EFFECTIVENESS OF GIST REASONING TRAINING IN IMPROVING DISCOURSE, VERBAL REASONING, AND GENERAL COGNITIVE PROCESSES IN AN ADULT WITH RIGHT-HEMISPHERE DAMAGE

A Thesis

Presented to

The Faculty of the Department

of Communication Sciences and Disorders

University of Houston

In Partial Fulfillment

Of the requirements for the Degree of

Master of Arts

By:

Casey K. Richardson

May, 2016

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ABSTRACT

There is limited research investigating treatments targeted at remediating cognitive-communicative deficits associated with right hemisphere damage. This single case study investigated the efficacy of using a gist-based approach with an adult in the chronic stage of recovery from right-hemisphere damage. After treatment, the participant made gains in some aspects of verbal reasoning, sustained attention, and perceived communicative ability. However, results indicated no global improvement in cognition. Gains in verbal reasoning and sustaining attention were maintained up to six weeks after treatment ended. The results suggest that this gist-based treatment approach is feasible for improving verbal reasoning individuals with RHD. Remediation of deficits in this area is of importance to the individuals with RHD as well as their families and friends because understanding each other's stories and ideas is an important aspect of our communication.

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INTRODUCTION

Successful communication includes establishing communicative context through cues, understanding the intention of the speaker, integrating facts, assimilating new information to revise previous interpretations, and understanding the nuances of language (Myers, 1999). In 1959, Eisensen suggested that following right-hemisphere damage (RHD) individuals have communication impairment that makes successful communication more difficult. Researchers have been working towards a clinical profile of those communication deficits. Although distinct characteristics have been documented, specific lesion sites have not been associated with a circumscribed set of deficits (Cote, Payer, Giroux, & Joanette, 2007). Myers (1999) explains that unlike aphasia, no specific label exists for the deficits associated with RHD, so clinicians and researchers use the term RHD to describe a general localization of damage but not a specific set of symptoms.

The distinct profile of communication deficits associated with RHD has been investigated but has not yet been universally established in the literature. In a review of the medical charts of 123 individuals with RHD, the most commonly diagnosed deficits were attention, neglect, perception, and learning/memory (Lehman-Blake, Duffy, Myers, & Tompkins, 2002). Of the 123 individuals, a speech language pathologist evaluated only 45% of the patients, and 16.3% of the 123 individuals were diagnosed with deficits in interpersonal interactions. The authors expressed the need for standardized definitions of terminology and an assessment tool to evaluate pragmatics. If there were established definitions of

terminology, perhaps, a better idea of the breadth of deficits could be more thoroughly detailed.

Cote et al. (2007) evaluated 28 individuals with and without known communication impairments who had RHD. The participants were evaluated for deficits in prosody, lexical-semantic, discourse, pragmatics, and awareness. A cluster of communication impairments did not correlate with a specific lesion site, and a right-hemisphere lesion did not necessarily result in a communicative impairment. The results suggest that 80% of the individuals with RHD in a rehabilitative setting have communication deficits while 50% of patients in an unselected population have communication deficits. In order to better diagnosis and identify patterns of deficits following RHD, standardized terminology to be used by both clinicians and researchers must be created.

Myers (2002) details this critical issue though the addition of commentary to her original article published in 1979. In the original article, eight individuals with RHD were tested with a series of assessments to provide a clinical profile of deficits following RHD. At the time of the research, there was not a means of categorizing the participants for levels of severity due to lack of research and available assessment tools. The results of the study indicated that that the participants had difficulty integrating information, drawing inferences, and made literal interpretations of statements. Myers (2002) explains that since the publication of the 1979 article, the following deficits have been found to be associated with RHD: impairment in producing macrostructures, summarizing story concepts and themes in both written and pictured narratives, itemization of information instead of integration, organizing information, semantic deficits,

inference revisions, and difficulty with understanding communicative intents, theory of mind, and discourse tailoring. Additionally, individuals with RHD can have difficulty with attention, visuospatial processing, anosognosia, memory, planning, organization, reasoning, and problem solving (Tompkins, Klepousniotou & Scott, 2013). As described above, these deficits can prevent successful communication. Discourse deficits or deficits which impact the communicative events in which an individual understands information in written or oral form, is of particular interest for this paper.

More recently, Ferre et al. (2010) has proposed four distinct communicative clinical profiles of individuals with RHD based on a hierarchical cluster analysis of the assessment result of 112 individuals with RHD. Cluster 1 has global and massive impairments (conversational discourse, metaphor interpretation, unconstrained verbal fluency, linguistic and emotional prosody comprehension and repetition, semantic judgment) while cluster 2 consists of mixed impairments (conversation, linguistic prosody, repetition, narrative discourse, retelling, semantic judgment). Cluster 3 presents with conversation and emotional prosody deficits. Individuals in cluster 4 demonstrated few or no impairments. The authors suggest that further research linking the clinical profile to the associated damaged area of the brain will lead to more precise interventions in this population. A shortcoming of the study was that aspects of cognition such as inhibition, attention, mental flexibility, and executive functions were not included. Individuals with RHD often have some cognitive deficits, so the association between the communicative clusters and cognitive deficits will be necessary in order to determine the most appropriate treatment for each cluster.

At this time, the clusters are not being used clinically and further research to evaluate the validity of these clusters as well as develop interventions for each cluster is necessary.

Discourse Deficits following RHD

In the body of research surrounding RHD, there are many studies investigating discourse deficits and the processes underlying these deficits (Meyers, 1999). The deficits are considered to be pragmatic language deficits or language use deficits and include reduced specificity, flexibility, capacity to generate alternative meanings, conversational conventions, verbose or unelaborated speech output, and a reduction in understanding the gist of discourse, intended meanings, emotional content, prosody, and theory of mind (Myers, 1999). Currently, there is not a unified theory for the underlying processes of these deficits. Not all individuals with RHD have the same set of deficits or level of severity. The theoretical underpinnings of these deficits have been explained using several different models: hemispheric asymmetry, cognitive deterioration, cognitive impairments affecting language, visual integration, holistic processing of the right hemisphere, theory of mind deficit, and suppression deficit (Sherrat & Bryan, 2012). These impairments make an impact on everyday functioning and a better understanding of the deficits can lead to better assessment and treatments targeted towards the RHD population.

There is a line of research investigating the suppression hypothesis or the inefficiency in suppressing unimportant or inappropriate meanings in a given context. In more than 40 adults with RHD, suppression deficits were correlated with poor discourse comprehension (Tompkins, Baumgaertner, Lehman, &

Fassbinder, 2000). Additionally, coarse coding may co-occur with a suppression deficit. Coarse coding is the activation of secondary and peripheral semantic relationships of words (Tompkins, Fassbinder, Scharp, & Meigh, 2008; Tompkins, Scharp, Meigh & Fassbinder, 2008). For example, when an individual reads, "He ate an apple", the associated features that may be activated are red, crunchy, tree, and bite. The RHD deficit is in activation of distantly related features, such as 'rotten'. A deficit in activating and maintaining multiple meanings may impact discourse during comprehension of non-literal language and during the revision of interpretations. While individuals with RHD tend to accurately at maintain these multiple meanings, they have difficulty quickly suppressing the alternative meanings. This same trend of an individual being accurate but with increased processing time is found in the research surrounding inferences. Individuals with RHD make predictive inferences when given a strong context but have more difficulty and take more time when there is a more ambiguous context (Blake, 2009). Additionally, the slowed suppression of less appropriate inferences given the context strongly correlated with poor discourse comprehension (Tompkins, Lehman Blake, Baumgaertner, & Jayaram, 2004).

