tx samples. Critiques--my interpretation: Represents a shift to perceptions of others in regards to the effect of verb tx. Claim on improved verb production very hard to fully back up (not using a verb does not indicate an inability--inability is demonstrated by lack of performance when given an opportunity that would be sufficient for a typical person.
Webster, J. and Gordon, B. (2009).	Context for tx: SVR AND SP Number of Participants: 1 Aphasia types: nonfluent Brief description of Participants: female, 63, 9mpo AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): case study Therapy type/tasks: The first tx was a mapping tx. The second was a verb and noun association tx, in which a picture of an action with a written cue was provided, along with four written nouns. The patient was asked to point to an appropriate noun that went with the target verb, then produce a sentence with them. If she made an inappropriate sentence, a correct one was provided, but she was not asked to repeat it. Basic treatment approach (domain): semantic/syntactic Stimuli: 80 verbs from the OANB Reliability: none Author's interpretation: No gains with the mapping tx. With the verb and noun association tx, tx targets were acquired without gx to a control set. When tx was extended to the control set, performance on that set improved. tx gains were maintained at an assessment six months following the end of tx. She increased in the number of sentences she could produce with the target verbs. Critiques--my interpretation: The reduction of meta-linguistic emphasis appears to have reduced the frustration and possibly cognitive load for this patient. Shows that meta-linguistic knowledge not always essential for improving verb retrieval and sentence production.
Links, P., Hurkmans, J., & Bastiaanse, R. (2010).	Context for tx: SVR AND SP Number of Participants: 11 Aphasia types: nonfluent (Broca's) Brief description of Participants: 8f, 3m; 31-68; 3-8mpo AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors and across participants (but without probes of treated items during treatment, and data analyzed with group statistics). Therapy type/tasks: Steps 2-4 of ACTION treatment (including the steps retrieving infinitives, then finite verbs, in a sentence context, followed by sentence production in picture description. Semantic and phonologic cueing as needed, as well as a verbal or written model of the sentence if needed. Basic treatment approach (domain): semantic/phonological/syntactic Stimuli: for the tx: 60 pictured action verbs (30 transitive, 30 intransitive, balanced for length, low-

	high frequency. Human-action-object sentences. for the probes: 40 other pictures. Reliability: none reported Author's interpretation: Untrained verbs improved for the group. Individually, just one patient significantly improved. Five patients improved on finite verbs. Gains were maintained at three months after tx. gx from trained to untrained infinitives was slight and to untrained finite verbs was absent. gx from trained to untrained finite verbs was positive, and to untrained infinitive verbs was absent. Untrained finite verbs also improved during sentence construction, but not untrained infinitives. No decline after three months. Verbs and sentences in spontaneous speech also improved, as well as a test of communicative function. Critiques--my interpretation: Only untreated items were probed during tx phase, which makes the exposure level of the sets unequal. Difficult to determine the results due to these factors. Also, five of the original sixteen participants did not complete the study, but the reason for this is not explained.
Marangolo, P., Bonifazi, S., Tomaiuolo, F., Craighero, L., Coccia, M., Altoe, G., et al. (2010).	Context for tx: SVR Number of Participants: 6 Aphasia types: 4 nonfluent, 2 fluent Brief description of Participants: 2f, 4m;49-75; 15-68mpp; 5 w/L CVA, 1 w/TBI; phonological verb deficit in nonfluent, semantic verb deficit in fluent AAN classification of level of evidence: III Experimental design (basic): G Experimental design (detail): group study Therapy type/tasks: Three treatments based to examine embodiment and mirror neuron system in relation to treatment of aphasia: 1 observation of clinician performing action and production of target; 2 observation and execution, followed by verbal production of target; Control treatment condition: observation of video clips and execution of meaningless movement, followed by verbal production of target. Basic treatment approach (domain): conceptual-semantic Stimuli: video clips of 128 transitive and 25 intransitive actions performed by a male actor; failed items on a baseline test were divided into three lists (one control, two treatment) Reliability: none Author's interpretation: The fluent participants did not benefit from the txs. The nonfluent participants benefited from the two experimental txs (observation and observation w/execution) Critiques--my interpretation: Benefit from observation of action demonstrated, but along with verbal production of the target. Observation and meaningless gesture clearly not enough, but should have included a repetition-only condition to compare the effect of a repetition alone.
McCann, C., & Greig, L. (2010).	Context for tx: SVR Number of Participants: 1 Aphasia types: severe nonfluent with AOS Brief description of Participants: L MCA CVA AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): case study Therapy type/tasks: Use of video verb stimuli while generating sentences Basic treatment approach (domain): conceptual-semantic Stimuli: video stimuli of 30 verbs with 2-3 arguments. Verbs were considered difficult to capture in a picture, and were personally relevant to the patient. Also included an unspecified home program. Reliability: none reported Author's interpretation: Increased retrieval of target verbs and untrained verbs. gx to formalized sentence production assessment and structured discourse speech, but not conversation. Critiques--my interpretation: Good rationale for video stimuli (targeted verbs that were difficult to statically picture; some more personally relevant (and likely less concrete)). A small study, with very little information provided.
Boo, M., & Rose, M. L. (2011).	Context for tx: SVR Number of Participants: 2 Aphasia types: nonfluent (Broca's), P1 w/AOS Brief description of Participants: 1f, 1m; 63, 57; both 21mpo L CVA; phonological verb impairment AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors and across participants Therapy type/tasks: a repetition-only treatment, a semantic treatment to highlight semantic information about the target, a gesture-only treatment (P2), a combined gesture-semantic treatment, and a repetition-orthographic treatment (P1). Orthographic forms provided in all treatments for P1

	except repetition-only Basic treatment approach (domain): gestural/semantic and phonological Stimuli: 100 b/w line drawings--pictured verbs from the OANB, VAST, and IPNP (5 lists of 20). Grouped for tx according to familiarity, syllable length, age of acquisition, presence of homophonous noun, and argument structure. Reliability: high inter-rater reliability for 10% of treatment sessions Author's interpretation: P1: Increase in naming accuracy with all txs except repetition only, with maintenance at one month for gains except in the semantic condition. No gx to untreated verbs. P2: Increase in naming accuracy with all txs except gesture only, with maintenance at one month for gains in the repetition and semantic conditions. No gx to untreated verbs. Critiques--my interpretation: Removed their control set partway through because it was improving; otherwise, results for untreated verbs would have been impossible to determine.
Edmonds, L. A., & Babb, M. (2011).	Context for tx: SP Number of Participants: 2 Aphasia types: nonfluent (severe Broca's with mild AOS) Brief description of Participants: 2f; 42, 49; 49 and 9 mpo; AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors and across participants Therapy type/tasks: Verb Network Strengthening Treatment (VNeST), which consists of requesting 3-4 agent-object pairs that go with each provided verb. Written options (among foils) were provided if the patient was unable to self-generate an appropriate item. Basic treatment approach (domain): semantic/syntactic Stimuli: Ten verbs were selected from a set of 27 for treatment. They were hand-drawn colored pictures of the target verbs, typically with specific a specific agent-patient pair. The verbs were divided into two sets, with each verb being semantically related to a verb in the other set. Verbs were matched for frequency, imageability, familiarity, and number of syllables, though several frequency and imageability values were missing. Reliability: high inter-rater reliability for probes (100%), testing (100% for most), and treatment fidelity (25%) Author's interpretation: P1: Rising baselines with no significant difference in slope as tx phase slope. Positive effect sizes for treated and untreated items at one and five months post-tx. P2: For both spoken and written responses, fairly stable baselines. Positive effect sizes for treated and untreated items at one and five month post-tx. Acquisition of treated items associated with tx. Critiques--my interpretation: P1: Positive effect sizes for treated items, but with rising baselines with the same slope as the tx phase, experimental control isn't demonstrated. P2: tx appeared effective, and gx to untreated verbs is promising.
Faroqi-Shah, Y., & Graham, L. E. (2011).	Context for tx: SVR AND SP Number of Participants: 2 Aphasia types: nonfluent (Broca's) Brief description of Participants: P1: male, 62, 5 years post L MCA CVA, native Chinese speaker (used primarily English for the past 30 years). P2: male, 47, 2 years post L MCA CVA, English speaker AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors and across participants Therapy type/tasks: adaptation of SFA Basic treatment approach (domain): conceptual-semantic Stimuli: video clips of 14cut,14contact, and 7non-verbal expression verbs, matched for argument structure Reliability: high inter-rater reliability for probes (seven sessions) and treatment fidelity (47%) Author's interpretation: P1: positive acquisition of treated items in both phases; no gx to untreated items in any category. P2: absence of acquisition of treated items in his one tx phase; no gx to untreated items. Critiques--my interpretation: It appears from this study that verbs may have even further complex nuances of organization past the "cut" and "contact" distinctions examined in this study; however, the small sample size should be replicated with further participants to verify.
Kempler, D., & Goral, M. (2011).	Context for tx: SVR Number of Participants: 2 Aphasia types: nonfluent Brief description of Participants: 2f; 54, 45; 2 and 7 years post onset

	AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): two case studies Therapy type/tasks: drill-based treatment: clinician model, unison production (Integral stimulation), followed by a patient repetition. Practice in the context of games. The communication-based ("generative") treatment: No predetermined targets; constraint-induced barrier games. Shaping and scaffolding used in both to encourage verb usage in sentences. Basic treatment approach (domain): phonological Stimuli: for the drill protocol: 32 verbs from Almore et al (2009) for treatment, with 32 similar ones added. For the generative protocol: no predetermined list of verbs. Reliability: high inter-rater reliability for 20% of sessions Author's interpretation: Positive acquisition effects during Drill tx, but not Generative tx, for P1 & P2. gx to untreated verbs for P1, but not P2. For the generative tx, no specific verbs were targeted; there was no improvement in accuracy of verbs attempted. Sentence quality and grammaticality in a narrative task increased after the generative tx, but not the drill tx. Critiques--my interpretation: Nice procedures for reducing differences between tx types. Shows specificity of training: have target verbs, increase target verbs. Targeting complete sentences (as generative tx did more), leads to increases in sentence quality.
McCann, C., & Doleman, J. (2011).	Context for tx: SVR AND SP Number of Participants: 5 Aphasia types: nonfluent Brief description of Participants: 3m; 27, 55, 74; 30, 17, & 59 mpo; L CVA AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): three case studies Therapy type/tasks: Verbs were elicited in three levels: sentence completion, naming to definition, and picture naming. A series of semantic and phonological cues were given to facilitate retrieval if needed. Basic treatment approach (domain): semantic/phonological Stimuli: 100 pictured verbs mostly from the OANB (50 for tx, 50 for measuring gx) (listed in the appendix). Grouped for tx according to transitivity (transitive, intransitive/unergative, optional transitive/unergative, and optional transitive/unaccusative). Reliability: none reported Author's interpretation: P1: improvement on verb retrieval for trained and untrained verbs; improvement on sentence production. P2: Nonsignificant increase in retrieval of trained verbs; large and maintained improvement on sentence production. P3: acquisition of trained verbs with gx to untrained; no changes in sentence production. Critiques--my interpretation: Difficult to tell relationship between trained and untrained items in response to tx. Would have been stronger as a single-subject design.
Conroy, P., & Scowcroft, J. (2012).	Context for tx: SVR Number of Participants: 4 Aphasia types: two nonfluent (severe and moderate), two fluent (anomic, severe and moderate) Brief description of Participants: 3f, 1m; 39-69; 8-99mpo; moderate to severe word retrieval impairments AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): two case studies Therapy type/tasks: decreasing cues hierarchy starting with full-word model repetition, and progressing to picture naming; ten items were added to the treatment every time 100% accuracy in treatment attained. Basic treatment approach (domain): phonological Stimuli: a dynamic list of nouns and verbs, consisting of failed items from the OANB Reliability: none reported Author's interpretation: Each patient made gains on treated items that were maintained at follow-up. Treated words significantly improved compared to untreated. Participants varied in how many targets they could take on, ranging from 36 to 84, with 100 as possible. Critiques--my interpretation: Dynamic tx list length was a new approach--interesting to see different abilities of how many targets can be taken on at once in a (relatively) errorless tx format.
Marangolo, P., Cipollari, S., Fiori, V.,	Context for tx: SVR Number of Participants: 7 Aphasia types: nonfluent

Razzano, C., & Caltagirone, C. (2012).	Brief description of Participants: 5f, 2m; 43-64; 11-130mpo; AAN classification of level of evidence: III Experimental design (basic): G Experimental design (detail): group study Therapy type/tasks: Treatment consisted of watching the clips and attempting to name the verb; no cues were given. Basic treatment approach (domain): conceptual-semantic Stimuli: 115 video clips of actions (78 human, 37 non-human) Reliability: none reported Author's interpretation: significant effect of time (showing improvement in end-of-tx compared to baseline, and significant effect of condition, showing higher accuracy for human-performed actions than non-human actions. Critiques--my interpretation: Novel approach: observation of video clip + attempt to name action. This approach appears to have promise today. Nonhuman actions are not as good as human actions for inducing improvements in naming accuracy for actions.
Bonifazi, S., Tomaiuolo, F., Altoè, G., Ceravolo, M. G., Provinciali, L., & Marangolo, P. (2013).	Context for tx: SVR Number of Participants: 6 Aphasia types: nonfluent Brief description of Participants: 5f, 1m; 35-68; 15-60mpo; L CVA; mild to mod-severe verb retrieval deficits (two semantic, four phonologic) AAN classification of level of evidence: III Experimental design (basic): G Experimental design (detail): group study Therapy type/tasks: Four treatments based to examine embodiment and mirror neuron system in relation to treatment of aphasia: 1 observation of clinician performing action and production of target; 2 observation and execution, followed by verbal production of target; 3 observation of action video clips and production of target; 4 observation of video clips and execution of meaningless movement, followed by verbal production of target. Basic treatment approach (domain): conceptual-semantic/neuropsychological Stimuli: video clips of 128 transitive and 25 intransitive actions performed by a male actor; failed items on a baseline test were divided into four lists (one control, three treatment) Reliability: none Author's interpretation: Significant effect of tx for the participants with phonological verb retrieval deficits; no detectable superiority of one tx over the other (meaningless gesture condition considered a control condition). Observation appears equivalently efficacious by video or live action; not effective for those with semantic deficits. Critiques--my interpretation: Very interesting comparisons, nice to compare video versus live actions; however, would have liked to see more individual data, and some replication with single-subject data to see the course, longer baselines, etc.
Carragher, M., Sage, K., & Conroy, P. (2013).	Context for tx: SVR AND SP Number of Participants: 9 Aphasia types: nonfluent Brief description of Participants: 2f, 7m; 34-64; 8-132mpo; AAN classification of level of evidence: III Experimental design (basic): G Experimental design (detail): group study Therapy type/tasks: Multi-faceted tx including SFA, gestures, and phonemic cueing Basic treatment approach (domain): gestural/semantic/phonological Stimuli: pictured action verbs from OANB and IPNP; light verbs from unpublished test, formatted in cloze sentences; personally relevant verbs from discussion with shareholders. Divided into 40-word tx and 40-word control lists; balanced on key psycholinguistic variables. Reliability: none reported Author's interpretation: Eight improved on naming verbs and maintained gains at one month. Five improved on untreated verbs and maintained gains. One participant generalized gains to light verbs. Home practice was higher for those with higher treated items gains. Two participants improved on sentence production, four remained the same, and three decreased sentence production. For the group, there was a lack of increase in verb usage during conversation. Critiques--my interpretation: Large group study; combined several effective techniques; lack of gx to conversation disappointing, but shouldn't be unexpected (it's a much less constrained task)
Fiori, V, Cipollari, S, Di	Context for tx: SVR Number of Participants: 7

Paola, M, Razzano, C, Caltagirone, C, Marangolo, P. (2013).	Aphasia types: nonfluent Brief description of Participants: 2f, 5m; 44-71; 7 months to 7 years post onset AAN classification of level of evidence: III Experimental design (basic): G Experimental design (detail): group study Therapy type/tasks: 2 tDCS anodic stimulation conditions: left Wernicke's area and left Broca's area, and sham stimulation over Wernicke's or Broca's area. Naming without verbal clinician models (written model presented if no/incorrect response). Basic treatment approach (domain): neuropsychological/phonological Stimuli: 102 pictures of concrete nouns; 102 video clips of actions; nouns and actions matched on imageability, age of acquisition, number of letters, and frequency. Reliability: double-blinded procedure (no reliability reported) Author's interpretation: At the last tx, significant effect of time, but no significant effect of task or condition. The time x task x condition interaction was also significant. For the one- and four-week follow-ups (maintenance), there was a significant effect of condition and a task x condition interaction. Accuracy on noun naming was associated with training during stimulation of Wernicke's area; accuracy on verb naming was associated with training during stimulation of Broca's area. Critiques--my interpretation: Although acquisition effects were equivalent across tDCS conditions, maintenance was promoted for nouns by anodic Wernicke's area stimulation, and for verbs by anodic Broca's area stimulation.
Marangolo P, Fiori V, Di Paola M et al. (2013).	Context for tx: SVR Number of Participants: 7 Aphasia types: nonfluent Brief description of Participants: 2f, 5m; 46-77; 7 months to 7 years post onset AAN classification of level of evidence: III Experimental design (basic): G Experimental design (detail): group study Therapy type/tasks: 2 tDCS anodic stimulation conditions: left Wernicke's area and left Broca's area, and sham stimulation over Wernicke's or Broca's area. Naming without verbal clinician models (written model presented if no/incorrect response). Basic treatment approach (domain): neuropsychological/phonological Stimuli: 150 video clips of actions performed with the hand, foot, mouth, or body. Reliability: none reported Author's interpretation: At the last tx, there was a significant effect of Time and of Condition, with the Broca's condition associated with a higher percentage of correct responses. The Time x Condition interaction was also significant. At the one- and four-week follow-ups (maintenance), there was a significant effect of Condition (with the Broca's condition again associated with a significantly higher percentage of correct responses), but no significant interaction. Critiques--my interpretation: Results are straightforward and provide convincing evidence for the role of Broca's area in rehabilitation of action naming in aphasia.
Thompson, C. K., Riley, E. A., den Ouden, D. B., Meltzer-Asscher, A., & Lukic, S. (2013).	Context for tx: SVR AND SP Number of Participants: 4 Aphasia types: nonfluent (Broca's), one with mild AOS; the four control participants also had aphasia Brief description of Participants: 3f, 1m; 46-60; 1.5 - 11 years post onset; L CVA AAN classification of level of evidence: III Experimental design (basic): G Experimental design (detail): group study Therapy type/tasks: Treatment was focused on 3-argument verbs in sentences. Pictures and cards with argument-structure placeholders were provided. Treatment involved attempts at naming and sentence production, teaching about the meaning and argument structure of the verb, and practice ordering the words. The treatment for this study was in part an evaluation of the Complexity Account of Treatment Efficacy (does training 3-argument verbs trickle down to simpler argument structures?) Basic treatment approach (domain): semantic/syntactic Stimuli: line drawings of 50 verbs of varying argument structure, frequency, length, and argument animacy. Reliability: high inter-rater reliability for 30% of probe sessions Author's interpretation: All experimental participants showed acquisition of treated 3-argument verbs, both in isolation and in sentences. Untrained 2- and one-argument verbs also improved in isolated retrieval and in sentence production. These support the CATE. Neural activation patterns for recovery varied, but overall involved increases in activity in the posterior perisylvian area and

