The language comprehension deficits in adults with relatively 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 and is often based on theoretically- and empirically-tenuous positions.

This abstract presents preliminary, Phase I data from a novel, implicit language processing treatment for adults with RHD. The focus of treatment is motivated by two major accounts of common language comprehension problems in adults with RHD: *coarse coding* and *suppression* deficits. Coarse coding processes activate wide-ranging aspects of word meaning independent of the surrounding context, and coarse coding deficits in adults with RHD impair the processing of distant meanings or features of words (e.g., "*rotten*" as a feature of "*apple*")[1]. A normal suppression process reduces mental activation of concepts that become less relevant to a current context, and its impairment in RHD is indexed by prolonged interference from contextually-inappropriate interpretations (e.g., the "*ink*" meaning of the word "*pen*," in the sentence "He built a pen")[2,3]. Coarse coding and suppression are partially domain-general language comprehension processes. For example, both predict aspects of discourse comprehension and are hypothesized to underpin figurative language comprehension; suppression is important for resolving lexical and inferential ambiguities; and coarse coding is involved in processing both literal lexical items and phrasal metaphors[4]. Thus, treatment that improves coarse coding (CC) and suppression (SUPP) processes may hold promise for inducing gains in a broad range of communicative outcomes.

The reported treatment approach is novel in that it aims to facilitate CC and SUPP processes implicitly, through contextual prestimulation. This approach contrasts with the majority of treatment for neurologically-based cognitive-linguistic disorders, which are direct, explicit, and/or metalinguistic. We implemented this approach to avoid confounding the treatment of impaired *processes* with irrelevant, and potentially difficult, *task* demands. Adults with RHD who can perform well on implicit assessments of language processing often have difficulty with metalinguistic assessments of the same processing operations[4].

This treatment approach is also unique in that it targets partially domain-general operations, rather than specific language structures or language forms (e.g., metaphor).

Method

Participants were three adults with RHD due to stroke, as confirmed by CT/MRI scan reports. One (P1) received CC treatment, and the other two (P2, P3) received SUPP treatment. Participants were at least 4 months post-onset, and averaged 74 years of age (range 67-81) and 11.6 years of formal education (range 10-13). All were right-handed, monolingual, native speakers of English.

Probe Stimuli and Tasks. Probe stimuli consisted of a sentence plus a target word. Each treatment had two lists of probe stimuli. Each list contained 16 brief spoken sentences (PRO-V-N or NP-V-N; 8 probe sentences and 8 filler sentences) that had been used in prior studies of CC[1] or SUPP[2,3] in adults with RHD. The key lexical items in the probe stimuli were balanced across lists for lexical properties.

CC sentences ended with a 1-2 syllable unambiguous noun (e.g., "There was an *apple*"). These sentences were presented in an implicit priming task. Shortly (175 ms) after the offset of the sentence-final noun, a spoken phoneme string was presented for timed lexical decision, and the participant indicated as quickly as possible whether the phoneme string was a real word. *Target words* were *semantically-distant subordinate features* of the sentence-final noun (e.g., "*rotten*"). The 175 ms interval is consistent with implicit priming[e.g.,5-7]. These CC probe stimuli required a 'Yes' response, so the filler stimuli had nonword targets.

SUPP sentences ended in a 1-2 syllable ambiguous noun (e.g., 'He built a *pen*'), and were biased toward the noun's nondominant (subordinate) meaning. The noun was followed (1000 ms later) by a *target word* that reflects the *unbiased* (*dominant*) meaning (e.g., "*ink"*). Participants indicated as quickly as possible whether the target word fit with the meaning of the sentence; expected response=No). The filler stimuli all required a "Yes" response.

The Dependent variable was the percentage of accurate responses to probe stimuli that met a preset response time criterion (%Crit). The 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] or SUPP[2,3].

The treatment introduced two levels of contextual bias to prestimulate the target concepts – i.e., the distant semantic feature (CC) or contextually-biased interpretation (SUPP) 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 1 for example). *Moderate bias contexts* included only the second (moderately biased) sentence. Strength of bias was validated in pilot studies.

Treatment for each item 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 the treatment flowchart (see Figure 1). For both CC and SUPP, the treatment was implicit in that the participant did not make any explicit decisions or judgments about the meaning of the constraint contexts.