Myers (1999) explains the inference failure hypothesis which is difficulty integrating multiple cues to derive meaning and form an overall picture of a situation. These difficulties can greatly impact discourse because understanding involves integrating and interpreting the cues accurately. Individuals with RHD appear to have difficulty with identifying relevant cues, then integrating those cues with prior experience to revise interpretations and inferences. The underlying component of revising relies on attention, thus redundant and

straightforward information is easier to comprehend because less attention and inferences are required. Similar to integration is the concept of macrostructure deficits, in which the individual cannot understand the gist of discourse because it must be created by integrating multiple cues and elements of a text or story.

Furthermore, a correlation between cognition and discourse production has been reported (Bartels-Tobin & Hinkley, 2005; Marini, 2012). Using picture sequencing, Marini (2012) analyzed the discourse of individuals with RHD in addition to assessing the participants' cognitive status. In the production of discourse, individuals with RHD had typical microstructure (clausal structure, mean length of utterance, and rate of speech), and errors were typically in the macrostructure. There were low levels of informative content, tangential errors, and lack of congruency between sentences. The deficits appeared to be a lack of organization of the story. The individuals with the highest rate of errors had lesions in the anterior right hemisphere which the authors suggest may indicate that the deficits may have a link to executive functions. Additionally, Bartels-Tobin and Hinckley (2005) reported a correlation between narrative discourse and attention, clock drawing, and visuospatial measures. Individuals with better attention produced more accurate and complete main concepts while those with poor attention produced more accurate yet incomplete main concepts. The clock task is dependent upon the integration of multiple sources of information. Thus, the authors explain that these results support the hypothesis that narrative production is dependent on attention and integration of different sources of information.

Another important consideration is the similar deficits in discourse between the aging population and individuals with RHD (Sherratt & Bryan, 2012). Four important factors that can be used to determine the quality of discourse are content, clarity, organization, and quantity of words (Blake, 2006). Both older adults and individuals with RHD can have difficulties with these areas. Twenty speech language pathologists (SLPs) were asked to analyze discourse samples according to theses factors. They were blinded as to whether the sample was from a healthy older adult or an individual with RHD, and after analyzing the sample, they were asked to determine which type of participant the sample came from. The SLPs varied in their accuracy, but the factors that set apart the RHD group were ratings of tangentially and egocentrism. In addition, the samples of discourse that were rated as verbose were correctly identified as RHD by most of the SLPs. This indicates that there are clinically relevant characteristics of RHD discourse that can be used in assessment and in selecting treatment targets.

Evidence-Based Treatments for discourse deficits following RHD

Blake, Frymarkand Venedictov (2013) conducted a systematic review of the literature for treatments targeting sentence or discourse level deficits following RHD and then evaluated the studies based on methodological quality. Only five studies were identified and each one targeted a different aspect of communication deficits (discourse production, metaphor interpretation, conversational exchange, and coarse coding or suppression). Since the publication of the systematic review, using the same criteria for methodological

quality, two additional studies have been found through literature review. Both treatment studies examine the generalization of coarse coding intervention.

Cannizzaro and Coehlo (2002) targeted improving story grammar through the use of filmstrips to either generate or retell a story. In the story retell condition, there were five training steps and a series of prompts used to identify episodes and their components, and for the story generation, there were four steps with prompts to facilitate the generation of multiple accurate episodes. At the end of the treatment, the participant was producing more complete episodes, but he still had overall poor story structure due to extraneous information and continued use of incomplete episodes. Gains made during treatment were not maintained at follow-up. Overall, the authors deemed this treatment approach as ineffective in improving story grammar and recommended other approaches be investigated.

In comparing treatments to improve conversational discourse, Youse and Coelho (2009) hypothesized that using a social skills (Interpersonal Process Recall) based approach would improve conversation while attention training (Attention Process Training program) would improve both conversation and attention skills. They employed a single subject design (A-B-A-C-A) with two participants with closed-head injury with primary lesions to the right hemisphere. The Attention Process Training (APT II) consists of placing demands on attention with increasingly more complex tasks as each level is mastered. In Interpersonal Process Recall (IPR), the participant's conversation with a conversational partner is recorded, then the examiner and the participant review the conversation together while discussing the conversational deficits.

The examiner provides feedback and models a more effective means of communicating. One of the participants did not make any conversational gains after either treatment approach, and this participant was not available for follow-up testing. The authors believe that his small social circle and his circle's acceptance of his aberrant conversational behaviors impacted his motivation to make changes in his conversational skills. The other participant did not make a change in conversational skills either, which the authors believe may have been due to motivational factors. The conclusion of the researchers is that candidacy of the participants may be a critical factor in treatment planning, and it cannot be determined from their study whether APT or IPR can change conversational quality.

A treatment study investigating the efficacy of The Metaphor Training program, which targets enhanced metaphor comprehension through improving semantic associations, provides preliminary evidence that this training may improve metaphor interpretations in individuals with RHD (Lundgren, Brownell, Cayer-Meade, Milione, & Kearns, 2011). During the training phase, performance on untrained metaphors, Benton line orientation (control task), and quality of life were measured. The training tasks included five steps that became increasingly more difficult as the participant completed each step. The treatment approach used bubble maps to give visual supports of the semantic associations and began with strengthening connotative meanings of single words, then the generation of word associations and the evaluation of these associations. The final stage was choosing the most appropriate interpretation of a metaphor from a written field of three interpretations. All five participants made gains in

interpretation of novel metaphors. This suggests that the treatment gains generalized to untrained metaphors. Another important finding is that the participants who performed the worst at baseline assessments made the most gains in the interpretations of metaphors. This indicates that the treatment is beneficial for those individuals with more severe deficits. In addition, there was variability within the subjects for time post onset, and all participants made gains. Thus, individuals who sustained damage many years ago still may make gains by using this intervention approach.

Tompkins, Blake, Wambaugh, and Meigh (2011) developed a treatment aimed at improving coarse coding and suppression deficits in individuals with RHD who had deficits in these two areas. The approach used an implicit approach, which they called Contextual Constraint Treatment (CCT) and was based on using two known strengths of individuals with RHD. The two strengths are better performance on tasks that are implicit in comparison to explicit and improved performance on interpretations when the context provides a moderate to strong bias towards the intended interpretation. This treatment is novel in that it focuses on the underlying processes of languages instead of a particular aspect of language such as inferences or metaphors. In addition, the deficit in coarse coding and suppression is not the accuracy but rather the speed of processing. Thus, this treatment used an implicit approach targeted at improving the speed instead of an explicit approach since the individuals with RHD tend to be accurate. Of the three participants included in the study, one had a coarse coding deficit and the other two participants had suppression deficits. The authors provide a flow chart depicting the progression of the treatment

which progresses from providing a strong constraint context and eventually to a minimal constraint context. The results suggest that improving the efficiency of coarse coding and suppression processes may be possible through implicit treatments even though typical recommendations are to treat the deficit using metalinguistic strategies.

In order to continue to determine the generalized effects of CCT, Blake, Tompkins, Scharp, Meigh and Wambaugh (2015) assessed the generalization of the treatment to narrative discourse, lexical metaphoric meaning, and explicit interpretation of non-literal language using a single subject design, which included four participants with coarse coding deficits. All four of the participants showed generalization on the Coarse Coding Generalization Tasks indicated by faster response times and increased accuracy. The results indicate that if there was generalization to lexical metaphors, the improvement was small. Three of the four participants showed generalization to the Discourse Comprehension Test (DCT), which indicates that the treatment improved overall discourse comprehension. The participants did not improve on the control task indicating that improvements were actually due to the treatment. Further research is needed, but the research indicates that CCT could be an efficacious treatment. Overall, the treatment approach is promising and may be a viable treatment option for improving underlying language processes in discourse comprehension.