	superior parietal sensory motor cortices. Critiques--my interpretation: Very strong theoretical grounding; good evidence for CATE and evidence for how verbs may be organized in the lexicon.
Edmonds, L. A., Mammino, K., & Ojeda, J. (2014).	Context for tx: SP Number of Participants: 11 Aphasia types: nine fluent, 2 nonfluent Brief description of Participants: 2f, 7m; 35-71; 14-144mpo AAN classification of level of evidence: III Experimental design (basic): G Experimental design (detail): group study Therapy type/tasks: Verb Network Strengthening Treatment (VNeST), which consists of requesting 3-4 agent-object pairs that go with each provided verb. Written options (among foils) were provided if the patient was unable to self-generate an appropriate item. Basic treatment approach (domain): semantic/syntactic Stimuli: Ten verbs were selected from a set of 28 for treatment. They were hand-drawn colored pictures of the target verbs, typically with specific a specific agent-patient pair. The verbs were divided into two sets, with each verb being semantically related to a verb in the other set. Verbs were matched for frequency, imageability, familiarity, and number of syllables, though several frequency and imageability values were missing. Reliability: high inter-rater reliability for 20% of probes; high inter-rater reliability for treatment fidelity in 25% of sessions Author's interpretation: Improvement in sentences for trained and untrained words, which was maintained at 3-months post tx. Significant increase in noun and verb naming at post-tx, and significant increase in sentence production at maintenance compared to pre-tx. Seven of ten showed increases in communicative function. Critiques--my interpretation: Not truly SSD; previous VNeST studies showed rising baselines without a change in tx phase slope, and so it would have been important to evaluate the slope of baselines in this study. Very large study for this type of research.
Furnas, D. W., & Edmonds, L. A. (2014).	Context for tx: SP Number of Participants: 2 Aphasia types: not specified Brief description of Participants: P1: m, 55, 6 years post L MCA CVA; P2: m, 54, 4 years post L MCA CVA. Both had computer experience. AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors Therapy type/tasks: Computerized Verb Network Strengthening Treatment (VNeST-C) via teleconferencing software. VNeST consists of requesting 3-4 agent-object pairs that go with each provided verb. Written options (among foils) were provided if the patient was unable to self-generate an appropriate item. Participants first spoke, then typed responses. The clinician provided live verbal feedback. Basic treatment approach (domain): semantic/syntactic/phonological Stimuli: Ten verbs were selected from a set of 28 for treatment. They were hand-drawn colored pictures of the target verbs, typically with specific a specific agent-patient pair. The verbs were divided into two sets, with each verb being semantically related to a verb in the other set. Verbs were matched for frequency, imageability, familiarity, and number of syllables, though several frequency and imageability values were missing. Reliability: high inter-rater reliability for standardized testing and 33% of probes (dependent variable) and 75% of service delivery (independent variable) Author's interpretation: P1: medium effect size for spoken and large effect size for typed responses for target verbs in sentences, maintained at 3 months post. Limited gx to untrained stimuli in spoken responses, but high generalization in typed responses. Improvement on action naming in typing responses for the OANB. P2: Moderate effect sizes for acquisition of treated items in both modalities, which were maintained at 3 months post tx, but only minimal for untreated items. Small effect size for trained and large effect size for untrained items in sentences, with maintenance for trained items in sentences at 3 months post. Critiques--my interpretation: Short, but good baselines, but very few probe data points (two) during tx phase. Ideally, more should be collected for a single-subject design. Satisfactory evidence for application of VNeST to computerization and typed modality; noteworthy that typing may improve separately from speaking, and that typing may generalize to handwriting.

Hoover, E. L., Caplan, D., Waters, G., & Budson, A. (2014).	Context for tx: SVR Number of Participants: 12 Aphasia types: nonfluent (Broca's) Brief description of Participants: 6f, 6m; 48-70; 1.5-20 years post language-dominant hemisphere CVA AAN classification of level of evidence: III Experimental design (basic): G Experimental design (detail): group study (within-subject, delayed treatment) Therapy type/tasks: VNeST (the individual treatment), socially oriented group treatment (conversation format based on topics surrounding target verbs) Basic treatment approach (domain): semantic/syntactic/pragmatic Stimuli: photos of people acting out 81 different verbs; divided into 3 lists: one targeted in individual treatment, one in group treatment, and one targeted in both treatments. Reliability: Not measured, but emphasized by pretreatment training and meetings after sessions. Author's interpretation: No change during baseline, increase in verb retrieval during tx for all sets (regardless of tx), and lack of maintenance at post-tx testing. Significant improvements for various noun and verb naming tests, as well as number of complete sentences in narrative samples. No changes in CIUs or number of verbs. Significant increases on communicative independence and quality of life scores following tx. Critiques--my interpretation: The overall pre- post measures are only valid as the result of all three conditions. The design used does not allow comparative interpretation between txs, which is unfortunate. Cumulative effects of multiple interventions may have occurred.
Kristensson, J., Behrns, I., & Saldert, C. (2014).	Context for tx: SVR Number of Participants: 3 Aphasia types: 1 fluent (Wernicke's), 2 nonfluent (1 mixed and 1 Broca's with AOS) Brief description of Participants: 1f, 2m; 54-71; 2-5 years post onset L CVA AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors and across participants Therapy type/tasks: SFA for objects and for actions Basic treatment approach (domain): semantic Stimuli: stimuli for probes: 168 b/w line drawings from the OANB, divided into four 42-item lists, based on various psycholinguistic variables. stimuli for treatment: color photographs of actions and objects from the Everyday Life Activities set and ColorCards sets Reliability: high inter-rater reliability for 33% of probe sessions; 25% of assessment material Author's interpretation: Treated items not probed during baseline, so no comparison possible (strategy the main focus, not the individual pictures). Few instances of gx to untrained items, conversation, and qualitative speech characteristics (there were a few exceptions, but with nonsignificant effect sizes.). Two participants increased self-ratings of functional communication, and the other rated himself unchanged. Significant others ranked one participant as decreasing, and two as increasing, in regards to functional communication. Two participants rated quality of life lower. Critiques--my interpretation: Lack of improvements is surprising. Perhaps lack of success/improvement on trained items (different pictures every time) caused motivational or other problems with acquisition of targets and untrained exemplars, which led to lack of more significant functional outcomes.
Kurland, J., Wilkins, A. R., & Stokes, P. (2014).	Context for tx: SVR Number of Participants: 5 Aphasia types: fluent (1 Wernicke's, 3 anomic, 1 transcortical sensory) Brief description of Participants: 3f, 2m; 58-80; 17-84mpo AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): 1 true multiple baseline across behaviors; 5 pseudo single-subject designs (no baseline measures, but repeated probing through treatment phases and follow-up) Therapy type/tasks: Following either Promoting Aphasic Communicative Effectiveness (PACE) or Intensive Language Action Therapy (ILAT), participants were trained on an iPad with a multimodal treatment program loaded onto it. This program included multiple phonemic and semantic cues, as well as video clips for action stimuli. Basic treatment approach (domain): semantic/syntactic/conceptual-semantic Stimuli: b/w line drawings of common objects and actions Reliability: none reported

	Author's interpretation: Evidence of a tx effect for all participants for untreated words that were practiced, and many increases on treated words that were practiced. These are gains beyond those made in the initial 2-week intensive tx phase. Critiques--my interpretation: The approach looks promising, although gx to discourse measures is lacking in this report.
Maul, K. K., Conner, P. S., Kempler, D., Radvanski, C., & Goral, M. (2014).	Context for tx: SP Number of Participants: 4 Aphasia types: nonfluent Brief description of Participants: 4f; 38-60; 1.5-7 years post L MCA CVA AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): three case studies Therapy type/tasks: Treatment consisted of a series of language activities (mostly barrier activities) requiring verbs in complete sentence contexts. The clinician assisted in shaping incomplete responses and modeling as needed. Basic treatment approach (domain): semantic/phonological/syntactic Stimuli: probes: 96 colorful action pictures divided into three lists. treatment: colorful, realistic action pictures (not the same exemplars as the probe pictures). Reliability: high inter-rater reliability for 25% of sessions Author's interpretation: Two participants increased in sentence production with treated verbs pre-post. Participants also improved the proportion of grammatical sentences in their responses. One participant generalized to a sequence description task, and two improved on answering wh- questions appropriately. Critiques--my interpretation: It is significant that improved in grammaticality of sentences without the tx targeting it. Perhaps improved retrieval freed up resources for grammatical construction.
Routhier, S., Bier, N., & Macoir, J. (2014).	Context for tx: SVR Number of Participants: 2 Aphasia types: P1 fluent; P2 nonfluent Brief description of Participants: P1: female, 51, 6 years post L CVA. P2: male, 61, 1 year post L MCA CVA AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors and across participants Therapy type/tasks: Two treatment conditions: one with a video and a cued hierarchy providing semantic and phonologic cues to assist in repeating the target, and one (called "repeated") with videos and a single opportunity to try the verb. Basic treatment approach (domain): semantic/syntactic/conceptual-semantic Stimuli: 113 5-s video clips of people performing actions. Three lists of 25 (P1) or 31 (P2) verbs matched for frequency, baseline naming and comprehension score, and syllable length. Reliability: high inter-rater reliability for 100% of probes Author's interpretation: P1: positive acquisition of treated items that received cueing that were maintained at 8 weeks post tx. No gx to the repeated or control lists. P2: Small degree of positive acquisition of treated items towards the end of the tx phase; no obvious improvement on the repeated or control lists. Both reported overall satisfaction with the self-administered tablet tx. Critiques--my interpretation: The smart tablet can be an effective vehicle for verb naming tx; with opportunities for repetition and cues, in addition to video clips of actions, verb naming may improve.
Takizawa, T., Nishida, N., Ikemoto, A., & Kurauchi, N. (2014).	Context for tx: SVR AND SP Number of Participants: 6 Aphasia types: nonfluent (Broca's) with AOS Brief description of Participants: 3f, 3m; 39-69; >13mpo; AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors and across participants--crossover design Therapy type/tasks: Single-word therapy and sentence therapy. Single-word therapy: confrontation naming attempt, given phonologic and semantic cues. Sentence therapy: confrontation sentence production attempt, given argument support and a syntactic frame if needed. Written practice for five of the participants. Basic treatment approach (domain): semantic/phonological/syntactic Stimuli: 80 verb drawings from the Noun and Verb Test and an in-lab test, divided into two treatment lists and an untreated control list.