Results

Figures 2 and 3 represent probe data for CC and SUPP treatment, respectively. Pre-treatment baseline probes were stable for each participant. For P1, 88% of the probes of List 1 items met the response time criterion after 8 CC treatment sessions. This improvement maintained when List 1 treatment ended. Performance on untreated probes (List 2) did not improve until treated, demonstrating treatment-contingent gains. P2 and P3 were treated on different lists of stimuli. (Due to time limitations, we were not able to treat both lists). Both showed gradual gains with SUPP treatment, though P3, whose performance was initially lower than that of P2, did not meet criterion. The final probe session documented stable performance on the untreated lists.

Discussion and Implications

Phase I treatment studies are designed to detect whether a treatment has positive effects and to provide a basis for future rigorous testing of the treatment's efficacy and effectiveness[8]. The results of this Phase I study suggest that this novel, implicit, facilitation-type treatment approach holds promise for addressing important underlying processing deficits in adults with RHD. It is of course possible that the observed gains were due to repeated exposures to the treated items. We are launching a larger, Phase II effort in which we will collect data on generalization of treatment gains to broader communicative outcomes, including general discourse comprehension, interpretation of implied information in discourse, resolution of ambiguous inferences, the processing of metaphor and other kinds of figurative language, and functional reasoning tasks that involve weighing competing options. If such generalization is evident, future studies can examine the contributions of non-specific practice.

It may be that we will need to incorporate more strategies to support these kinds of generalization, such as integrating aspects of the natural environment into the treatment, or developing a “looser” form of the treatment. Alternately, we may need to treat long enough to effect overlearning, rather than accepting standard criteria for terminating treatment (e.g., 90% over three consecutive sessions). Or, the treatment may have more real-world consequences when provided in the acute phase, augmenting spontaneous recovery processes. These and similar questions remain for future phases of treatment development, and will be discussed.

References

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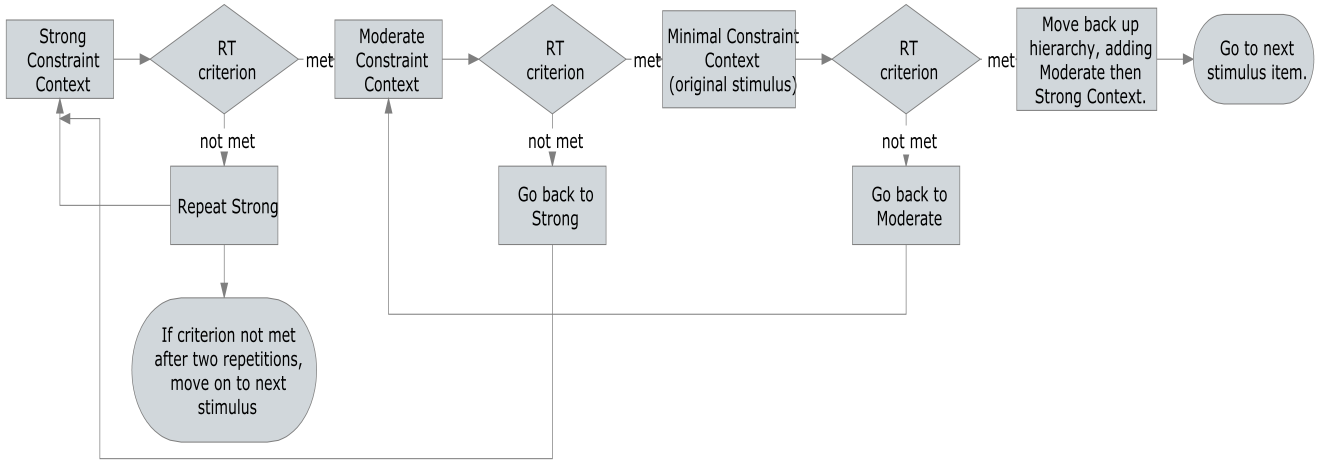
Table 1. Sample Strong Constraint Context for Coarse Coding Treatment (target concept: *rotten*).

Sentence 1: The fruit smelled awful.
Sentence 2: It had turned very soft.