The studies described show promising treatments for metaphor interpretation, coarse coding, suppression, and discourse comprehension. In the review of the five treatment studies, Blake, Frymarkand, and Venedictov (2013)

conclude that the available research on treatments, while meager, is strong and promising. They suggest that applying treatments designed for people with traumatic brain injury (TBI) that target cognitive-communication impairments may be beneficial even though the studies did not directly investigate the approaches with individuals with RHD. In addition, if necessary, using expert opinion that is grounded in theory may be another route to finding an appropriate treatment. Many of the current interventions for discourse deficits following RHD rely on expert opinion based on theoretical models because there is a lack of evidence-based treatments in the RHD literature (Blake, 2007). The author suggests that perhaps the small number of researchers focusing on RHD may be one reason for the limited research in treatment approaches for individuals with RHD. The absence of a single theory of communication deficits following RHD complicates the situation. Although there has been progress in developing treatments for discourse deficits, there is still a need for evidence-based treatments that improve discourse as a whole.

Gist Training (SMART)

A potential treatment for improving discourse comprehension is Strategic Memory and Reasoning Training (SMART), which targets gist-reasoning abilities in individuals and has been shown to indirectly improve other executive functions such as cognitive switching, fluency, working memory, and inhibition (Cook, Chapman, Elliot, Evenson, & Vinton, 2014). Chapman et al. (2006) define gist as understanding the experience and not the details. There are three types of gist: transformed, main-idea, and categorical. Transformed gist is conveying the

meaning of a passage in a single sentence using world knowledge. Main-idea gist is stating the main point of the passage and requires little world knowledge. Categorical gist is grouping items into semantic categories not explicitly stated. Transformed gist has been shown to remain stable over the life span and occurs in daily life to reduce the cognitive overload of details and retain the general idea of an experience (Chapman et al., 2006). The training program targets transformed gist from a top-down learning process. In addition, three processes underlying gist reasoning are strategic attention, integrated reasoning, and the ability to fluently derive multiple interpretations (Vas et al., 2011). Research suggests that gist reasoning is frontally mediated and related to the executive functions of inhibition, working memory, conceptual abstraction, fluency, and cognitive flexibility. SMART was developed with these underlying principles and focuses on teaching *how* to think versus *what t*o think.

The program's efficacy and effectiveness has been demonstrated in several target populations including adults with dementia, adolescents post TBI, cognitively normal seniors, and middle school students. The length, duration, and service delivery of the protocol varied according to the target populations. However, in all of the intervention studies, the treatment followed the same step-by-step process targeting a specific skill in each session. The treatment process is outlined below in below in *Table 1.1.* The table is taken from the study in which the treatment was used with adolescents in chronic-stage TBI with sessions occurring two times a week for an hour each time(Cook et. al., 2014)..

Table 1.1: SMART training protocol

Process	Description	Session
Inhibiting	To delete/inhibit unimportant or irrelevant details	1
Organizing and managing	To organize and manage information by chunking similar ideas together	1
Inferencing	To use inferencing to extract the deeper or more abstract meaning of the information	2
Paraphrasing	To convey information in one's own words	3
Synthesizing	To combine details together into gist based concepts, using inferencing and paraphrasing	4
Integrating	To integrate previous knowledge with new information to formulate "take-home messages" from multiple perspectives	5
Abstracting and generalizing	To summarize using abstract, high-level gist-based concepts and applying learning beyond the immediate context to other contexts and situations	6-8

The first treatment research published to determine the efficacy of SMART targeted gist reasoning in older adults with typical cognition (Anand et. al., 2010). Twenty-six older adults with typical cognition between 64 and 85 years old attended eight 1-hour sessions over the course of a month in a group service delivery format. Gist-reasoning skills were targeted in the order presented in *Table 1.1.* Significant improvement was found in abstracting meaning from texts, but there was no statistically significant improvement for recalling details. Improvement in untrained areas of executive functioning, specifically cognitive switching and fluency, were statistically significant. In addition, those who performed lower on baseline measures experienced the greatest amount of gain in abstracting meaning. This was a pilot study and there was not a control group for comparison, so the authors viewed these results with caution and continued to research the benefits of the training.

Gamino et al. (2010) compared SMART training and rote memory training in a randomized controlled pilot study. Fifty-four eighth graders with no learning or cognitive deficits were randomized to the three groups: SMART, rote memory training, and a control group that received education about the brain. The participants were blinded as to whether they were in the control or experimental group, and all groups appeared similar according to baseline assessment. Each training group attended nine, 45-minute sessions delivered over four weeks with a session two weeks later to assess maintenance. Gist-reasoning scores as measured by the *Test of Strategic Learning (TOSL)* were significantly different for the SMART group when comparing pre and post training scores. In the other two groups, no significant differences were found. In the SMART and rote memory training, fact recall was significant different. In the previous study with older adults with typical cognition, SMART did not lead to a significant difference in fact recall (Anand et. al., 2010). For the participants in the study, there was a small correlation of r=.28 between the state's standardized assessment and performance on the *TOSL,* which the authors interpret to mean that increased gist-reasoning skills can increase performance in academics (Gamino et al., 2010). The researchers did not assess executive functions as in the previous study.

Some participants from both the SMART group and rote memory-training group were recruited from the previous study of eighth graders to examine the impact of SMART on inhibitory control (Motes et al., 2014). Participants completed a Go/No-Go task, which is based on semantic categories and has been used in previous research to assess inhibitory control. In this task, the participant

makes a quick decision about whether or not an item belongs to a specific semantic category, and false positives are compared with true positives to determine inhibitory control The dependent variables were response times and event-related potentials (ERPs) collected through continuous electroencephalogram (EEG). Those in the SMART group had significant changes in inhibitory control from pre to post training. Inhibitory control is the ability to suppress a response. The rote memory group did not show any changes after treatment for inhibitory control. These results support the hypothesis that gist reasoning and inhibitory control are related and that SMART therapy can result in inhibitory gains.

To continue to assess the feasibility of the SMART protocol, 28 out of 35 recruited participants, aged 20 to 65 with chronic traumatic brain injury, completed either SMART or an information based training called Brain Health Workshop (BHW; Vas et al., 2011). Participants were randomly assigned to SMART or BHW and were blinded as to whether or not they were in the experimental group. For both groups, there were 12, 1.5 hour group training sessions that occurred over eight weeks. The first ten sessions occurred two times a week for five weeks. Skills were taught and practiced in the order described in *Table 1.1*. A difference in this protocol in comparison to the previous studies is the addition of homework assignments to facilitate generalization. Assessment occurred pre-training, immediately post-training, and 6 months post-training. There were no significant differences between groups at the pre-training assessments. For the SMART group, working memory, *Community Integration Questionnaire (CIQ)* scores, and gist-reasoning scores were higher in post-training

and six months post-training in comparison to pre-training scores. The BHW groups did not have a statistically significant change for working memory, gist-reasoning, or *CIQ*. For the SMART group, main effects were found for other untrained areas of executive functions: inhibition, non-verbal reasoning, and cognitive flexibility. The authors report that this indicates that these skills may have improved and a larger sample is needed to determine if these areas might improve significantly after SMART training. This study demonstrated gains in executive functions, gist reasoning, and life participation immediately and at six months post-training which indicates maintenance of gains.