	Reliability: none reported Author's interpretation: Five of six showed positive acquisition associated with both txs; P1 showed positive acquisition that reached criterion with the single-word therapy condition only. Small amount of gx to untreated items for all participants. Gains maintained at four weeks for five of the six participants. gx to connected speech with the single-verb tx, but not for the sentence production tx. Critiques--my interpretation: Rising baselines for P1, but others look good. Another replication of the effect of single-word txs generalizing to connected speech.
Wambaugh, J. L., Mauszycki, S., & Wright, S. (2014).	Context for tx: SVR Number of Participants: 4 Aphasia types: P1 conduction; P2 anomic; P3 & P4 Broca's with AOS Brief description of Participants: 1f, 4m; 48-90; 21-276mpo post CVA (L for 3, R for 1) AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors and across participants Therapy type/tasks: Semantic Feature Analysis (SFA) modified for action names and designed to describe thematic roles Basic treatment approach (domain): semantic Stimuli: four 10-items lists of actions per participant, redrawn from the OANB, balanced on a variety of psycholinguistic variables. Two lists were designated for treatment, and two for generalization (one repeatedly probed, the other with limited exposure). Reliability: high inter-rater reliability for 25% of probes, 20% of discourse samples Author's interpretation: P1: positive acquisition of treated items in both phases; minimal gx to untreated items. Increased CIUs in a post-tx discourse task. P2: positive acquisition of treated items in both phases; no gx to untreated items. Maintenance of gains at 2 and 6 weeks post tx. P3: No systematic acquisition of treated items or gx to untreated items. P4: positive acquisition of treated items in both phases; no gx to untreated items. Maintenance of gains at 2 and 6 weeks post tx. Critiques--my interpretation: Good evidence for acquisition of trained verbs in 3 of 4 participants. SFA for action names may not be appropriate for very severe cases of aphasia.
de Aguiar, V., Bastiaanse, R., Capasso, R., Gandolfi, M., Smania, N., Rossi, G., et al. (2015).	Context for tx: SVR AND SP Number of Participants: 9 Aphasia types: three fluent, six nonfluent Brief description of Participants: 3f, 6m; 43-76; 8-92mpo; 6 with phonologic impairments, 3 with mixed semantic-phonologic impairments AAN classification of level of evidence: II Experimental design (basic): G Experimental design (detail): group study with double-blind and crossover design Therapy type/tasks: ACTION treatment, which contains four steps: verb retrieval, infinitives retrieval, then finite verbs retrieval, in a sentence context, followed by sentence production in picture description. Semantic and phonologic cueing as needed, as well as a verbal or written model of the sentence if needed. This protocol was administered following a twenty minute tDCS LH anodic and RH cathodic stimulation or sham treatment. Basic treatment approach (domain): semantic/phonological/syntactic Stimuli: b/w line drawings depicting actions Reliability: none reported Author's interpretation: Main effects of time, set (treated vs untreated), phase, stimulation, and verb test. Greater improvement during tDCS stimulation compared to sham. Acquisition of trained verbs and gx to untrained verbs. The effect of concurrent tDCS on the ACTION therapy remains unclear. Critiques--my interpretation: ACTION may be an effective tx option for some with verb retrieval deficits. It is not clear from this study to what extent tDCS may affect response to ACTION tx.
Galletta, E. E., & Vogel-Eyny, A. (2015).	Context for tx: SVR AND SP Number of Participants: 1 Aphasia types: fluent (anomic) Brief description of Participants: 1m; 42, 20mpo L CVA AAN classification of level of evidence: III Experimental design (basic): CS Experimental design (detail): case study with double blind and crossover Therapy type/tasks: Three treatments: sentence production training (emphasizing production of sentences of increasing difficulty). sentence-embedded production training, which involved sentence production for describing a scene; focused discourse: the clinician and patient browsed a newspaper to come up with topics to discuss, and the clinician provided recasts and other strategies to support the patient's productions. Anodic or sham tDCS applied to Broca's area during the first twenty

	minutes of a session. Basic treatment approach (domain): semantic/phonological/syntactic/neuropsychological Stimuli: colored pictures of transitive sentences with action verbs Reliability: unspecified reliability for 100% of sessions Author's interpretation: Increases in verb retrieval in sentences after anodic TMS; gx to untreated items Critiques--my interpretation: Presentation of two participants would be better as a true multiple baselines design. However, the results suggest that tDCS concurrent with the speech and language tx provided, improves acquisition of targets and generalizes to untrained items.
Knoph, M. I. N., Lind, M., & Simonsen, H. G. (2015).	Context for tx: SP Number of Participants: 1 Aphasia types: nonfluent Brief description of Participants: 1f; 59; 7mpo L CVA; quadrilingual (tx provided in L4, Norwegian) AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): case study Therapy type/tasks: SFA for actions Basic treatment approach (domain): semantic Stimuli: b/w drawings of actions from the Verb and Sentence Resource; later color drawings and photos from online Reliability: high inter-rater reliability for 33% of probes Author's interpretation: Production of trained verbs in L4 increased with tx, but no gx to untreated verbs. Production in L2 (English) decreased with tx, but increased in L3 (German), and did not change in L1 (Japanese). L4 and L3 sentences more complete after tx, while L2 sentences remained unchanged, and L1 sentences decreased in complexity and completeness. In L4, %CIUs increased, but not in the other languages. Critiques--my interpretation: Verb training with SFA for bilingual/multilingual speakers may be associated with acquisition of action names, but gx to other languages varies considerably.
Lavoie, M., Routhier, S., Legare, A., & Macoir, J. (2015).	Context for tx: SVR Number of Participants: 1 Aphasia types: nonfluent (mixed) Brief description of Participants: 1f; 63, 2 years post L MCA CVA AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines across behaviors Therapy type/tasks: n Basic treatment approach (domain): n Stimuli: visual presentation of the pictured verb on the iPad screen, along with an increasing cueing hierarchy to scaffold written production of the action name. Control list was pictured without a cueing hierarchy. Home practice on the iPad. Reliability: semantic/phonological Author's interpretation: three lists of forty pictured verbs, with actions being performed by human actors Critiques--my interpretation: high inter-rater reliability
Macoir, J., Leroy, M., Routhier, S., Auclair-Ouellet, N., Houde, M., & Laforce, R., Jr. (2015).	Context for tx: SVR Number of Participants: 1 Aphasia types: Primary Progressive Aphasia (PPA w/inferiolateral deterioration--more pronounced in left) Brief description of Participants: 1f; 72; 2 years post diagnosis AAN classification of level of evidence: III Experimental design (basic): SSD Experimental design (detail): multiple baselines withdrawal design (ABA) Therapy type/tasks: one list given increasing cue therapy (semantic and phonologic cues following observation of the action video and an attempt to name); the second list given repetition therapy (observation of the action video and an attempt to name) Basic treatment approach (domain): semantic/phonological/conceptual-semantic Stimuli: 111 5-s videos of actions being performed, divided in three lists of 37 (two treatment phase lists, one control list) Reliability: high inter-rater reliability for 100% of probes Author's interpretation: Possible improvement with application of therapy (but rising baselines). No significant gx to untreated verbs.

	Critiques--my interpretation: Therapy likely was responsible for the change, as the slope during tx appears different than in baseline.
Manenti, R., Petesi, M., Brambilla, M., Rosini, S., Miozzo, A., Padovani, A., et al. (2015).	Context for tx: SVR Number of Participants: 1 Aphasia types: nonfluent Brief description of Participants: 1f; 49; 8mpo L MCA CVA AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): case study Therapy type/tasks: semantic-phonologic cueing treatment for verbs; performed after a-tDCS of L DLPFC and c-tDCS of the R homologous area Basic treatment approach (domain): semantic/phonological/neuropsychological Stimuli: 58 b/w line drawings Reliability: none reported Author's interpretation: acquisition of target verbs and gx to untreated verbs. Critiques--my interpretation: Another example tDCS, although design does not allow clear differentiation between effects of the behavioral therapy and the tDCS.
Routhier, S., Bier, N., & Macoir, J. (2015).	Context for tx: SVR Number of Participants: 2 Aphasia types: nonfluent (P1 mixed, P2 Broca's) Brief description of Participants: P1: female, 49, 9 years post L CVA. P2: female, 59, 37 years post L CVA AAN classification of level of evidence: IV Experimental design (basic): CS Experimental design (detail): case study Therapy type/tasks: one list given increasing cue therapy (semantic and phonologic cues following observation of the action video and an attempt to name); the second list given repetition therapy (observation of the action video and an attempt to name) Basic treatment approach (domain): semantic/phonological/conceptual-semantic Stimuli: 113 5-s videos of actions being performed, (three lists of 37 items: two treatment phase lists, one control list) Reliability: high inter-rater reliability for 100% of probes Author's interpretation: Increase in naming of treated items for P1 & P2. Gains maintained for 2, 4, and 6 weeks for P1, but not for P2. no gx to untreated items. Critiques--my interpretation: Provides contrary evidence to other findings of the efficacy of action observation in verb naming.

