Introduction

Verb Network Strengthening Treatment (VNeST) is a semantic treatment influenced by "verb as core" treatment (e.g., Loverso, Selinger, and Prescott, 1979) as well as priming studies showing that verbs prime typical agents (pray-nun) and patients (arrest-criminal) (Ferretti, McRae, & Hatherell, 2001) and vice-versa in young adults (McRae, Hare, Elman, & Ferretti, 2005) and older adults (verb to noun and noun to verb priming as well) (Edmonds & Mizrahi, in preparation).

Because verbs can have more than one thematic role, a given verb can simultaneously be a feature of two or three noun concept representations and can link these representations to each other. Thus, measuring is something that can be done by carpenters, chefs, and surveyors and to lumber, sugar and land. VNeST, therefore, aims to improve lexical retrieval of content words in a sentence context by promoting systematic retrieval of verbs and their thematic roles.

In a phase I study (Edmonds, Nadeau, & Kiran, in press), four participants with moderate aphasia (mean AQ = 74.82) received VNeST. Results demonstrated generalization to lexical retrieval of content words in sentences with trained (e.g., The carpenter is measuring the stairs) and semantically related untrained verbs (The nurse is weighing the baby.). There was also pre- to post-treatment improvement on lexical retrieval in single word naming of nouns (using the *Boston Naming Test (BNT),* Goodglass, Kaplan, & Weintraub, 1983) and verbs (using the *Northwestern Verb Production Battery, NVPB,* Thompson, 2002) as well as sentences (*NVPB*) for all participants. Additionally, improvements on lexical retrieval of content words in complete utterances during connected speech tasks improved in 3 of 4 participants (Edmonds, et al., in press).

The current study aims to evaluate the effects of VNeST in persons with moderate-severe aphasia and lexical retrieval deficits. It was predicted that participants would exhibit similar patterns of improvement to those in Edmonds et al (submitted) but to a lesser degree and/or requiring treatment for a longer period.

Methods

Participants. Two females with left a history of a left MCA CVA more than 9 months prior to beginning the study participated. Based on *Western Aphasia Battery* (WAB) results and clinical interpretation of all pre-treatment testing, both participants had symptoms most consistent with Broca's aphasia. Participant 1 (P1) (42 years old, 16 years education) had an Aphasia Quotient (AQ) of 45.2 on the *WAB*. Participant 2 (P2) (49 years old, 12 years education) had an AQ of 36.4. P1 had some ability to put 2-3 words together, but words often had low semantic weight (e.g., "Boy go."). More than > 50% of her naming errors were "I don't know" (IDK) or "No response" (NR). P2 used very little speech and relied on writing (which was relatively more intact) in most situations. She could not put more than one word together. Her naming errors were also primarily IDK/NR.

Treatment stimuli and procedure

Treatment. Ten concrete verbs were trained. Stimuli consisted of cards containing 1) the names of the trained verbs (measure) and 2) related agent and patient nouns (*chef/sugar*) representing a range of scenarios. Sentences used for semantic judgment were also developed.

Design and probes. A single subject experimental design with a multiple baselines across participants was used. After 4-5 stable baselines, treatment was applied to trained verbs (N = 10). Weekly probes investigated changes in one sentence descriptions of a pictures depicting scenarios containing trained verbs (N=10) (*The carpenter is measuring the stairs*) and semantically related untrained verbs (N=10) (*The nurse is weighing the baby.*). Each sentence

contained an agent, verb, and patient, totaling 30 possible content words for each condition (trained and untrained). A weekly adjective control task consisting of generating an adjective synonym in a sentence completion task (*Someone who is sick is also said to be ill.*) was also conducted.

Scoring. For probe responses, each content word was assigned a point value. Full credit (1 point) was given for the target response with 1 phoneme off allowance (e.g., carfenter for carpenter), ½ point was given for a semantic error (fireman for policeman), general verb/noun (chop for slice, car for limo), or 2 phonemes off (*/chet/* for */shef/*), and ¼ point was awarded for a general noun (man for gardener).