Cook et al. (2014) investigated the effectiveness of SMART training in adolescents with chronic traumatic brain injury. Participants were assigned to one of two groups, gist-based SMART or fact-based memory training and blinded to whether or not they were in the experimental group. The same outcome measures were used for both groups with assessment occurring pre-treatment and post-treatment. The primary outcome measure was the *Test of Strategic Learning (TOSL)*, which assesses how an individual understands and derives meanings from complex passages (Chapman, Gamino, & Cook, *under review*). The secondary outcome measure, the *Wechsler Intelligence Scale for Children* or the *Wechsler Adult Intelligence Scale* in addition to the *Delis-Kaplan Executive Function System*, measured executive functions (Cook et al., 2014). Another secondary outcome measure, the *Behavior Rating Inventory of Executive Function (BRIEF)*, assessed executive functions through parent-report. Both groups received equivalent time in training, eight 45-minute individual sessions over the course of a month. Skills learned in one session were reviewed and

expanded upon in the subsequent sessions. The analysis of performance on the primary outcome measure, the *TOSL (*Chapman, Gamino, & Cook, *under review)*, indicated a significant difference between the two groups with SMART training resulting in a higher score for abstracting meaning and providing interpretive statements. The SMART group had significant gains for recalling details while the Memory group had a trend but no significant improvement in recalling details. The secondary outcome measures indicate an increase in working memory and inhibition in the SMART group, but not in the Memory training group. However, on the *BRIEF*, analyses revealed a trend but no significant change for either group. The results could have some bias because the measure was not returned in a timely manner by all parents and some parents did not return the measure. The authors explain that the results demonstrate that SMART training improves gist-reasoning skills, fact recall, working memory, and inhibition in adolescents with TBI. The results are similar to other studies examining the effect of SMART training with adults with TBI and middle-school children.

Research Questions

The studies examining the efficacy and effectiveness of SMART described above indicate that the gist reasoning training improves not only gist reasoning but also other areas of cognitive functioning such as inhibition, working memory, and cognitive flexibility. These gains may also impact quality of life and functional improvements. Anand, Chapman, Rackley, and Zientz (2011) postulate that the underlying processes of gist reasoning are strategic attention,

integrated reasoning, and reasoning flexibility. Strategic attention requires inhibition and focusing on relevant information. Integrated reasoning depends on incorporating important details with explicit information to develop the meaning that is not explicitly stated. Reasoning flexibility depends upon deriving and adjusting multiple interpretations throughout discourse. These processes underlie many of the deficits typical of individuals with RHD, so this training may be beneficial in remediating some of these deficits. Additionally, verbal reasoning is a key component of discourse as it includes an individual's ability to weigh the facts, get the facts, eliminate the irrelevant, generate and predict consequences in a verbal task. Theses skills are necessary to comprehend oral and written discourse and are targeted in SMART. As noted above, there is a critical need for interventions focusing on improving communication for individuals with RHD. Thus, this study is designed to assess the effects of gist reasoning on cognitive-communicative abilities of an individual with RHD. The following research questions will be answered by the present study:

1) Does gist training improve verbal reasoning in an adult with chronic right-hemisphere damage as measured by the *Functional Assessment of Verbal Reasoning and Executive Strategies (FAVRES)*?
2) Does gist training improve discourse comprehension in an adult with chronic, right-hemisphere damage as measured by the *Discourse Comprehension Test (DCT)?*
3) Does gist training improve general cognitive processes including immediate and delayed memory, attention, language, and visuospatial skills in an adult with chronic, right-hemisphere damage as measured

by the *Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)*?

4) Does gist training improve communicative ability in an adult in the chronic stage of recovery from right-hemisphere damage as measured by the *La Trobe Communication Questionnaire (LCQ)*?
5) Are any gains achieved during intervention maintained for 6 weeks post-treatment?

METHODOLOGY

Participant

The single participant is a 54-year-old male who has right-hemisphere damage caused by a stroke in 2009, which resulted in language and cognitive deficits. According to his medical records, the right-sided infarct affected the anterior perisylvian region, extending into the corona radiata and basal ganglia. Cognitive-communication deficits initially included memory, attention, and visuospatial neglect. Assessments conducted over the past two years in conjunction with research studies at the University of Houston indicate persistent deficits in discourse comprehension and production, working memory, and executive functions. Visuospatial neglect has resolved. According to previous assessments, his eyesight (with glasses) and hearing are within functional limits. The results of these previous assessments suggest that this participant's deficits are similar to those commonly associated with TBI, and thus may be remediated by gist training.

Procedures

A single subject design was used to assess the effectiveness of gist training on verbal reasoning and discourse comprehension as well as the indirect effect on other cognitive domains. The graduate student administered all assessments and treatment with the thesis committee chair observing 25% of intervention sessions and assessments. Sessions were digitally recorded on the University Speech, Language and Hearing Clinic's secure video recording system, *Landro Play Analyzer*, for review by the graduate student and the thesis committee chair. All tasks were completed in a therapy room at the University Speech, Language,

and Hearing Clinic. The University of Houston Institutional Review Board reviewed and approved all aspects of this study before it was initiated. In the first session, the participant read and signed the consent form, and any questions or concerns were addressed.

Outcome Measures

All measures were administered at three time points: prior to treatment (baseline), immediately post-treatment, and a follow up conducted 4-6 weeks after treatment.

Functional Assessment of Verbal Reasoning and Executive Strategies (FAVRES)

The *FAVRES* takes about an hour to administer and assesses verbal reasoning, complex comprehension, discourse, and executive functioning. The test involves novel situations that may occur in daily life, and the examinee completes four verbal reasoning tasks: planning an event, scheduling, making a decision, and building a case. The examinee receives scores for accuracy, rationale, time, and total reasoning subskills. The subskills are getting the facts, eliminating the irrelevant, weighing the facts, flexibility, generating, and predicting consequences. The overall verbal reasoning skill score is the primary outcome measure for this study.

Discourse Comprehension Task (DCT)

In DCT, the participant reads a set of five short (~14 sentence) humorous stories. After each story, the participant answers a series of eight yes/no questions about explicit and implied information. The

assessment takes about 20 minutes to complete and was designed to measure discourse comprehension in adults with aphasia, RHD, or TBI.

Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)

The *RBANS* is a cognitive battery of tests that assesses delayed memory, attention, language, and visuospatial skills, which takes about 25 minutes to administer. There are three forms, which reduce practice effects and are ideal for measuring change over time. The test is appropriate for adults and can be used to screen for neurocognitive deficits, track progress during rehabilitation, and track the progression of neurological disorders. One version of the form was used at baseline and follow-up, and a second version was used at post-treatment.

La Trobe Communication Questionnaire (LCQ)

The *LCQ* is a quality of life assessment that provides an estimate of perceived communicative ability based on information gathered from the examinee and family members or caretakers. The assessment takes about twenty minutes to administer and is composed of 30 items with a four-point scale (never/rarely, sometimes, often, usually/always). This assessment was designed for people who have had a traumatic brain injury and who have cognitive-communication deficits. Four factors (initiation/conversation flow, disinhibition/impulsivity, conversational effectiveness, partner sensitivity) were used to classify the scores on the LCQ (Struchen et. al., 2008). A higher score indicates a greater difficulty

with that component of communication. The participant completed the assessment at all three-time points. Additionally, his wife and the graduate clinician completed the LCQ post treatment.

Treatment Materials

Articles from newspapers, magazines, and online journals in addition to short video clips were used during intervention sessions. Some articles were selected that were of interest to the participant and other articles were selected out of the participant's breadth of knowledge or interest.

Treatment Protocol

The participant completed a total of 28 hours of assessment and treatment over the course of five months. There were approximately 12 hours of assessments; two 2-hour sessions were conducted at each of the three time points. The assessment battery included the *RBANS, FAVRES, DCT,* and *LCQ*. The 16 hours of intervention occurred in one hour sessions, twice a week for eight weeks. The following areas were targeted during intervention: inhibiting, organizing and managing, inferencing, paraphrasing, synthesizing, integrating, and abstracting and generalizing as shown in Table 1.1. The order of the treatment target is modeled after the SMART program developed by Chapman and colleagues (Cook et al., 2014). However, the time spent on each target skill was doubled in number of sessions in order to provide further instruction. The decision to double the time was based on the clinical judgment of the thesis committee chair who had spent numerous hours working with the client for previous research projects. Following the guidelines of the SMART program, the participant moved on to each new skill whether or not the previous skill was

mastered, and each session included review of previously targeted skills. *Table 2.1* details the order of the sessions and the skill that were targeted during each session.