APPENDIX B

SENTENCE COMPLETION STIMULI BY PARTICIPANT

Participant 1

list	target	sentence stem	synonyms	norming study responses
A1	CAUSE	Be careful with your private information. You never know what problems sharing it may	beget, breed, bring, bring about, bring on, catalyze, effect, create, do, draw on, effectuate, engender, generate, induce, invoke, make, occasion, produce, prompt, result in, spawn, translate into, work, yield	start, cause, create, occur, bring
A1	ENFORCE	It is almost impossible to see if people are wearing their seatbelts while driving on the freeway. The seat belt law is difficult to	administer, apply, execute, implement	enforce, keep, follow, uphold
A1	EXPECT	My sister always shows up late to everything. Her tardiness is what we have come to	anticipate, await, hope for, watch for	expect, accept, notice, adapt, tolerate, hate
A1	FEEL	The dentist just numbed my mouth. Now the pain is hard to	perceive, see, sense, touch	feel, locate, bear
A1	GUESS	Don't spend too much time on a question. if you don't know the answer, just try to	assume, conjecture, daresay, imagine, presume, speculate, suppose, surmise, suspect,	guess ,ask, answer
A1	MOURN	Our next-door neighbor lost his	agonize, anguish, bleed, hurt, grieve, sorrow,	mourn, grieve, feel, mourned,

		grandmother. Her death we all	suffer	felt, grieved
A1	OFFER	I noticed an older woman carrying many groceries. Although it looked she had things under control, my help is what I thought I should	extend, give, proffer, tender, trot out, advance, bounce, propose, pose, proffer, propound, suggest, vote, carry, give, mount, present, stage	offer, lend, give, receive, share
A1	PLEASE	It was difficult to gain the man's approval. He was a hard man to	agree with, content, delight, feast, gladden, gratify, pleasure, rejoice, satisfy, suit, warm, like, choose, want, will, wish	please, impress, convince, appease, find, befriend, influence
A1	PREFER	I like all kinds of chocolate. Between dark and milk chocolate, milk chocolate is the one that I	care for, favor, lean toward, like, cherry-pick, cull, elect, handpick, name, opt for, pick, choose, select, single out, tag, take	prefer, refuse, eat, favor, best, desire
A1	PREPARE	The professor teaches three classes on Monday. To get ready, he has a lot of materials he needs to	fit, fix, groom, lay, prep, ready, cast, craft, draft, draw up, formulate, frame, compose	review, collect, prepare, organize, gather, study
A2	APPOINT	The old senator passed away. In his place, a successful businessman is who the governor will	designate, fix, name, set, assign, attach, commission, constitute, designate, detail, nominate, place	appoint, take over, be appointed, preside, replace nominate, select, support, elect, hire
A2	DESCRIBE	The explorers returned with a lot of documentation. A rhinoceros, to someone who has never seen one before, is difficult to	delineate, depict, draw, image, limn, paint, picture, portray, render, set out, sketch, chart, chronicle, character, tell, narrate, recount, relate, report, define, characterize, portray, represent	recognize, picture, describe, ignore, comprehend, place, explain, imagine, visualize, understand, identify
A2	DESERVE	My grandma always rewards me. She says after a long day of work, a big bowl of ice cream is what I	earn, merit, rate	need, deserve, earned, have earned, eat

A2	EARN	My mother won't just give me money for asking for it. She says it's something I need to	acquire, attain, bag, bring in, capture, carry, come by, draw, gain, garner, get, knock down, land, make, obtain, procure, pull down, realize, reap, secure, win, deserve, merit, rate	earn
A2	FORGIVE	When we make mistakes, adults are quick to condemn. However, children are quick to	pardon, blink at, brush off, condone, discount, disregard, excuse, gloss over, gloze over, ignore, overlook, overpass, paper over, pardon, pass over, remit, shrug off, whitewash, wink at	forgive, overlook, learn
A2	GAIN	Going on the trip will be educational. There is a lot of experience that you will	build up, gather, grow, pick up, acquire, attain, bag, bring in, capture, carry, come by, draw, earn, garner, get, knock down, land, make, obtain, procure, pull down, realize, reap, secure, win	gain, remember, bring back, value, have, acquire, get, receive, enjoy
A2	KEEP	I sort through my toys. Most of my old toys I donate to thrift stores, but there are a few that I	hold, reserve, retain, withhold	keep
A2	LEARN	Preschool is important for growth and development. Colors, letters, shapes and numbers are a few things that children	get, master, pick up, con, memorize, study	learn, remember
A2	MAINTAIN	While running a race, keep a steady pace. Too fast a pace may be difficult to	conserve, keep up, preserve, save, support, uphold	maintain, keep, finish, continue, sustain
A2	RISK	Not wearing a seatbelt is dangerous. Your life is what you	adventure, chance, gamble on, hazard, tempt, venture	risk, endanger, lose, protect, need, jeopardize, value
C	ARREST	The brand-new policeman took the suspect into custody. He was the first criminal he would	apprehend, collar, nab, nail, pick up, pinch, pull in, restrain, run in, seize	arrest, prosecute, apprehend, convict, collar, indict, book

		ever		
C	FIGHT	When you're sick, get plenty of rest. The infection is what your body will	battle, clash with, combat, scrimmage with, skirmish with, war against, contend with, counter, oppose, oppugn, resist, repel, withstand	fight, reject, prevent, do, heal, attack, overcome
C	HANDLE	The school should consider hiring more teachers. Fifteen preschoolers may be too much for one teacher to	address, contend with, cope with, field, grapple with, hack, manage, maneuver, manipulate, negotiate, play, swing, take, treat	handle, manage, supervise
C	HANG	The wall in our bedroom looks empty. I bought some pictures I want to	dangle, sling, suspend, swing	hang, display, decorate with
C	MEASURE	The contractor wondered if the board was long enough. To make sure, the board is what he will	gauge, scale, span	measure, order
C	STOP	The policeman was directing traffic. He put up his hand to the car that he wanted to	arrest, bring up, catch, check, draw up, fetch up, hold up, pull up, stall, stay, still, halt	stop, direct, go
C	STUDY	I want to do well on the test. My notes are what I will	bone up, con, learn, memorize, chew over, cogitate, consider, contemplate, debate, deliberate, entertain, eye, kick around, meditate, mull over, perpend, pore over, question, revolve, ruminate, ponder, think over, turn, weigh, wrestle with	study, review, learn, bring
C	TACKLE	The football player looked at the other team's quarterback. He was the one that he needed to	dive into, attack, wade into	tackle, block, outwit, reach, defend, defeat, cover, sack, approach, hit, evade, stop
C	WEAR	School starts again tomorrow. I	-	wear

		pick out my favorite outfit to		
C	WITNESS	Tyler was walking down the street. He did not realize that a crime is what he would soon	behold, catch, descry, discern, distinguish, espy, eye, look at, note, notice, observe, perceive, regard, remark, sight, spot, spy, view, see	witness, encounter, see, commit, occur, happen
M	ATTEND	We cannot go to the movies tonight. We have a wedding we need to	see, watch	attend, plan
M	BRING	The swimming party is Saturday. Add a towel and sunscreen to the list of things you should	beget, breed, effect, bring about, bring on, catalyze, cause, create, do, draw on, effectuate, engender, generate, induce, invoke, make, occasion, produce, prompt, result in, spawn, translate into, work, yield	bring, take, remember
M	BUY	We are going to meet with a realtor. We're looking for a new house to	pick up, purchase, take	purchase, buy
M	HELP	The teacher had two struggling students. The student the furthest behind was the first one she wanted to	abet, aid, assist, back, backstop, prop up, support	help, assist, cut, fail, assess
M	HIRE	I was impressed with the first applicant. He is the one we ought to	charter, engage, lease, rent, assume, engage, employ, pay, place, recruit, retain, sign on, take on	consider, hire, accept, choose, select
M	OPEN	The birthday girl is excited to find out what all of her presents are. The present wrapped in silver paper is the first one she will	unclose, clear, free	open, tear into

M	PRODUCE	The fruit trees needed fertilizer. More fruit is what they would then	beget, breed, bring, bring about, bring on, catalyze, cause, create, do, draw on, effectuate, engender, generate, induce, invoke, make, occasion, effect, prompt, result in, spawn, translate into, work, yield	produce, yield, acquire, bear, grow
M	PUBLISH	The author has been working for years on several different projects. There are many books he is now ready to	get out, issue, print, put out	publish, release, write, complete
M	RESCUE	The sailor was stranded at sea. He is someone that we need to	bail out, bring off, deliver, save	rescue, find, save, maroon, locate
M	TUNE	The strings on our old piano need to be tightened. Older instruments can be difficult to	-	maintain, tune, repair

Participant 2

list	target	sentence stem	synonyms	norming sample responses
A1	APPOINT	The old senator passed away. In his place, a successful businessman is who the governor will	designate, fix, name, set, assign, attach, commission, constitute, designate, detail, nominate, place	appoint, take over, be appointed, preside, replace, nominate, select, support, elect, hire
A1	DEFEND	Before graduating, the student still needed to go before his committee. His thesis is what he still has to	bulwark, cover, fence, fend, forefend, guard, keep, protect, safeguard, screen, secure, shield, ward, maintain, justify, support, uphold	defend, write, present, complete