Treatment procedure. VNeST was administered two times/week for 2 hour sessions. Treatment included: 1) generating 3 agent-patient pairs (*chef/sugar*) related to the target verb (*measure*), 2) answering three *wh-* questions related to one pair (*Where/When/Why does a chef measure sugar*?), 3) deciding whether 12 orally presented sentences containing the verb (*The chef measures the book.*) were semantically correct, 4) repeating step 1. Criterion for terminating treatment was 80% accurate retrieval of agent-patient pairs in step 1 across all trained verbs in one week. Because P2's spoken output was primarily neologistic with relatively better written naming, a slight modification to the treatment was made so P2 was permitted to write, then read, her responses during treatment when verbal attempts were unintelligible.

Results

Probes. A time series analysis (C-statistic) (Tyron, 1982) was used to evaluate baseline to treatment phase changes. Effect sizes were calculated to indicate changes from baseline to post-treatment (for P1, post-treatment probes were maintenance probes (1 and 5 month), but due to their stability, effect sizes were calculated with them). Both participants showed significant improvements from baseline phase to the treatment phase for sentences containing trained and untrained verbs ($p = .001$ for both conditions and both participants). Effect sizes for P1 were 6.54 and 5.06 for trained and untrained conditions, respectively. For P2, effect sizes were 11.30 and 5.42 for trained and untrained conditions, respectively. No improvement was seen on the adjective control task for either participant. See Figure 1 for raw data, statistics and effect sizes.

Pre- to post-treatment scores. For P1, *WAB* AQ improved from 45.2 to 55.5. Pre- to post-treatment improvements (more than 10 percentage point increase) were also seen on lexical retrieval of nouns and verbs on the *Object and Action Naming Battery* (List A = 81 verbs and 50 nouns) (Druks & Masterson, 2000).

For P2, the *WAB* AQ improved from 36.4 to 48.1. Improvements were seen on oral naming on the *BNT* and the *Object and Action Naming Battery* (nouns and verbs). Pre- to post-treatment written naming was also evaluated using the *Object and Action Naming Battery*, and improved were seen for both nouns and verbs. Sentence production on the *NVPB* also improved. See Table 1 for all pre- to post-treatment results.

Discussion

Both participants showed significant generalization to retrieval of content words in sentences for treated and untrained semantically related verbs and their thematic roles, an encouraging finding, especially with participants with moderate-severe deficits. As expected, number of sessions was greater for these participants than for previous ones with less severe deficits. Additionally, pre- to post-treatment improvements were also seen in *WAB* scores, single word naming of nouns and verbs and sentences. These result patterns replicate Edmonds et al. (in press) findings and indicate that VNeST may be appropriate for participants with mod-severe lexical retrieval deficits. Possible reasons for such consistent generalization for all participants

across both studies (N = 6) include engaging large semantic networks surrounding verbs during treatment and the saliency of treated items.

