The language comprehension deficits in adults with focal right hemisphere brain damage (RHD) can cause considerable social handicap. To date, however, treatment for language deficits in this population remains almost entirely untested.

This abstract reports a single-subject experimental design study, performed to investigate whether Contextual Constraint Treatment -- a novel, implicit, stimulation-facilitation treatment for language comprehension processes -- can yield generalized gains to broader measures of language comprehension in adults with RHD.

The focus of Contextual Constraint Treatment (CCT) is motivated by two major accounts of common language comprehension problems in adults with RHD: *coarse coding* and *suppression* deficits. The patient in this study had a coarse coding (CC) deficit, so we describe here only the CC version of the treatment. CC processes activate wide-ranging aspects of word meaning independent of the surrounding context, and CC deficits in adults with RHD impair the processing of distant meanings or features of words (e.g., "*rotten*" as a feature of "*apple*")[1]. CC is a partially domain-general language comprehension process. That is, CC ability predicts aspects of discourse comprehension, is hypothesized to underpin figurative language comprehension, and is involved in processing phrasal metaphors[2]. Thus, treatment that improves CC processes has the potential to generalize to a range of communicative outcomes.

CCT is novel in aiming to facilitate comprehension processes implicitly, through contextual prestimulation. This approach contrasts with the majority of treatments for neurologically-based cognitive-linguistic disorders, which are direct, explicit, and/or metalinguistic. We implemented this approach to avoid confounding treatment of impaired *processes* with irrelevant, and potentially difficult, *task* demands, as adults with RHD who can perform well on implicit assessments of language processing often have difficulty with metalinguistic assessments of the same processing operations[2].

Method

Participant. Mr. R, age 75 with 10 years of education, had a right CVA six years prior to study participation. A right-handed, monolingual, native speaker of American English, Mr. R had normal hearing in his better ear and corrected normal vision. He was diagnosed with a CC deficit using the original task developed to identify CC deficit[1]. Table 1 provides data on clinical measures of language and cognition, compared with group data from a prior study of CC and discourse comprehension[3].

Probe Stimuli and Tasks. There were 3 Probe Lists: Lists 1 and 2, slated for treatment, and List 3, which examined generalization to lexical metaphors. Each list contained 25 well-validated probe stimuli, 15 experimental and 10 filler. The key lexical items in probe stimuli were balanced across lists for lexical properties.

Experimental probes for Lists 1 and 2 were spoken, short, semantically-neutral sentences that end with a 1-3 syllable, concrete, common noun (e.g., "There was a piano"), followed by a spoken target word (e.g., *song*). The target represents a semantically-remote subordinate feature of the sentence-final noun. For List 3, homophones whose subordinate senses are metaphoric were placed in sentence final-position of neutral sentence frames (e.g., "There was a jewel"). In experimental items, the target represents the subordinate, metaphoric sense of the homophone (e.g., *helpful*).

Probe stimuli were administered in an implicit priming task. Shortly (175 ms) after the offset of the sentence-final noun, a spoken phoneme string (the target) was presented for timed lexical decision, and the participant indicated as quickly as possible whether or not the phoneme string was a real word. The experimental probe stimuli required a 'Yes' response, so the filler stimuli had nonword targets.

The Dependent variable was the percentage of accurate responses to experimental probe stimuli that met a preset response time criterion (%Crit). This criterion was a value 1 standard deviation below the mean achieved by non-brain-damaged control participants in prior studies of RHD and CC[1].

The treatment introduced two levels of contextual bias to prestimulate the target concept – i.e., the distant semantic feature of each sentence-final noun. *Strong constraint contexts* were composed of two brief sentences, the first of which strongly biased and the second of which moderately biased the target concept (see Table 2 for example). *Moderate bias contexts* included only the second (moderately biased) sentence. Strength of bias was validated in pilot studies.