A1	KEEP	I sort through my toys. Most of my old toys I donate to thrift stores, but there are a few that I	hold, reserve, retain, withhold	keep
A1	LEARN	Preschool is important for growth and development. Colors, letters, shapes and numbers are a few things that children	get, master, pick up, con, memorize, study	learn, remember
A1	OWE	The bill is important to look at. It tells you how much you	-	owe
A1	PREFER	I like all kinds of chocolate. Between dark and milk chocolate, milk chocolate is the one that I	care for, favor, lean toward, like, cherry-pick, cull, elect, handpick, name, opt for, pick, choose, select, single out, tag, take	prefer, refuse, eat, favor, best, desire
A1	PREPARE	The professor teaches three classes on Monday. To get ready, he has a lot of materials he needs to	fit, fix, groom, lay, prep, ready, cast, craft, draft, draw up, formulate, frame, compose	review, collect, prepare, organize, gather, study
A1	SAVE	A firefighter's job is important. Every day there are many lives to	bail out, bring off, deliver, rescue, pinch, economize, scrimp, skimp, spare	save, protect
A1	TRUST	The firefighters tell the girl to jump and they will catch her. The firefighters are who the girl needs to	commend, commit, confide, consign, delegate, deliver, entrust (also intrust), give over, hand, hand over, leave, pass, recommend, repose, transfer, transmit, give, turn over, vest	watch, trust, follow, help, obey, fear, listen, see
A1	WELCOME	The statue of liberty is a symbol. New immigrants we	drink in, lap up, embrace, eat up	are, welcome, admire, cherish, see, salute you, accept, embrace, like

A2	DESCRIBE	The explorers returned with a lot of documentation. A rhinoceros, to someone who has never seen one before, is difficult to	delineate, depict, draw, image, limn, paint, picture, portray, render, set out, sketch, chart, chronicle, character, tell, narrate, recount, relate, report, define, characterize, portray, represent	recognize, picture, describe, ignore comprehend, place, explain, imagine, visualize, understand, identify
A2	EXPLAIN	My car broke down on my way to the party. The reason I was late was easy to	clarify, clear up, construe, demonstrate, demystify, elucidate, explicate, expound, get across, illuminate, illustrate, interpret, simplify, spell out, unriddle, account for	explain, see, understand, guess, fix it, excuse, know
A2	FORGET	The man must file his taxes next week. He ties a string on his finger so he will not	disremember, unlearn, neglect, shirk, fail, omit	forget
A2	FORGIVE	When we make mistakes, adults are quick to condemn. However, children are quick to	pardon, blink at, brush off, condone, discount, disregard, excuse, gloss over, gloze over, ignore, overlook, overpass, paper over, pardon, pass over, remit, shrug off, whitewash, wink at	forgive, overlook, learn
A2	GAIN	Going on the trip will be educational. There is a lot of experience that you will	build up, gather, grow, pick up, acquire, attain, bag, bring in, capture, carry, come by, draw, earn, garner, get, knock down, land, make, obtain, procure, pull down, realize, reap, secure, win	gain, remember, bring back, value, have, acquire, get, receive, enjoy
A2	LOSE	We are five points behind. This game is one we don't want to	mislay, misplace, drop, bow out, fail, blow, dissipate, fiddle away, fritter away, lavish, waste, misspend, run through, spend, squander, throw away, trifle away	lose, win
A2	LOVE	Valentine's Day is in February. We give valentines to our family members we	appreciate, cherish, prize, treasure, value, adore, worship, delight in, dig, fancy, get off on, groove on, like, enjoy, rejoice in, relish, revel in, savor	love, like

A2	MAINTAIN	While running a race, keep a steady pace. Too fast a pace may be difficult to	conserve, keep up, preserve, save, support, uphold	maintain, keep, finish, continue, sustain
A2	MOURN	Our next-door neighbor lost his grandmother. Her death we all	agonize, anguish, bleed, hurt, grieve, sorrow, suffer	mourn, grieve, feel, mourned, felt, grieved
A2	SOLVE	The teacher just handed out the math test. There are many problems to	answer, break, crack, dope (out), figure out, puzzle (out), resolve, riddle (out), unravel, unriddle, work, work out	solve, complete, figure out, answer, do
C	AWARD	The end of the year ceremony is tomorrow. Three scholarships are what we will	reward, accord, confer, grant, vest	award, earn, announce, present, give, be awarded, achieve, offer, distributed, reward
C	CUT	I have the scissors. Tell me which string I need to	gash, incise, rip, shear, slash, slice, slit	cut, snip
C	HANG	The wall in our bedroom looks empty. I bought some pictures I want to	dangle, sling, suspend, swing	hang, display, decorate with
C	HURT	My friend doesn't tell me the food tastes terrible. It's my feelings she doesn't want to	ache, pain, smart, damage, harm, injure, wound, agonize, anguish, bleed, grieve, mourn, sorrow, suffer, blemish, bloody, break, compromise, crab, cripple, cross up, deface, disfigure, endamage, flaw, harm, impair, mar, spoil, vitiate	hurt, offend
C	PICK	Please pull the car over. I see some wildflowers I want to	gather, harvest, reap, cherry-pick, cull, elect, handpick, select, tag, take, single out	photograph, pick, sniff, smell
C	PUSH	An elevator is easy to operate. There are only a few buttons to	drive, propel, shove, thrust, bore, bull, bulldoze, crash, elbow, jam, jostle, muscle, press, shoulder, squeeze	press, push, select, know

C	RECORD	I'm going to be gone when the big game is on TV. To watch it later, the game is what I'll	jot down, log, mark, note, put down, register, report, set down, take down, write down	record, DVR, tape
C	TACKLE	The football player looked at the other team's quarterback. He was the one that he needed to	dive into, attack, wade into	tackle, block, outwit, reach, defend, defeat, cover, sack, approach, hit, evade, stop
C	WITNESS	Tyler was walking down the street. He did not realize that a crime is what he would soon	behold, catch, descry, discern, distinguish, espy, eye, look at, note, notice, observe, perceive, regard, remark, sight, spot, spy, view, see	witness, encounter, see, commit, occur, happen
C	WRITE	I haven't communicated with my friend in a long time. A long letter is what I should	author, pen, scratch, scribble, correspond	write, consider, do, send
M	BRING	The swimming party is Saturday. Add a towel and sunscreen to the list of things you should	beget, breed, effect, bring about, bring on, catalyze, cause, create, do, draw on, effectuate, engender, generate, induce, invoke, make, occasion, produce, prompt, result in, spawn, translate into, work, yield	bring, take, remember
M	COLLECT	I don't see the value in having a lot of knick-knacks. A lot of dust is what they	accrete, accumulate, amass, build up, concentrate, conglomerate, gather, mass, pile up, stack up, anthologize, compile, assemble, corral, garner, group, lump, pick up, round up, constellate	collect, acquire, gather, accumulate, claim
M	ENTER	We could not go in any of the stores quite yet. As soon as they unlock the door, the sporting goods store is the first store we will	access, penetrate, pierce	enter, shop, visit, go to, hit
M	FILL	The club was holding elections. There were many empty	brim, charge, cram, heap, jam, jam-pack, load, pack, stuff,	fill, run, filled

		positions to		
M	HIRE	I was impressed with the first applicant. He is the one we ought to	charter, engage, lease, rent, assume, engage, employ, pay, place, recruit, retain, sign on, take on	consider, hire, accept, choose, select
M	OPEN	The birthday girl is excited to find out what all of her presents are. The present wrapped in silver paper is the first one she will	unclose, clear, free	open, tear into
M	PLAY	Jenny likes the game of chess. She says it's a fun game to	dally, disport, frolic, recreate, rollick, skylark, sport, toy,	play, win, lose
M	RESCUE	The sailor was stranded at sea. He is someone that we need to	bail out, bring off, deliver, save	rescue, find, save, maroon, locate
M	SELL	Oscar was running out of money. Unless he got more money soon, his motorcycle is what he would	deal, merchandise, put up, retail, market, vend	discard, sell, ride, pawn, have to sell, lose
M	TUNE	The strings on our old piano need to be tightened. Older instruments can be difficult to	-	maintain, tune, repair, fix

Participant 3

set	target	sentence completion stems	synonyms	norming sample responses
A1	APPOINT	The old senator passed away. In his place, a successful businessman is who the governor will	designate, fix, name, set, assign, attach, commission, constitute, designate, detail, nominate, place	appoint, take over, be appointed, preside, replace, nominate, select, support, elect, hire
A1	BELIEVE	The two witnesses had different stories. The judge wasn't sure which	accept, buy, credit, swallow, take, trust, allow, conceive, consider, esteem, deem,	believe, vindicate

		story he should	feel, figure, guess, hold, imagine, judge, reckon, suppose, think	
A1	CURE	The scientist discovered a new plant. There were three types of cancer it could	heal, mend, remedy, fix, rehab, rehabilitate, set up	benefit, cure, alleviate, treat, prevent, help, cause, medicate
A1	FORGET	The man must file his taxes next week. He ties a string on his finger so he will not	disremember, unlearn, neglect, shirk, fail, omit	forget
A1	FORGIVE	When we make mistakes, adults are quick to condemn. However, children are quick to	pardon, blink at, brush off, condone, discount, disregard, excuse, gloss over, gloze over, ignore, overlook, overpass, paper over, pardon, pass over, remit, shrug off, whitewash, wink at	forgive, overlook, learn
A1	GAIN	Going on the trip will be educational. There is a lot of experience that you will	build up, gather, grow, pick up, acquire, attain, bag, bring in, capture, carry, come by, draw, earn, garner, get, knock down, land, make, obtain, procure, pull down, realize, reap, secure, win	gain, remember, bring back, value, have, acquire, get, receive, enjoy
A1	KEEP	I sort through my toys. Most of my old toys I donate to thrift stores, but there are a few that I	hold, reserve, retain, withhold	keep
A1	MAINTAIN	While running a race, keep a steady pace. Too fast a pace may be difficult to	conserve, keep up, preserve, save, support, uphold	maintain, keep, finish, continue, sustain
A1	SOLVE	The teacher just handed out the math test. There are many problems to	answer, break, crack, dope (out), figure out, puzzle (out), resolve, riddle (out), unravel, unriddle, work, work out	solve, complete, figure out, answer, do
A1	TRUST	The firefighters tell the girl to jump and they will catch her. The firefighters are who the girl needs to	commend, commit, confide, consign, delegate, deliver, entrust (also intrust), give over, hand, hand over, leave, pass,	watch, trust, follow, help, obey, fear, listen, see