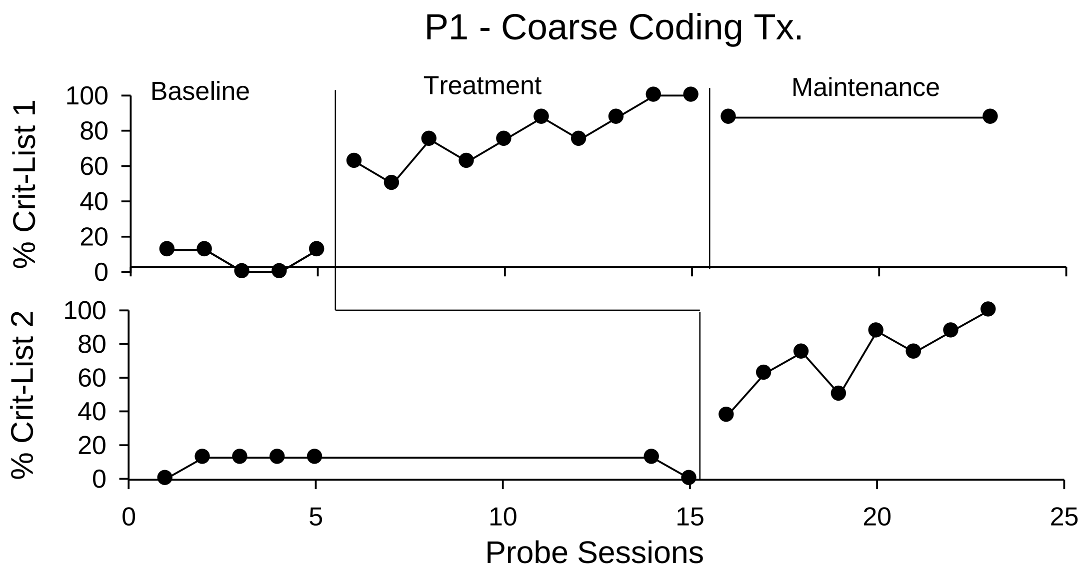
Probe stimulus: There was an apple – rotten.

Figure 1. Flowchart for Coarse Coding and Suppression Treatment.



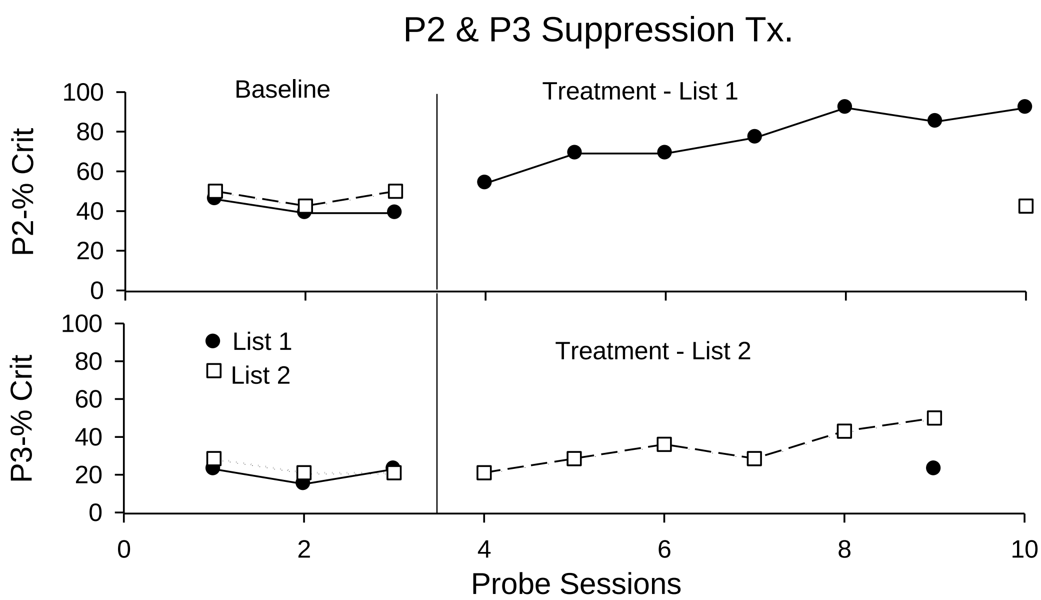
Original stimulus = Probe stimulus.

Figure 2. Probe Data for Participant 1, Coarse Coding Treatment.



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

Figure 3. Probe Data for Participants 2 and 3, Suppression Treatment.



P2 = Participant 2; P3 = Participant 3.
%Crit = percentage of correct responses that met response time criterion.