Treatment began with auditory presentation of the Strong constraint context, prior to the probe stimulus. If %Crit was met, the Moderate Constraint context was provided similarly, prior to the probe stimulus, and so on, as illustrated in Figure 1. The treatment was implicit in that the participant did not make any explicit decisions or judgments about the meaning of the constraint contexts.

Results

Probe Task Measures (see Figure 2)

List 1 probe performance improved rapidly with treatment. In the first and third follow-up sessions, probe performance remained high. Performance fell off during follow-up session 2, when Mr. R. was distracted by family who were visiting.

List 2 probe performance never stabilized, so List 2 was not treated.

During treatment of List 1, List 3 performance remained stable (i.e., change no more than 1 item from 1 session to the next). The uptick on List 3 in the first follow-up session is not interpretable, given the instability in baseline.

Generalization and Control Measures (see Table 3)

Five probe stimuli from the diagnostic assessment that were not included in treatment were also evaluated as generalization trials. %Crit improved from 0/5 in the diagnostic session to 5/5 in the two follow-up sessions in which these trials were re-administered.

Performance on the *Discourse Comprehension Test*[4], both Total accuracy and Accuracy for questions about implied information, increased substantially from baseline to post-treatment, far exceeding the standard error of 1 point. These improvements remained at follow-up.

Performance on the control measure, Emotional Prosody Production[5], was variable in two baseline administrations, increasing by 2 of 12 points (16.7%). However, performance remained unchanged during the treatment phase. The 1-point gain at follow-up was within the error variability established during baseline.

Discussion and Implications

While still quite preliminary, study results indicate the potential for generalization to meaningful comprehension measures from treatment that implicitly targets an underlying comprehension process in adults with RHD. Probe List gains were treatment-contingent, and maintained through the follow-up phase. The gains appear to reflect improvements in the underlying comprehension process, coarse coding, rather than just item-specific improvements due to repeated exposures, because generalization was evident to untrained items. The gains in treatment do not appear to be due to some form of global improvement, as performance did not change from baseline to later phases for either the control measure of Emotional Prosody Production or for List 3. Most importantly, the effects of treatment generalized to the DCT-based measures of narrative comprehension, both Total accuracy and Accuracy for questions about implied information, and these generalized improvements lasted into the follow-up phase.

Our investigation of CCT is ongoing, and includes individuals with suppression deficits, for whom there is another version of the treatment. With these efforts we hope to bolster the scientific underpinnings of the treatment of language comprehension difficulties in adults with RHD. CCT is very different from the metalinguistic association tasks that typify most clinical interventions for neurologically-based language disorders. If promising results for this approach continue to accrue, future work can compare it with more typical metalinguistic approaches that engage participants in guided problem-solving and self-discovery.

References

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Table 1. Clinical characteristics for Mr. R. and participants with RHD from a prior study of coarse coding and discourse comprehension

	Mr. R.	Prior RHD Participants[3] (N = 32)
Auditory Working Memory for Language[a]		
Word recall errors	15	M = 13.2; SD = 7.0
Behavioural Inattention Test[b]	146	M = 137; SD = 13.5
Visual Form Discrimination[c]	27	M = 28.1; SD = 3.5
Judgement of Line Orientation[d]	25	M = 22.2; SD = 5.2
ABCD[e] Story Retell		
Immediate Retell	15	M = 13.2; SD = 2.5
Delayed Retell	14	M = 12.7; SD = 3.1
PPVT–R[f] raw score	162	M = 157.3; SD = 11.3

Note. RHD = Right Hemisphere Damaged ; M = Mean ; SD = Standard Deviation

[a] Tompkins et al. (1994; maximum errors = 42).

[b] Wilson, Cockburn, & Halligan (1987; maximum = 146; neglect cutoff = 129).

[c] Benton, Sivan, Hamsher, Varney & Spreen, (1983; maximum = 32; cutoff for defective performance = 23).