References

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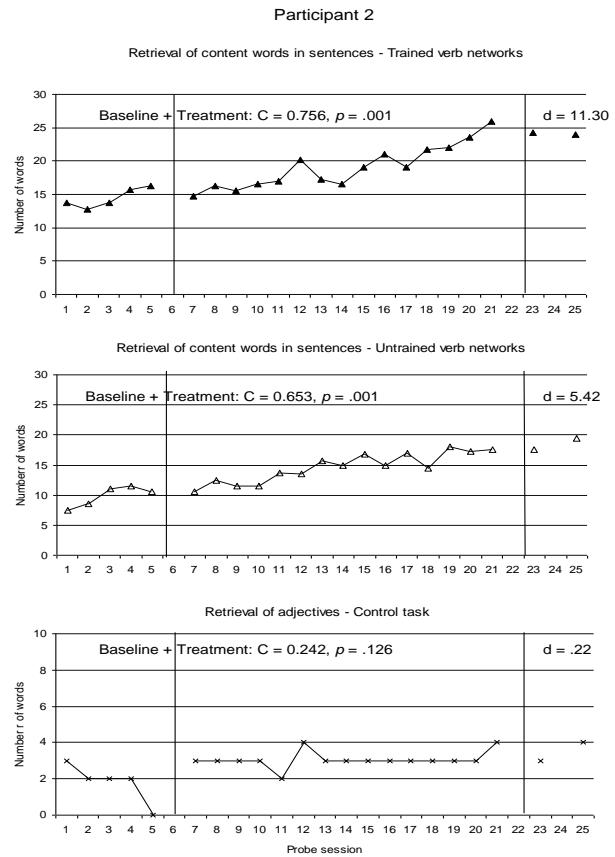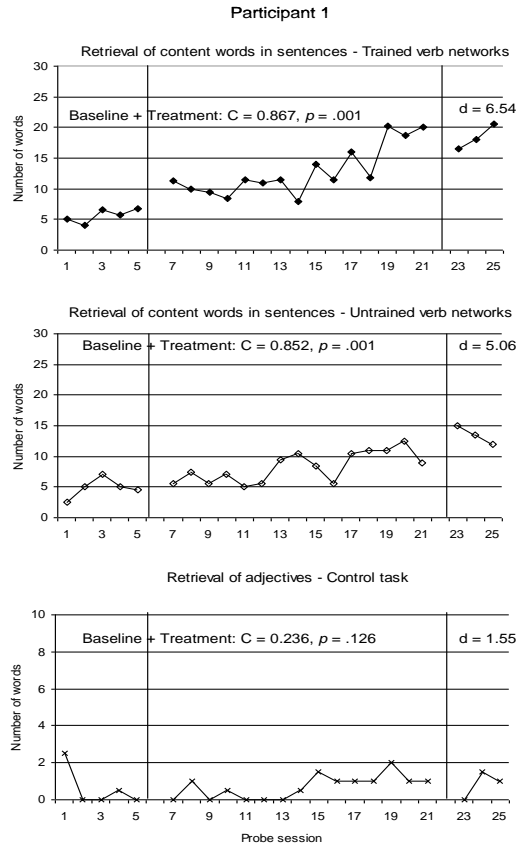
Fig. 1. Top two graphs indicate number of content words (agent, verb, agent) produced during picture description probes of scenarios containing trained verbs (The <u>carpenter</u> is <u>measuring</u> the <u>stairs</u>.) and untrained verbs (The <u>nurse</u> is <u>weighing</u> the <u>baby</u>.). The bottom graph indicates number of adjectives produced for control task for Participants 1 and 2. A time series analysis (C-statistic) was used to evaluate baseline to treatment phase changes. Effect sizes (d) were calculated on baseline and post-treatment data (for P1, post-treatment probes were maintenance probes (1 and 5 month)).

Table 1

Pre- and post-treatment scores for all administered tests

	Participant 1		Participant 2	
	pre-tx	post-tx	pre-tx	post-tx
APHASIA SEVERITY				
Western Aphasia Battery (AQ)	**45.2**	**55.5**	**36.4**	**48.1**
SINGLE WORD NAMING - SPOKEN				
Boston Naming Test (%)	33.3	36.6	**6.6**	**14**
Object and Action Naming				
5.06 to 11.3 Battery – Nouns (%)	**43.2**	**66.6**	**14.8**	**48.1**
Object and Action Naming				
Battery – Verbs (%)	**38**	**48**	**12**	**46**
SINGLE WORD NAMING – WRITTEN				
Object and Action Naming				
Battery – Nouns (%)	n/a	n/a	**75**	**85**
Object and Action Naming				
Battery – Verbs (%)	n/a	n/a	**68**	**86**
SENTENCE PRODUCTION				
*Northwestern Verb				
Production Battery (NVPB) (%)	22.2	22.2	**0**	**25**

tx: treatment; * *The Northwestern Verb Production Battery* (Thompson, 2002) protocol requires showing and reading aloud the verbs for each sentence to be produced. However, the verbs were not seen or heard by the participants in this study during administration of the test in order to evaluate better noun and verb retrieval changes. Also, verbs seen in probes were omitted (thus, N = 22). **Changes of more than 10 percentage points are bolded.**