			recommend, repose, transfer, transmit, give, turn over, vest	
A2	DESCRIBE	The explorers returned with a lot of documentation. A rhinoceros, to someone who has never seen one before, is difficult to	delineate, depict, draw, image, limn, paint, picture, portray, render, set out, sketch, chart, chronicle, character, tell, narrate, recount, relate, report, define, characterize, portray, represent	recognize, picture, describe, ignore, comprehend, place, explain, imagine, visualize, understand, identify
A2	ENFORCE	It is almost impossible to see if people are wearing their seatbelts while driving on the freeway. The seat belt law is difficult to	administer, apply, execute, implement	enforce, keep, follow, uphold
A2	ENJOY	Some people go regularly to symphony concerts. Classical music is something they	adore, delight in, dig, fancy, get off on, groove on, like, love, rejoice in, relish, revel in, savor	enjoy, love, crave, like
A2	EXPECT	My sister always shows up late to everything. Her tardiness is what we have come to	anticipate, await, hope for, watch for	expect, accept, notice, adapt, tolerate, hate
A2	GUESS	Don't spend too much time on a question. if you don't know the answer, just try to	assume, conjecture, daresay, imagine, pres ume, speculate, suppose, surmise, suspect,	guess, ask, answer
A2	LIKE	There are many colors available. I hope you find one that you	care for, want, lean towards, prefer, adore, delight in, dig, fancy, get off on, groove on, enjoy, love, rejoice in, relish, revel in, savor	like, love, enjoy, want
A2	MOURN	Our next-door neighbor lost his grandmother. Her death we all	agonize, anguish, bleed, hurt, grieve, sorrow, suffer	mourn, grieve, feel, mourned, felt, grieved
A2	OWE	The bill is important to look at. It tells you how much you	-	owe

A2	PREPARE	The professor teaches three classes on Monday. To get ready, he has a lot of materials he needs to	fit, fix, groom, lay, prep, ready, cast, craft, draft, draw up, formulate, frame, compose	review, collect, prepare, organize, gather, study
A2	RISK	Not wearing a seatbelt is dangerous. Your life is what you	adventure, chance, gamble on, hazard, tempt, venture	risk, endanger, lose, protect, need, jeopardize, value
C	BREAK	Be careful while carrying the mirror. If you drop it, the glass is what you will	break up, bust, disintegrate, dismember, disrupt, fracture, fragment, rive	break, get cut on, shatter
C	BURY	Our dog is always digging holes in the yard. Bones are one of his favorite things to	hide, cache, conceal, ensconce, secrete	bury, find, discover, hide
C	CONTACT	The customer service desk answers phone calls, emails, and letters. If you need something, they are the ones you should	address, communicate with, get, reach	contact, ask, call
C	HANDLE	The school should consider hiring more teachers. Fifteen preschoolers may be too much for one teacher to	address, contend with, cope with, field, grapple with, hack, manage, maneuver, manipulate, negotiate, play, swing, take, treat	handle, manage, supervise
C	HEAR	Lightning is something we see. Thunder is something we	attend, hark, harken, listen, hearken, heed, mind	hear
C	HIT	Tennis is a physical sport. The ball is what the players try to	bang, bash, bat, belt, biff, bludgeon, bob, bonk, bop, box, bust, clap, clip, clobber, clock, clout, crack, hammer, knock, nail, paste, pound, punch, rap, slam, slap, slog, slug, smack, smite, sock, strike, swat, swipe, tag, thump, thwack, wallop, whack, whale, zap	hit, serve
C	MEASURE	The contractor wondered if the board was long enough. To make	gauge, scale, span	measure, order

		sure, the board is what he will		
C	PUSH	An elevator is easy to operate. There are only a few buttons to	drive, propel, shove, thrust, bore, bull, bulldoze, crash, elbow, jam, jostle, muscle, press, shoulder, squeeze	press, push, select, know
C	SLAP	My mother told me I was not to eat any more cookies. If I reached into the cookie jar one more time, my hand is what she would	bang, bash, bat, belt, biff, bludgeon, bob, bonk, bop, box, bust, clap, clip, clobber, clock, clout, crack, hammer, knock, nail, paste, pound, punch, rap, slam, hit, slog, slug, smack, smite, sock, strike, swat, swipe, tag, thump, thwack, wallop, whack, whale, zap	slap, amputate, smack, catch, spank, remove, hit, spat
C	STUDY	I want to do well on the test. My notes are what I will	bone up, con, learn, memorize, chew over, cogitate, consider, contemplate, debate, deliberate, entertain, eye, kick around, meditate, mull over, perpend, pore over, question, revolve, ruminate, ponder, think over, turn, weigh, wrestle with	study, review, learn, bring
M	BUY	We are going to meet with a realtor. We're looking for a new house to	pick up, purchase, take	purchase, buy
M	COLLECT	I don't see the value in having a lot of knick-knacks. A lot of dust is what they	accrete, accumulate, amass, build up, concentrate, conglomerate, gather, mass, pile up, stack up, anthologize, compile, assemble, corral, garner, group, lump, pick up, round up, constellate	collect, acquire, gather, accumulate, claim
M	DESIGN	My son is an architect for a construction company. Apartment complexes, and single-family homes are a few buildings he gets to	arrange, blueprint, budget, calculate, chart, choreograph, plan, frame, lay out, map out, organize, prepare, project, scheme out, shape, strategize about	design, manage, plan
M	ENTER	We could not go in any of the stores quite yet. As soon as they unlock the	access, penetrate, pierce	enter, shop, visit, go to, hit

		door, the sporting goods store is the first store we will		
M	FOLLOW	Our dog wasn't lost for long. His muddy trail was easy to	bird-dog, chase, course, dog, hound, pursue, run, shadow, tag, tail, trace, track, trail	see, follow, track, find, spot
M	JOIN	Ronald had lots of free time. He wondered which club he should	enlist in, enroll in, enter, sign on for, sign up for	join, attend, hit, play, try out
M	MISS	Fred was in a new country. There were many things back home he started to	-	miss, appreciate, do, request
M	PASS	John stepped on the gas. There was a slow car ahead that he wanted to	chase, pursue, gain, reach, surpass, overtake	pass, catch, beat, avoid
M	RESCUE	The sailor was stranded at sea. He is someone that we need to	bail out, bring off, deliver, save	rescue, find, save, maroon, locate
M	SELL	Oscar was running out of money. Unless he got more money soon, his motorcycle is what he would	deal, merchandise, put up, retail, market, vend	discard, sell, ride, pawn, have to sell, lose

APPENDIX C

TREATMENT PROTOCOL

Treatment session steps:

Introducing each session: Show the first sentence frame and say, "*We are going to practice sentences that are about a person (point to the person spot) that is doing something (point to the verb) with someone or something (point to the last slot).*"

Estimated time per target: five to seven minutes (10 targets per session).

For each target verb:

Step 1 Request for imitation of the target verb after a verbal model of the verb in an SVO sentence:

1. Say, "I'm going to say a sentence with three important parts: a person doing something, an action that the person is doing, and the thing that the person is performing the action with. After I say the sentence, you tell me the action word in the sentence." (After the first item in a session, feel free to abbreviate to just, "Tell me the action word in this sentence".) Provide a verbal model of the target verb in an SVO sentence (with these semantic roles: ANIMATE-SUBJECT (person or animal) TARGET-VERB OBJECT (animate or inanimate). Give, as needed and in this order, a phonemic cue, a repeat of the full model, and integral stimulation as needed, up to three attempts.

Step 2 Creating sentences with the abstract verb:

1. Present the sentence frame[1] for the target verb. The sentence frames already

[1] The sentence frame has a slot for the agent (a person), the target verb, and the object (a person or thing)

have the verb in the middle slot.

2. Write down the agent and the object from your example sentence in the first line, model the sentence, and request a repetition of the entire sentence. Underline any sound errors and provide phonemic cues and/or IS as necessary. Three maximum solo attempts.
3. Copy down (to the next line) either the subject or the object and request the other agent or object by saying, "*Tell me someone else who can TARGET OBJECT" or "Tell me someone or something else that AGENT can TARGET."*
    a. If plausible response, then reinforce, write the word on the sentence frame, and repeat the sentence.
    b. If inappropriate or no response, select two plausible options (ideas provided in the word bank[2]) and provide a forced choice between two. After the patient selects one, reinforce, write and model the selected one.
        i. If still inappropriate or no response, say, "*Say <insert one of the two options>*." Provide phonemic cues and/or IS if there are sound errors. Three maximum solo attempts.
4. After both slots are filled in a sentence, model and request a repetition of the entire sentence. Provide phonemic cues and/or IS if there are sound errors. Three maximum solo attempts.
5. Repeat step 3 again so all three rows on the sentence frame are filled. Where appropriate, provide and encourage variation of word selection within and between sessions.