[d] Benton, Hamsher, Varney, & Spreen (1983; age & gender corrected score maximum = 35).

[e] ABCD = Arizona Battery for Communication Disorders in Dementia; Bayles & Tomoeda, (1993; maximum = 17)

[f] PPVT–R = Peabody Picture Vocabulary Test--Revised; Dunn & Dunn (1981; maximum = 175).

Table 2. Sample Strong constraint context for coarse coding version of Contextual Constraint Treatment (target concept: *song*).

Sentence 1: She played the melody.
Sentence 2: She forgot the words.

Probe stimulus: There was a piano – song.

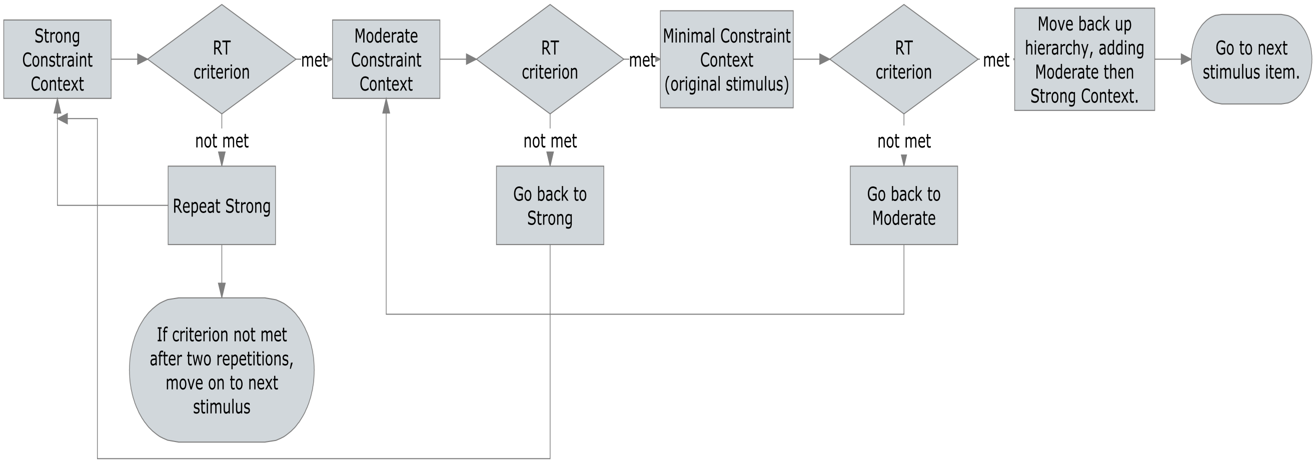
Table 3. Mr. R's performance on generalization and control measures

	Pre-treatment	Immediate post-treatment	Maintenance	Follow-up
Generalization Measures				
DCT Total accuracy (80 possible)[a]	55 (69%)	31/40[b] (78%)	N/A	62 (78%)
DCT Implied information accuracy (40 possible)	27 (68%)	15/20[b] (75%)	N/A	30 (75%)
Control Measure				
MEC Emotional Prosody Production[c] (12 possible)	2, 4	N/A	4	5

Note. DCT = *Discourse Comprehension Test* (Brookshire & Nicholas, 1993[3]); MEC = experimental English-language version of *Protocole Montreal d'Evaluation de la Communication* (Joanette et al., 2004[5]); N/A = not administered.