Table 2.1: Treatment session targets

Process	Description	Session
Assessment #1	Assessment battery	1-2
Inhibiting	To delete/inhibit unimportant or irrelevant details	3-4
Organizing and managing	To organize and manage information by chunking similar ideas together	3-4
Inferencing	To use inferencing to extract the deeper or more abstract meaning of the information	5-6
Paraphrasing	To convey information in one's own words	7-8
Synthesizing	To combine details together into gist based concepts, using inferencing and paraphrasing	9-10
Integrating	To integrate previous knowledge with new information to formulate "take-home messages" from multiple perspectives	11-12
Abstracting and generalizing	To summarize using abstract, high-level gist-based concepts and applying learning beyond the immediate context to other contexts and situations	13-18
Assessment #2	Assessment battery	19-20
Assessment #3 (4-6 weeks post treatment)	Assessment battery	21-22

RESULTS

The results of the assessments conducted at baseline, post treatment, and follow-up were compared in order to determine if the treatment had any effects on verbal reasoning, discourse comprehension, general cognitive processes, and perceived communicative ability. In addition, the participant's wife completed a structured interview in order to obtain qualitative information about the effects of treatment.

Verbal Reasoning

The *FAVRES* measured verbal reasoning, and the scores are presented in *Table 3.1*. The raw scores are reported for all subtests to provide an indication of improvements across the targeted skills. The *total reasoning* score, the primary outcome measure, is derived from combining the raw scores on the following subskills: *getting the facts, eliminating irrelevant, weighing facts, flexibility, generating*, and *predicting consequences*. *Total reasoning* improved from 29 out of 48 at baseline to 33/48 post treatment and 34/48 at follow-up. The participant improved in all areas except *predicting consequences*, for which he showed no deficit even at baseline. During the baseline assessment, the participant obtained a raw score of 1 out of 4 for *eliminating irrelevant information*. His scores indicate improvement after treatment as he obtained a score of 3 out of 4 post treatment and 4 out of 4 during the follow-up assessment. Of note, *eliminating irrelevant information* was directly targeted during treatment. Additionally, *weighing the facts* improved from 1/ 5 to 4/5 post treatment and 5/5 at follow-up. For *flexibility*, the participant obtained a score of 1 out of 4 during baseline assessment, which improved to 3 out of 4 both during post treatment and follow-

up assessments. Thus, the gains made during treatment were maintained for *eliminating irrelevant information, weighing the facts,* and *flexibility*.

The *accuracy* and *rationale* raw scores are determined by the examinee's written response. The participant's *accuracy* improved from a raw score of 3 out of 20 at baseline to 8 out of 20 post treatment and 13 out of 20 at follow-up. Additionally, rationale scores improved from 9 out of 20 to 13 out of 20 at both post treatment and follow-up. This improvement suggests that treatment may have improved both *accuracy* and *rationale* for responding to verbal reasoning tasks.

The participant's scores for *getting the facts* suggest no change after treatment as he obtained a score of 12 out of 20 at baseline and 11 out of 20 post treatment. However, his scores indicate a decrease in performance at follow-up as he obtained a score of 9 out of 20 during the follow-up assessment.

Overall, the scores on the *FAVRES* indicate an improvement in verbal reasoning, comprehension, and executive functioning after treatment and those skills were maintained 6 weeks after the completion of treatment. There is no SEM reported in the test manual, so it is difficult to determine if the positive increase in scores is statistically significant.

Table 3.1: Functional Assessment of Verbal Reasoning and Executive Strategies (FAVRES)

	Baseline	Post Treatment	Follow-up
Accuracy	3/20	8/20	13/20
Rationale	9/20	13/20	13/20
Getting the Facts	12/20	11/20	9/20
Eliminating Irrelevant Information	1/4	3/4	4/4
Weighing the Facts	1/5	5/5	4/5
Flexibility	1/4	3/4	3/4
Predicting Consequences	14/14	12/14	14/14
Total Reasoning	29/48	33/48	34/48

Discourse Comprehension

Scores on the *DCT* are reported in *Table 3.2*. At baseline, the participant obtained a raw score of 37 out of 40. All 3 of the errors were on questions requiring an inference. Post-treatment, the participant obtained a raw score of 39 out of 40 and incorrectly responded to one question about a detail stated in the story. During follow-up, he obtained a raw score of 31 out of 40 and incorrectly answered questions about the details and main ideas stated and inferred.

Since the standard error of the mean is 3, the scores indicate no change in discourse comprehension from baseline to post-treatment. The participant had consistently high scores pre and post treatment. He was over 90% accurate at the beginning, so the assessment probably was not sensitive enough to measure deficits in comprehension or inferences. The decline in scores at the follow-up testing was unexpected and is inconsistent with the results from the other language and cognitive assessments.

Overall, there was no change in discourse comprehension, and the scores pre & post-treatment were consistently high.

Table 3.2: Discourse Comprehension Task (DCT)

	Baseline	**Post Treatment**	**Follow-up**
Detail Stated	10/10	9/10	6/10
Detail Inferred	8/10	10/10	7/10
Main Idea Stated	10/10	10/10	10/10
Main Idea Inferred	9/10	10/10	8/10
Total	37/40	39/40	31/40

General Cognitive Processes

The *RBANS* was used as a secondary outcome measure to determine if the treatment affected any associated cognitive skills, and the scores are provided in *Table 3.3*. Judgments about change are based on the Standard Error of the Mean (SEM), which are provided in Table 3.3. The participant obtained an overall standard score of 80 (baseline), 77 (post treatment), and 80 (follow-up), which are considered slightly below average. The scores indicate no overall improvement after treatment. However, changes were observed on several of the index scores.

The immediate memory index scores include the subtests of list learning and story memory. The participant obtained index scores of 94 (baseline), 90 (post treatment), and 103 (follow-up). The scores do not indicate improvement from baseline to post treatment, but there was improvement at follow-up in comparison to baseline and post-treatment.

The visuospatial/constructional index score indicates the individual's capacity to perceive spatial relations as well as spatially reconstruct a figure. This index score includes the subtests of figure copy and line orientation. The participant obtained an index score of 92 during his baseline assessment. However, he obtained a score of 69 during both the post treatment and follow-up assessments. These scores indicate a decrease in performance in his visuospatial skills after treatment. Performance on this subtest was not expected to improve, as this skill is not related to the cognitive skills targeted in treatment. However, the decline was not anticipated.

The language index score includes the subtests of picture naming and semantic fluency. The participant obtained index scores of 84 (baseline), 79 (post

treatment), and 97 (follow-up). These scores indicate an improvement in language during the follow-up session. It is noted that different forms of the RBANS were administered at each time point. In the version used at post-treatment, the semantic fluency category (musical instruments) seemed to be more difficult than those in the other versions (vegetables) based on the judgment of the graduate clinician and thesis committee chair. In the test manual, there is a conversion score between Form A (fruits and vegetables) and Form B (zoo animals), but not for Form C. This indicates that different semantics categories may not be comparable and would affect the language score. Thus the decline at this time point could have been related to this, and not reflective of a change in language ability.

The attention index score indicates the examinee's capacity to remember and manipulate information and includes the subtests of digit span and coding. The participant obtained index scores of 49 (baseline), 64 (post treatment), and 56 (follow-up). His scores indicate improvement from baseline to post treatment as the he improved more than the SEM (4.9) and these gains were maintained six weeks post treatment.