Step 3 <u>Production practice with alternating contrastive stress placement</u>:

1. Pick <u>one</u> of the sentences and ask three separate questions to elicit contrastive

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[2] These are functional clinician-selected corpus-informed collocates, as well as items from the client-informed list prepared before treatment. Vary these between sessions as much as is reasonable, depending on the verb's possibilities and the patient's preferences. The idea is that this may promote rehabilitation of extracting meaning from context (PWA can improve naming with incidental word learning [statistical word learning based on increased frequencies of appearance of "correct" pairings compared to "incorrect"], even without online feedback, showing that bottom-up frequency-based word learning is possible in PWA (Breitenstein, Kamping, Jansen, Schomacher, & Knecht, 2004)).

stress, once for each of the three major slots. For the foil, pick semantically unlikely alternatives (i.e., if the sentence is, "I enjoy movies," the question to highlight the object might be, "Do you enjoy doors?" or the question to highlight the verb might be "Do you break movies?").

   a. If appropriate response with stress in the correct position, reinforce.
   b. If the words are correct, but the stress is not in the correct position or present at all, point to and model the word that needs to be emphasized.

2. If the answer is incorrect, encourage and model, emphasizing (with exaggeration if necessary) the stress on the appropriate word by increasing its duration, intensity, and pitch. Underline any sound errors and provide phonemic cues and/or IS as necessary. Three maximum solo attempts.
   a. If still not producing sufficient emphasis, move on.

Step 4 Sentence repetition from memory[3]: Remove the sentence frame from view. Wait five seconds, then repeat the most recent (contrastive stress) question.

1. If successful, reinforce and proceed to the next target.
2. If unsuccessful, model the sentence and request a repetition again. If needed, provide phonemic cues and/or IS as necessary. Allow a maximum of three more attempts, and then proceed to the next target.

[3] (Potagas, Kasselimis, & Evdokimidis, 2011)

APPENDIX D

FORM FOR TRACKING PROTOCOL ADHERENCE

Participant ID: _____	At beginning of session, show the first sentence frame and say, "We are going to practice sentences that are about a person (point to the person spot) that is doing something (point to the verb) with someone or something (point to the last slot)."									
	Step 1: Request for imitation of the target verb after a verbal model of the verb in an SVO sentence	Step 2-- Creating sentences with the target verb						Step 3--Exploring the meaning and contrastive stress practice		Step 4--sentence repetition from memory
Date: _____ Session #: _____	Say, "I'm going to say a sentence with three important parts: a person doing something, an action that the person is doing, and the thing that the person is performing the action with. After I say the sentence, you tell me the action word in the sentence." (After first item in a session, abbr.:"Tell me the action word in this sentence".) Give verbal model of target verb in SVO sentence (ANIMATE-SUBJECT, TARGET-VERB, OBJECT. As needed phon. cue, rep. of sentence model, and IS, up to 3 attempts.	Write down the agent and the object from example sentence in the first line of sent. fram, model sentence, and req a rep. Underline sound errors and provide phon. cues and/or IS as necessary. Three maximum solo attempts.	Copy down (to next line) the subject or the object and request the other agent or object by saying, "Tell me someone else who can TARGET OBJECT" or "Tell me someone or something else that AGENT can TARGET."	**If plausible response,** then reinforce, write the word on the sentence frame, and repeat the sentence. Underline any sound errors and provide phonemic cues and/or IS as necessary. Three maximum solo attempts. **Errors** If inappropriate or no response, select two plausible options (ideas provided in the word bank) and provide a forced choice between two. After the patient selects one, reinforce, write and model the selected one.	**Errors** If inappropriate or no response, select two plausible options (ideas provided in the word bank) and provide a forced choice between two. After the patient selects one, reinforce, write and model the selected one.	**Inacc S or O w/support:** If still inappropriate or no response, say, "Say <insert one of the two options>." Provide phonemic cues and/or IS if there are sound errors. Three maximum solo attempts.	After both slots are filled in a sentence, model and request a repetition of the entire sentence. Provide phonemic cues and/or IS if there are sound errors. Three maximum solo attempts. Then, repeat steps 1 and 2 again so three rows on the sentence frame are filled. Where appropriate, provide and encourage variation of word selection within and between sessions.	Pick one of the sentences and ask three separate questions to elicit contrastive stress, once for each of the three major slots. Pick semantically unlikely alternatives (i.e., if the sentence is, "I enjoy movies," the question to highlight the object might be, "Do you enjoy doors?")	a If appropriate response with stress in the correct position, reinforce. b If words are correct, but stress not in correct position, point to and model word needing emphasis c If words incorr., model stress of correct word. Underline sound errors, provide phon. cues and/or IS as nec. 3 max solo attempts.	Remove the sentence frame from view. Wait five seconds, then repeat the most recent question. **Ace**--reinf. **Inacc stress**--model, request rep again. Provide phonemic cues and/or IS as needed. Allow max 3 more attempts, and then proceed to the next target verb
Target 1 _____	□ Acc. prod. of target verb □ With cues	□ Acc. prod. of full sentence □ With cues	Sentence 2: Plausible Err. Sentence 3: Plausible Err.		Help needed for: S V O Help needed for: S V O	Corrected Erroroneous Corrected Erroroneous	□ Repetition or 3 attempts □ Repetition or 3 attempts	3 questions asked: □ □ □ Acc Inacc	Q1 □a □b □c Q2 □a □b □c Q3 □a □b □c	□ Repeated from memory □ With cues
Target 2 _____	□ Acc. prod. of target verb □ With cues	□ Acc. prod. of full sentence □ With cues	Sentence 2: Plausible Err. Sentence 3: Plausible Err.		Help needed for: S V O Help needed for: S V O	Corrected Erroroneous Corrected Erroroneous	□ Repetition or 3 attempts □ Repetition or 3 attempts	3 questions asked: □ □ □ Acc Inacc	Q1 □a □b □c Q2 □a □b □c Q3 □a □b □c	□ Repeated from memory □ With cues
Target 3 _____	□ Acc. prod. of target verb □ With cues	□ Acc. prod. of full sentence □ With cues	Sentence 2: Plausible Err. Sentence 3: Plausible Err.		Help needed for: S V O Help needed for: S V O	Corrected Erroroneous Corrected Erroroneous	□ Repetition or 3 attempts □ Repetition or 3 attempts	3 questions asked: □ □ □ Acc Inacc	Q1 □a □b □c Q2 □a □b □c Q3 □a □b □c	□ Repeated from memory □ With cues
Target 4 _____	□ Acc. prod. of target verb □ With cues	□ Acc. prod. of full sentence □ With cues	Sentence 2: Plausible Err. Sentence 3: Plausible Err.		Help needed for: S V O Help needed for: S V O	Corrected Erroroneous Corrected Erroroneous	□ Repetition or 3 attempts □ Repetition or 3 attempts	3 questions asked: □ □ □ Acc Inacc	Q1 □a □b □c Q2 □a □b □c Q3 □a □b □c	□ Repeated from memory □ With cues
Target 5 _____	□ Acc. prod. of target verb □ With cues	□ Acc. prod. of full sentence □ With cues	Sentence 2: Plausible Err. Sentence 3: Plausible Err.		Help needed for: S V O Help needed for: S V O	Corrected Erroroneous Corrected Erroroneous	□ Repetition or 3 attempts □ Repetition or 3 attempts	3 questions asked: □ □ □ Acc Inacc	Q1 □a □b □c Q2 □a □b □c Q3 □a □b □c	□ Repeated from memory □ With cues
Target 6 _____	□ Acc. prod. of target verb □ With cues	□ Acc. prod. of full sentence □ With cues	Sentence 2: Plausible Err. Sentence 3: Plausible Err.		Help needed for: S V O Help needed for: S V O	Corrected Erroroneous Corrected Erroroneous	□ Repetition or 3 attempts □ Repetition or 3 attempts	3 questions asked: □ □ □ Acc Inacc	Q1 □a □b □c Q2 □a □b □c Q3 □a □b □c	□ Repeated from memory □ With cues
Target 7 _____	□ Acc. prod. of target verb □ With cues	□ Acc. prod. of full sentence □ With cues	Sentence 2: Plausible Err. Sentence 3: Plausible Err.		Help needed for: S V O Help needed for: S V O	Corrected Erroroneous Corrected Erroroneous	□ Repetition or 3 attempts □ Repetition or 3 attempts	3 questions asked: □ □ □ Acc Inacc	Q1 □a □b □c Q2 □a □b □c Q3 □a □b □c	□ Repeated from memory □ With cues
Target 8 _____	□ Acc. prod. of target verb □ With cues	□ Acc. prod. of full sentence □ With cues	Sentence 2: Plausible Err. Sentence 3: Plausible Err.		Help needed for: S V O Help needed for: S V O	Corrected Erroroneous Corrected Erroroneous	□ Repetition or 3 attempts □ Repetition or 3 attempts	3 questions asked: □ □ □ Acc Inacc	Q1 □a □b □c Q2 □a □b □c Q3 □a □b □c	□ Repeated from memory □ With cues
Target 9 _____	□ Acc. prod. of target verb □ With cues	□ Acc. prod. of full sentence □ With cues	Sentence 2: Plausible Err. Sentence 3: Plausible Err.		Help needed for: S V O Help needed for: S V O	Corrected Erroroneous Corrected Erroroneous	□ Repetition or 3 attempts □ Repetition or 3 attempts	3 questions asked: □ □ □ Acc Inacc	Q1 □a □b □c Q2 □a □b □c Q3 □a □b □c	□ Repeated from memory □ With cues
Target 10 _____	□ Acc. prod. of target verb □ With cues	□ Acc. prod. of full sentence □ With cues	Sentence 2: Plausible Err. Sentence 3: Plausible Err.		Help needed for: S V O Help needed for: S V O	Corrected Erroroneous Corrected Erroroneous	□ Repetition or 3 attempts □ Repetition or 3 attempts	3 questions asked: □ □ □ Acc Inacc	Q1 □a □b □c Q2 □a □b □c Q3 □a □b □c	□ Repeated from memory □ With cues

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