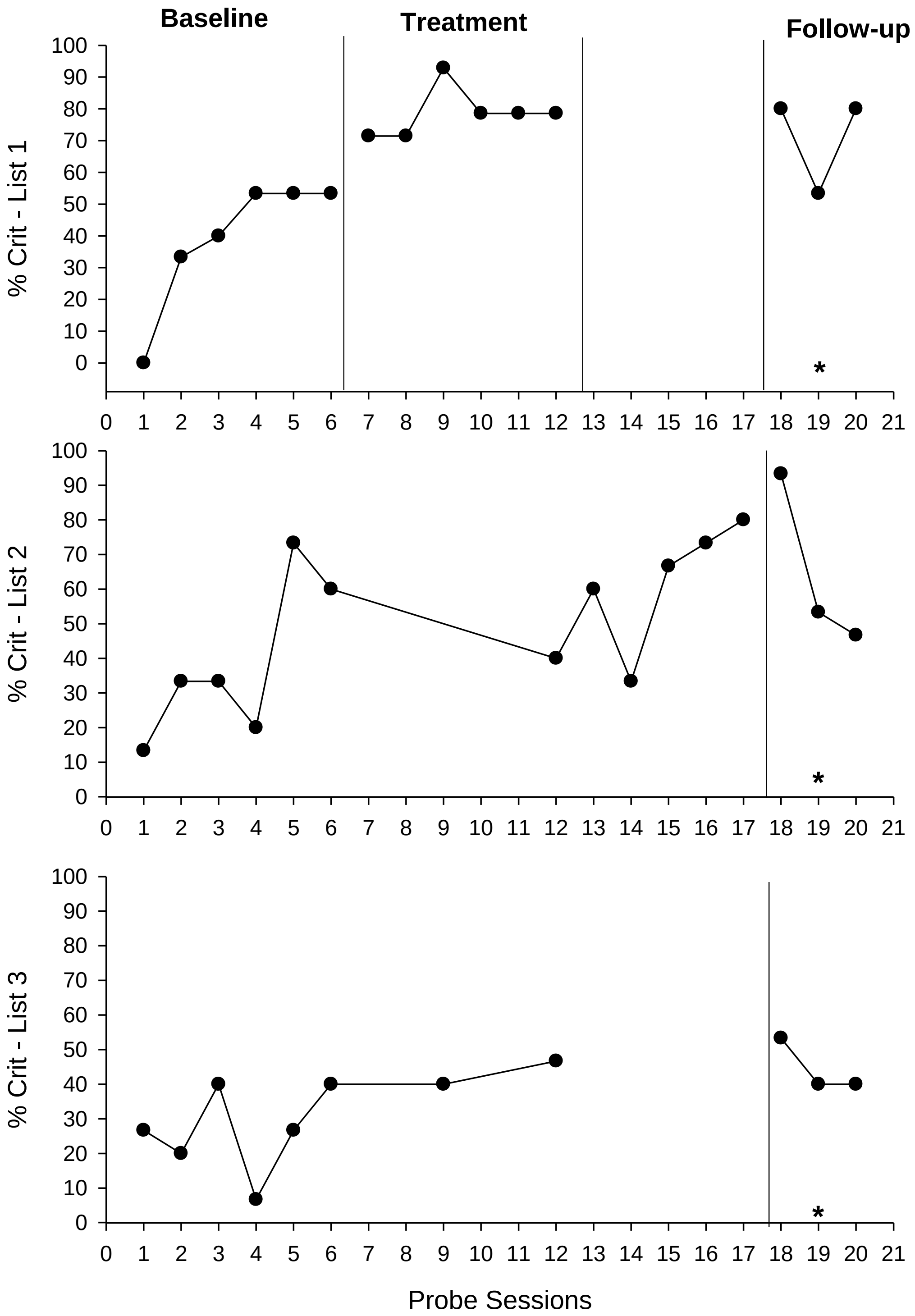
[a] Standard error for RHD standardization sample = 1 point
[b] Only Set A administered (half the total items)
[c] Administered twice during baseline phase to estimate variability associated with re-test

Figure 1. Flowchart for Contextual Constraint Treatment.



Original stimulus = Probe stimulus.

Figure 2. Mr. R.’s Performance on 3 Probe Lists Across Experimental Design Phases



% Crit = percentage of correct responses that met response time criterion

* Probe #19 conducted on day prior to Thanksgiving;
probe condition less than optimal due to family members creating distractions