The delayed memory index score includes the subtests of list recall, list recognition, story memory, and figure recall and indicates the examinee's anterograde memory capacity. The participant obtained index scores of 106 (baseline), 105 (post treatment), and 101 (follow-up). The participant's scores are all within the SEM, which indicates that this skill remained unchanged throughout the course of treatment.

Table 3.3: Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)

	Baseline	Post Treatment	Follow-up
Immediate Memory SEM = 4.98	94	90	103
Visuospatial/ Constructional SEM = 6.44	92	69	69
Language SEM = 5.39	84	79	97
Attention SEM = 5.70	49	64	56
Delayed Memory SEM = 5.97	106	105	101
Total Scale SEM = 3.39	80	77	80

Perceived Communicative Ability

The scores on the LCQ are provided in Table 3.4. Higher scores indicate greater perceived communicative difficulties. There are not any current guidelines for interpreting a significant difference (Struchen et. al., 2008). At baseline, the participant's self-reported score was 66 with a mean response of 2.44. Post-treatment, his total score was 60 with a mean response of 2.22. During the follow-up assessment, the participant had a total score of 69 with a mean of 2.6. At baseline, post-treatment, and follow-up, the greatest areas of perceived weakness was conversational effectiveness.

Overall the scores indicate that the participant perceived his communicative ability to be greater after treatment, but slightly lower than

baseline at follow-up. Additionally, his wife and the clinician rated his communicative ability post treatment. Of note, the clinician completed the questionnaire several days after the administering it to him, so the clinician may have been biased by knowing his responses to the questions. The ratings of both the clinician and his wife are consistent with the participant's scores, which may indicate that he is self-aware of his communication deficits and accurately reported his difficulties.

Table 3.4: La Trobe Communication Questionnaire (LCQ)

		Post-Treatment			
	Baseline-Self Report	**Self Report**	**Clinician**	**Spouse**	**Follow-up- Self Report**
Initiation / Conversation Flow	19	17	17	19	23
Disinhibition / Impulsivity	16	14	16	19	19
Conversational Effectiveness	18	18	15	17	16
Partner Sensitivity	12	11	9	10	11
Total	66	60	57	65	69
Mean	2.44	2.22	2.1	2.4	2.6

Spouse Interview

A semi-structured interview with the participant's spouse was conducted in order to provide further insight into the effectiveness of the treatment. Overall, she felt like the treatment was beneficial and directly applicable to his social and familial communication needs, but he needed more repetition and practice using the strategies. She explained that since his stroke, he has received occupational, physical, and speech therapy from over seventy therapists, and she felt like this was the first treatment that targeted his everyday problems. In a thank you note to the graduate clinician, she wrote, "You truly have focused on an area where his loss has been significant (an understatement) and what we care about the most. Never addressed in any rehabilitation based therapy."

When asked about the effectiveness of the treatment, she stated that is was a "bulls eye" match for his deficits, but he needs a lot of practice in order for these strategies to be really effective. She reports that he has minimally improved as a communication partner, but he has improved at maintaining conversation topics and does not jump around to different topics as much as he used to. Communication breakdowns frequently occur when he does not attend to keywords in conversations, which frequently happens when he is excited or emotional and when important background information is omitted in conversation. Throughout the treatment, his wife observed him trying to use the strategies, especially inhibiting ("removing the fluff"), in all areas of his life. Additionally, the treatment opened a door for him to start reading genres that he hadn't previously enjoyed.

In order to make the treatment more effective, the spouse suggested including her more into the treatment so that she could aid in the transition of the skills to the home. Additionally, she felt there were too many different strategies targeted, and it would be more beneficial to identify 2-3 core items for him to focus on.

Importantly, his wife felt that the treatment validated the everyday communication difficulties that she experiences such as the participant jumping ahead during conversations, filling in the gaps with incorrect information or ideas, and making unnecessary or incorrect inferences. She also valued the treatment because his intelligence was recognized. Thus, the participant's wife viewed the treatment as beneficial despite the shortcoming of the participant needing more practice with the skills learned and the limited generalization to daily communication activities.

Participant Input

Throughout the treatment, the participant was actively engaged in the activities and viewed the treatment as beneficial in improving discourse in his everyday life. He commented several times that he recognized that the strategies for written discourse apply to verbal discourse, especially the skill of "removing the fluff." Additionally, in a thank you note to the graduate clinician, he stated, "Many thanks for all of your hard work and patience. Working with you, I feel this therapy most beneficial (includes about 100s hour of PT, OT, ST)!" The participant demonstrated active engagement through his personalization of the strategies learned. With the clinician, he created a tip sheet (*Appendix I: Tip Sheet*) in his own words to help him remember the strategies and serve as a reminder to

use them. He placed the tip sheet on his nightstand, so he could easily read the tips daily. Additionally, the participant independently created a mnemonic (*Appendix II: Participant Created Mnemonic*) to remember the tips/strategies in an abbreviated format. Overall, the participant demonstrated engagement in the treatment, and he perceived the treatment as beneficial.

Summary of Results

Overall, the scores on the outcome measures indicate that immediately following treatment the participant made gains in verbal reasoning (accuracy, rationale, eliminating irrelevant information, weighing the facts, flexibility), understanding inferences, sustaining attention, and perceived communicative ability. Gains in verbal reasoning and sustaining attention were maintained up to 6 weeks after treatment ended.

Additionally, the scores suggest that there was no global improvement in cognition. Several areas of verbal reasoning remained unchanged including predicting consequences and getting the facts.

Regardless of the objective findings, the participant and his wife considered the treatment to be beneficial and to have targeted his deficits.

DISCUSSION

The purpose of this study was to examine the effectiveness of gist training for remediation of communication deficits in an adult with chronic RHD. Based on knowledge of deficits following RHD and previous studies investigating the efficacy and effectiveness of SMART, it was predicted that the participant would make improvements in verbal reasoning, discourse comprehension, and perceived communicative ability, but there would be no change in general cognitive processes including immediate and delayed memory, attention, language, and visuospatial skills.

Implications

Overall, the participant made gains in verbal reasoning skills after treatment and maintained those skills for six weeks. Specific skills measured by the FAVRES included: reasoning accuracy, rationale, eliminating irrelevant information, weighing the facts, and flexibility. Skills that did not improve were getting the facts and predicting consequences, the latter of which was already at ceiling before treatment. All of the skills assessed by the *FAVRES* were either directly or indirectly targeted by the treatment. Particularly salient for the participant was eliminating irrelevant information, which he termed "removing the fluff." For this participant, eliminating irrelevant information helped him determine what was important in discourse and focus on the main idea and relevant details. He practiced this skill at home in various contexts including conversations with his family. These gains indicate that this treatment may be a viable option to improve verbal reasoning skills in individuals with RHD.

Of note, the results of this study cannot be directly compared to the results of the studies conducted by Chapman and colleagues because the *TOSL* was not available for this study. Additionally, this study focused on an individual with RHD while the SMART studies have focused on adults with dementia, adolescents post TBI, older adults with typical cognition, and middle school students. Treatment time was also doubled in order to account for the severity and chronicity of the participant's deficits. However, some indirect comparisons can be made in order to determine if the results of this study are similar to past studies.

Because the TOSL was not available for this study, the *FAVRES* was used as the primary outcome measure. It is a functional assessment that measures skills that have been reported to improve in previous SMART studies. An important difference is that the *TOSL* assesses recalling facts while the *FAVRES* assesses identifying the most important facts. The *DCT* was also used to provide insight as to whether or not the treatment would lead to gains in comprehension of both stated and inferred details. The participant was at ceiling on the DCT prior to treatment, so it was not possible to measure any positive changes in these skills, as the measures may have not been sensitive enough.

Similar to the results of this study, participants in the first SMART study did not improve in recalling details (Anand et. al., 2010). Conversely, Cook et al. (2014) and Gamino et al. (2010) found an improvement in fact recall after treatment. Thus, there are conflicting results about whether SMART will improve the skill of recalling the facts. Additionally, it is unknown whether a gist-based approach will lead to improvements in fact recall in an individual with RHD.

Furthermore, the *TOSL* was not available to directly compare the ability of the participant to abstract meanings. Several studies have found that found that SMART led to improved ability to abstract meanings from discourse (Gamino et al., 2010; Anand et. al, 2010; Cook et al., 2014). Thus, further research with a more sensitive measure of discourse comprehension and a validated measure that assesses abstracting meanings will help determine if this treatment will lead to improvement in these skills in an individual with RHD.

After treatment, the participant exhibited gains in only one cognitive process measured by the RBANS: attention. The gains were maintained at follow-up. Attention was indirectly targeted throughout the treatment as the clinician had him keep a list of his distractions, which they would discuss at the end of the session. This was a not a component of the original treatment but was added to facilitate his ability to focus and sustain his attention on the treatment tasks and eliminate some tangential discourse. With these distractions removed and not discussed, he more easily focused on the strategies being taught in the session. Additionally, to complete many of the treatment tasks, he had to attend to either the written or verbal discourse in order to determine the gist meanings of the discourse. Practicing the skill of attending during the sessions may have contributed to an increased score on the attention index of the *RBANS*, which included digit span and coding.

Previous studies have shown an increase in inhibitory control (Motes et al., 2014, Cook et al., 2014, Vas et al., 2011) and other executive functions such as non-verbal reasoning and cognitive flexibility (Vas et al., 2011) as well as working memory (Cook et al. 2014) after SMART training. Anand et al. (2010)

also found gains in cognitive switching and fluency. However, some of the studies determining the efficacy and effectiveness of SMART did not measure any cognitive processes. The program does not directly target cognitive processes but the researchers posit that the training may indirectly affect cognitive processes. Given that the studies did not all measure the same facets of cognition, there is not enough evidence to determine whether or a gist reasoning treatment can improve cognition.

Additionally, the current best practice for cognitive rehabilitation is including both compensatory strategies and remediation treatment (Marshall, 2015). This treatment does not directly target any aspects of cognition nor provide any compensatory strategies. Thus, more research needs to be conducted to determine if a gist based treatment approach can improve cognition.

An important component to the success of the treatment may have been the participant's awareness of his deficits. This was evident through his comments throughout the treatment sessions. For instance, he frequently was aware that he made an incorrect inference but was not sure why or what the correct answer should have been. He engaged in discussions with the clinician to determine where and why the breakdown occurred. In addition, his ratings on the *LCQ*, which measured perceived communicative ability, were in agreement with both his wife's and the clinician's ratings, which further indicated knowledge of his deficits. Without the perception or acknowledgement of the error, a metacognitive treatment such as this one may not have been as beneficial. Anosognosia is often associated with RHD (Vossel et al., 2013) and future studies are needed to determine whether this treatment may be effective

for individuals with RHD who have no or limited awareness of their deficits. Furthermore, this participant's awareness of his communicative abilities may have contributed to his observed and self-described motivation to improve his communication skills. Participant motivation likely impacted the success of this treatment in improving verbal reasoning.

Limitations and Future Directions

The result of this study indicate that a metacognitive training such as this gist-based training protocol may be a viable option to remediate verbal reasoning deficits in adults in the chronic stage of RHD. However, this study was a single case study and individuals with RHD present with a diverse set of deficits affecting language and cognition. Future research should include a larger sample in order to determine the characteristics of individuals with RHD who would benefit from this treatment.

This participant was in the chronic stage of RHD, and the participants from the *SMART* studies were either in the chronic stage or without deficits. It is unknown whether this treatment would have a greater impact if introduced in the more acute stages of recovery. Researching this treatment in the acute stage presents with difficulties such as differentiating gains from treatment versus spontaneous recovery. Additionally, immediately after an acquired injury, the individual and family may be confronted with medical complications and a disruption of their daily lives. The introduction of this treatment in the acute stages may not be appropriate for all individuals. On the other hand, one principle of neuroplasticity is that time matters (Kleim & Jones, 2008). Thus, if the treatment is introduced shortly after the injury, better outcomes may result.

Determining the most appropriate time to implement the treatment would be beneficial for individuals with RHD.

Future research should also investigate whether focusing on the most salient strategy for each participant would result in the same gains. Since each individual has their own strengths and weaknesses, focusing on the most salient feature for each participant may result in greater gains. Individuals with cognitive deficits in addition to communication deficits may need more repetition of targeted strategies in order to effectively use the strategies. Decreasing the cognitive load by focusing on just the salient feature could result in better outcomes.

In addition, the number of treatment sessions was doubled in comparison to the SMART program because the participant in this study appeared to have more severe deficits than the participants described in the published articles. Further research should determine the appropriate distribution and number of sessions for individuals with different patterns of deficits and severity levels.

From a clinical standpoint, a crucial weakness of the treatment as provided was not including the family in order to promote carryover into the home environment. The family component should include demonstration of the strategy learned each day in addition to a home program. Especially in a population that tends to have some cognitive deficits, the family may serve as an important resource to engage and remind the participant of the treatment strategies. In this study, the clinician gave a brief summary of the skills targeted to the participant's wife after each session. However, this discussion was limited

and did not include enough information for her to help him implement the strategies outside of the therapy room.

According to the principles of neuroplasticity, the family component would promote generalization and may improve short term and long-term gains for individuals with RHD. The principles of neuroplasticity include use or lose it, use it to improve it, and repetition matters (Kleim & Jones, 2008). In other words, the client must practice and use a skill in order to promote neurological change, then continue to use the skill or they may possibly lose some of the gains they made. Additionally, participants may reach a plateau, but continued training is necessary in order for new synaptic connections to be made.

Conclusions

In general, there is limited research on treatments for individual with RHD. In order to improve communication, treatments have targeted metaphor interpretation, coarse coding deficits, and suppression deficits. Other interventions are based on expert opinion and theory and have not been validated through conducting a treatment study. Thus, despite the limitations of this single case study, the results suggest that this gist-based treatment approach is feasible for improving verbal reasoning individuals with RHD. Remediation of deficits in this area is of importance to the individuals with RHD, their families, and their friends because understanding each other's stories and ideas is an important aspect of our communication. Although Coelho (2007) was addressing individuals with TBI, he explains that a disruption of discourse can greatly affect someone's quality of life. With more research to determine the appropriate individuals for this treatment as well as the most beneficial length of treatment,

gist reasoning training may lead to better quality of life through improving verbal reasoning and discourse.

REFERENCES

Anand, R., Chapman, S., Rackley, A., Keebler, M., Zientz, J., & Hart, J. (2010) Gist reasoning training in cognitively normal seniors. *International Journal of Geriatric Psychiatry, 26* (9), 961-968.

Anand, R., Chapman, S., Rackley, & A., Zientz, J. (2011). Brain health fitness: Beyond retirement. *Educational Gerontology, 37,* 450-464.

Bartels-Tobin, L., & Hinkley, J. (2005). Cognition and discourse production in right hemisphere disorder. *Journal of Neurolinguistics, 18*, 461-477.

Blake, M. (2006). Clinical relevance of discourse characteristics after right hemisphere damage. *American Journal of Speech-Language Pathology, 15,* 255-267.

Blake, M. (2007). Perspective on treatment for communication deficits associated with right hemisphere brain damage. *American Journal of Speech-Language Pathology, 16*, 331-342.

Blake, M. (2009). Inferencing processes after right hemisphere brain damage: Effects of contextual bias. *Journal of Speech, Language, and Hearing Research, 52,* 373-384.

Blake, M., Frymark, T., & Venedicotv, R. (2013). An evidence based systematic review on communication treatments for individuals with right hemisphere brain damage. *American Journal of Speech-Language Pathology, 22*, 146-160.

Blake, M., Tompkins, C., Scharp, V., Meigh, K., & Wambaugh, J. (2015). Contextual constraint treatment for coarse coding deficits in adults with

right hemisphere brain damage: Generalisation to narrative discourse. *Neuropsychological Rehabilitation, 25*(1), 15-52.

Cannizzaro, M., & Coehlo, C. (2002). Treatment of story grammar following traumatic brain injury: A pilot study. *Brain Injury, 16*, 1065-1073.

Chapman, S., Gamino, J., Cook, L.. *Test of Strategic Learning (TOSL)*. San Antonio, TX: Pearson Assessments (under review).

Coelho, C. (2007). Management of discourse deficits following traumatic brain injury: Progress, caveats, and needs. *Seminars in Speech and Language, 28* (2), 122-135.

Cook, L, Chapman, S., Elliot, A., Evenson, N., & Vinton, K. (2014). Cognitive gains from gist reasoning training in adolescents with chronic-stage traumatic brain injury. *Frontiers in Neurology*, 5, 1-9.

Cote, H., Payer, M., Giroux, F., & Joanette, Y. (2007). Towards a description of clinical communication impairment profiles following right-hemisphere damage. *Aphasiology, 21*, 739-749.

Eisenson, J. (1959). Language dysfunctions associated with right brain damage. *American Speech and Hearing Association, 1,* 107.

Gamino, J., Chapman, S., Hull, E., & Lyon, R. (2010). Effects of higher-order cognitive strategy training on gist-reasoning and fact-learning in adolescents. *Frontiers in Psychology, 1*, 1-16.

Kleim, J., & Jones, T. (2008). Principles of experience-dependent neural plasticity: Implications for rehabilitation after brain damage. *Journal of Speech, Language, and Hearing Research, 51*, S225-S239.

Lehman-Blake, M., Duffy, J., Myers, P., & Tomkins, Connie (2002). Prevalence and patterns of right hemisphere cognitive/communicative deficits: Retrospective data from an inpatient rehabilitation unit. *Aphasiology, 16,* 537-547.

Lundgren, K., Brownell, H., Cayer-Meade, C., Milione, J., & Kearns, K. (2011). Treating metaphor interpretation deficits subsequent to right hemisphere brain damage: Preliminary results. *Aphasiology, 25,* 456-474.

Marini, A. (2012). Characteristics of narrative discourse processing after damage to the right-hemisphere. *Seminars in Speech and Language, 33*(1), 68-78.

Marshall, S. (2015). Updated clinical practice guidelines for concussion/mild traumatic brain injury and persistent symptoms. Brain Injury, 29(6), 688-700.

Myers , P. (1999). *Right-Hemisphere Damage*. San Diego: Singular Publishing Group, Inc.

Myers, P. (2002). Profiles of communication deficits in patients with right cerebral hemisphere damage: Implications for diagnosis and treatment. *Aphasiology, 19*(12), 1147-1160.t

Motes, M., Gamino, J., Chapman, S., Rao, N., Maguire, M., Brier, M. . . . Hart, J. (2014). Inhibitory control gains from higher-order cognitive strategy training. *Brain and Cognition, 84*, 44-62.

Sherratt, S. & Bryan, K. (2012). Discourse production after right brain damage: Gaining a comprehensive picture using a multi-level processing model. *Journal of Neurolinguistics, 25*, 213-239.

Struchen, M., Pappadis, M., Mazzei, D., Clark, A., Davis, L., & Sander, A. (2008). Perceptions of communication abilities for persons with traumatic brain injury: validity of the La Trobe Communication Questionnaire. *Brain Injury, 22*(12), 940-951.

Tompkins, C., Baumgaertner, Lehman, M., & Fassbinder, W. (2000). Mechanisms of discourse comprehension impairment after right hemisphere brain damage: Suppression in lexical ambiguity resolution. *Journal of Speech, Language, and Hearing Research, 43*, 62-78.

Tompkins, C., Fassbinder, W., Lehman-Blake, M., Baumgaertner, A., Jayaram, N. (2004). Inference generation during text comprehension by adults with right hemisphere brain damage: Activation failure versus multiple activation. *Journal of Speech, Language, and Hearing Research, 47*, 1380-1395.

Tompkins, C, Fassbinder, W., Scharp, V., & Meigh, K. (2008). Activation and maintenance of peripheral features of unambiguous words after right hemisphere brain damage in adults. *Aphasiology, 22*(2), 119-138.

Tompkins, C., Scharp, V., Meigh, K, & Fassbinder, W. (2008). Coarse coding and discourse comprehension in adults with right hemisphere brain damage. *Aphasiology, 22* (2), 204-223.

Tompkins, C., Blake, M., Wambaugh, J., & Meigh, K. (2011). A novel, implicit treatment for language comprehension processes in right hemisphere brain damage: Phase I data. *Aphasiology, 25*, 789-799.

Tompkins, C., Klepousniotou, E., & Scott, A. (2013). Nature and Assessment of Right Hemisphere Disorders. In Papathanasious, I., Coppens, P., &

Potagas, C. (Eds.), *Aphasia and Related Neurogenic Communication Disorders* (297-327). Burlington, MA: Jones & Bartlett Learning.

Tompkins, C., Scharp, V., Meigh, K., Blake, M., & Wambaugh, J. (2012). Generalisation of a novel implicit treatment for coarse coding deficit in right hemisphere brain damage: A single-participant experiment. *Aphasiology, 26*(5), 689-708.

Rosenbeck, J., Rodrigues, A., Hieber, B., Leon, S., Crucian, G., Ketterson, T., . . . Gonzalez-Rothi, L. (2006). Effects of two treatments for aprosodia secondary to acquired brain injury. *Journal of Rehabilitation Research and Development, 43,* 379-390.

Vas, A., Chapman, S., Cook, L., Elliot, A., & Keebler, M. (2011). Higher-order reasoning training years after traumatic brain injury in adults. *Journal of Head Trauma Rehabilitation, 26*(3), 224-239.

Vossel, S., Weiss, P., Eschenbeck, P., & Fink, G. (2013). Anosognosia, neglect, extinction and lesion site predict impairment of daily living after right-hemispheric stroke. *Cortex, 49,* 1782-1789.

Youse, K., & Coelho, C. (2009). Treating underlying attention deficits as a means for improving conversational discourse in individuals with closed head injury: A preliminary study. *Neurorehabilitation, 24,* 355-364.

APPENDICES

Appendix I: Tip Sheet

1. Remove the fluff
2. Stop and summarize paragraphs before continuing on
3. Organize information
4. Active Reading
5. Focus
6. Ignore distractions and fixations (write them down so you can come back to them later)
7. Don't fill in the blanks
8. Recognize that your bias may be influencing your interpretations
9. Communication is two ways: active listener and speaker
10. During conversation, summarize and ask communication partner if you understood
11. Try not to tune out when you think you know what the other person is going to say. They may have something surprising to tell you!
12. Be Patient while listening and reading!!! Don't rush it!
13. Slow down and enjoy the conversation or reading
14. Don't always try to figure out the logic!

Appendix II: Participant Created Mnemonic

Be CLEAR

- **B**efore
- **C**ommunicate
- **L**isten
- **E**valuate
- **A**ssimilate
- **R**emove distractions